

# State Capacity and Military Conflict\*

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October 11, 2012

## 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 financial cost of war, 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 escalated further, all states engaged in a "race to the top" towards greater state building.

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\*We have received helpful comments from Philippe Aghion, Roland Benabou, Tim Besley, Francesco Caselli, Mark Dincecco, Regina Grafe, Phil Hoffman, Peter Koudjis, Gerard Padro-i-Miquel, Jim Robinson, Enrico Spolaore, Mathias Thoenig, Davide Ticchi, Pierre Yared, Andrea Vindigni, Fabrizio Zilibotti and from seminar participants at FU Amsterdam, IMT Lucca, CREI, 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 generous support through StG (#241114) and AdG (#230515). This research was also supported by Barcelona GSE. Gennaioli: ngennaioli@crei.cat. Voth: jvoth@crei.cat.

Capable states cannot be taken for granted – states with a centralized bureaucracy, controlling a significant share of national output, are a recent innovation. For most of mankind’s history, there was no highly centralized apparatus that could successfully assert a monopoly over the legitimate use of violence, collect vast revenues, administer justice, and employ large numbers of civil servants and armed men. Most scholars agree that states as we know them today 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). Initially, rulers possessed limited tax powers; there was no professional bureaucracy; armies were largely composed of mercenaries; and powerful elites were often above the law. And yet, within three short centuries European powers managed to pull ahead of the rest of the world.

The leading explanation for state building emphasizes the role of warfare. As Charles Tilly (1990) argued, “states made war, and war made states”. War gave monarchs the incentive to create an effective fiscal infrastructure: in a belligerent environment, the ability to finance war is 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. Besley and Persson (2010) have also proposed formal models to study the incentives to create a capable state, arguing that war is as a common-interest public good that allows for accelerated investments in state building.

This perspective helps to explain the coexistence of frequent warfare and growing state capacity. 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 to finance typically met with resistance 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 (and not only the consequence) of war.

This paper addresses these issues by building a model of military conflict and state building. In our model, two contending rulers choose to invest in centralizing their tax system, taking the risk of military conflict into account. Centralization is our measure of state capacity, and captures the extent to which the ruler - as opposed to local power holders - controls revenue collection. Military conflict is financed with taxes and redistributes future fiscal revenues from the losing ruler to the winning one. In this setup, a greater centralizing impetus allows a ruler to collect more fiscal revenues and win wars more often. It also requires the ruler to spend resources to sideline domestic power holders, who lose out under centralization. In this

sense, state building entails a domestic political cost (in similar spirit to Besley and Persson, 2009). We first study this tradeoff in the simplest case where war is an exogenous event. We endogenize war in Section 5.

Sections 3 and 4 present the model, showing that the impact of war on state building depends on two aspects. The first one is the financial cost of war. When military success crucially depends on the ability to spend, raising fiscal revenues is a key asset. The second parameter is the relative political fragmentation of contenders. *Ceteris paribus*, state building will be more costly for the rulers of internally divided states.

When the cost of war is low we find that - contrary to Tilly's hypothesis - the presence of military conflict dampens state building compared to a peaceful world. The intuition is that in this case both contenders are similarly likely to win the war regardless of their fiscal revenues. As a result, war primarily creates the risk for a ruler of losing his fiscal revenues, which reduces his gain from building a more effective tax apparatus. Additionally, 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 military conflict causes strong divergence in state building. Indeed, now the odds of winning the 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 (and conquer) divided ones. Warfare is still frequent, but now it coexists with the consolidation of strong, cohesive states while weak, divided ones gradually lose out.

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 reduce domestic opposition to centralization. Therefore, these institutions can emerge if a ruler engages in state building but not otherwise. We thus underline the conditions under which a war threat induces a complementary upgrading of different forms of state effectiveness (Besley and Persson, 2009), and when it does not.

In Section 6 we examine state-building in Europe after 1500 in light of our model. The results show the key role of the "military revolution" – a set of interrelated technological and organizational changes occurring between the 16th and 17th century that made wars more costly and protracted (e.g., Downing, 1992; Roberts, 1956). Before the 16th century the relatively low cost of war can explain the lack of state building. Thereafter, the military revolution created strong incentives to invest in state building. Consistent with this notion, using a dataset on 374 battles we show that during the 17th century fiscal strength became an increasingly important determinant of military success. Crucially, using data on the number of predecessor states, linguistic heterogeneity, and geography, we show that after the 17th century more homogenous states found it much easier to collect higher revenues. This is consistent with our model's prediction that the military revolution created a "race to the top" for those powers starting with low levels of domestic fragmentation while it stifled the state building of divided countries. States such as Britain or France succeeded in this highly competitive environment, and came to exert centralized control on an impressive scale. Divided and weak states such as Poland failed to do so, and disappeared from the map.

In addition to recent work on state capacity (Besley and Persson, 2009, 2010), we also contribute to the empirical literature on taxation and the growth of European states after 1500 (Tilly, 1990; Brewer, 1988; Bonney, 1996; 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 analysed inter alia by Dincecco (2009). Stasavage (2003, 2011) 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 centralization and representation led to the highest rates of taxation. The arrangements that allowed representative assemblies and the ruler to strike a bargain is explored in Hoffman and Rosenthal (1997). We rationalize this positive feedback between the creation of checks and balances and the growth of fiscal capacity, and stress the importance of warfare as a catalyst for such feedback.

Our paper also 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 they had stronger incentives to do so as a result of more frequent warfare (see also Lagerlöf, 2011). Our model may help to understand Europe's technological lead. By reducing domestic opposition, state building by European states facilitated the mobilization of greater resources and advances in military technology.

Second, we take domestic political divisions to be exogenous. In actual fact, rulers tried to actively shape the religious, cultural and ethnic composition of their populations and domestic opponents sometimes allied with central rulers to withstand foreign threats (see Magalhaes and Giovannoni, 2012). For simplicity we abstract from these forces, but our analysis still goes through as long as the risk of war does not resolve all domestic rivalries, so that preexisting domestic divisions still make it more difficult to wage wars.

Third, Acemoglu, Cantoni, Johnson, and Robinson (2011) argue that foreign conquest spread institutional reforms across 19th century Europe. Ticchi and Vindigni (2008) stress the importance of the rise of mass armies for extensions of the franchise in 19th century Europe. We focus on an earlier period and on domestic reforms – either through conquest or “defensive modernization”. We view these alternative stories as broadly consistent with our approach.<sup>1</sup>

Finally, other related literature includes work on institutions and interstate conflict (Martin, Mayer, and Thoenig, 2008; Spolaore and Wacziarg, 2010; Yared, 2010; Jackson and Morelli, 2007), as well as on the origins of growth-promoting institutions. Alesina and Spolaore (2005) study how the risk of war affects the size of countries and political alliances between them, while taking each country's institutional structure as given. The vast literature on institutions (e.g. Acemoglu, 2005; Acemoglu, Johnson, and Robinson, 2001, 2005; North, 1989; Greif, 1993; DeLong and Shleifer, 1993) does not explicitly consider the role of external conflict, but it sometimes argues that war can overcome domestic agency problems that stand in the way of better institutions (e.g. Acemoglu and Robinson, 2006).

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<sup>1</sup>For defensive modernization in Germany after 1815, cf. Blanning (1989) and Wehler (1996).

# 1 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 (Table 1). The data collected by Levy (1983) show that in Europe between 1500 to 1700, a Great Power war was underway in 95 percent of all years (Table 1).

**Table 1 here**

We argue that this is more of a puzzle 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 (cf Figure A1.1 in the Appendix) 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.

## 1.1 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 the growing divergence between European states.

Fiscal revenue is one important indicator of fiscal capacity. Figure 1 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> The second aspect that clearly emerges from Figure 1 is growing differences between European powers. In 1500, Poland’s total revenue was half of England’s. In 1780, it was equivalent to only 5 percent. 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.

**Figure 1 here**

The vast increase in revenue was facilitated by a different administrative structure. Medieval rulers had largely been expected to ‘live on their own’, i.e. to finance themselves from their domain income (Landers,

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<sup>2</sup>The value of silver declined, but only gradually. The real increase was still by a factor of more than 3.

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 and customs taxes, and was about to introduce the first successful income tax in history. France, on the other hand, still used tax farming for both direct and indirect taxes (Bonney, 1981). There, tax exemptions for the nobility and the clergy 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, 1969). Reforms in Poland foundered on the unanimity principle in the *sejm*, the assembly of nobles.

## 1.2 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 2 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.

### Figure 2 here

Some powers succeeded in mobilizing many more resources than others (see Table 2 below). 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.

### Table 2 here

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 officered by 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, 1988) – resulted in a rise in the financial cost of war. As a result of these 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, 1988). 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 -- the *trace italienne*. It consisted of large earthen bulwarks, clad with brick, which could withstand cannonfire. 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, 1988):

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, 1988). 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, 1988).

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 saw the increasing use of debt financing. During wartime, 80 percent 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.<sup>6</sup>

## 2 The Basic Model

We now present a model shedding light on the link between state building and the military revolution. Sections 2.1 and 2.2 illustrate the role of centralization. Section 2.3 describes a ruler’s decision to centralize or not when there is no external war threat. Section 2.4 introduces an external war threat.

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<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, 1997).

<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, 1988).

<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>Military spending exceeded revenue by 50 percent in Habsburg Spain during the 1570s (Bean, 1973).

## 2.1 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. In each period, an agent can undertake either local ( $l$ ) or market ( $m$ ) production. Local production yields output  $A_l$  and occurs in an agent's own district. Market production is more profitable but requires an agent to carry out some steps of the production process (e.g. input purchases) in a neighboring district.<sup>7</sup> If agent  $j$  undertakes market production, he obtains  $A_m > A_l$ . 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:

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

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

## 2.2 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 the surplus of market over home production. This is attained by setting:

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

At these tax rates, everybody chooses to produce for the market (i.e.,  $n_m = 1$ ) and the ruler extracts the full surplus  $A_m - A_h$  so created.

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, the tax rate levied on a producer operating in districts  $i$  and  $i'$  is equal to  $(\tau_{m,i} + \tau_{m,i'})$  and the producer's 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.

<sup>7</sup>We assume that districts  $i \in [0, 1]$  are located around a circle and that market production is spatially ordered: each agent undertaking market production in a district  $i$  must carry out one step of production in the immediately left-adjacent district. This assumption simplifies the analysis of taxation under partial centralization.

<sup>8</sup>Our results go through if the ruler can borrow/lend in financial markets provided these are imperfect enough.

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 where 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.*

Decentralized districts over-tax market production because of a lack of coordination among power holders: each 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 of 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. Decentralization reduces the ruler's revenues by reducing output (as  $A_l < A_m$ ) and by allowing power holders to grab local taxes. This latter effect is important because it shapes the resistance of power holders to the ruler's centralizing efforts.

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, setting 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:

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

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

Output and tax revenues increase in centralization  $\kappa$ . In Equation (4), the ruler's revenue is equal to the surplus generated by each centralized district times the measure of districts that are centralized.

This setup seeks to capture 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 less distortionary taxation, which generated additional revenues for the monarch while facilitating the growth of

<sup>9</sup>The logic of Lemma 1 is that, at the equilibrium level of taxes, the ruler of each district prefers to discourage market production (by setting a high tax  $\tau_{m,d}$  on it) so as to grab all the surplus created by local production. In principle, there is also an equilibrium where all power holders magically coordinate to set  $\tau_{m,d} = (A_m - A_h)/2A_h$ , so that output and tax revenues are first best. One can rule out such equilibrium by assuming that the return to market production is heterogeneous across agents.

<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 footnote 7, all market production occurs within centralized districts and only a zero-measure (negligible) amount of market production occurs between centralized and decentralized districts. We simplify the analysis even further by posing that no economic activity occurs between centralized and decentralized districts. As a result, a partially centralized country can be split into a fully centralized and a fully decentralized region.

commerce. Here we do not imply that political centralization was necessarily desirable (even economically) in early modern Europe. In fact, some of the reforms leading to administrative centralization may have also led to an undesirable concentration of power in the hands of central rulers.<sup>11</sup> As we show in Section 4, in our model state building is in fact most effective when it occurs in tandem with the creation of checks and balances limiting central power. Our setup simply seeks to capture the notion that, in the fragmented early modern state, administrative centralization allowed for more efficient forms of taxation, paving the way for the creation of states capable of providing public goods on a large scale.

### 2.3 State Building and Domestic Conflict

At the outset, which we denote  $t = 0$ , the ruler chooses what measure  $\kappa$  of districts to centralize (initially centralization is zero, i.e.  $\kappa_0 = 0$ ). To do so, he must overcome domestic opposition by local power holders, who lose the control rent  $(A_l - A_h)$  under centralization. This amounts to a total loss of  $2(A_l - A_h)$  over periods  $t = 1, 2$ . Although centralization increases total tax collection, at  $t = 0$  the ruler cannot commit to compensate power holders for losing tax control. This creates opposition to centralization. In Section 4, we show how institutions can be viewed as a mechanism alleviating this commitment problem.

To overcome domestic opposition, the ruler needs to spend money. In particular, he can crush the power holder of district  $i$  (or buy him off) by spending an amount  $\beta_i \cdot 2 \cdot (A_l - A_h)$  of resources. Parameter  $\beta_i \geq 0$  proxies for the ability and willingness of power holder  $i$  to oppose the ruler, and is distributed across districts according to c.d.f  $F(\beta)$ , which captures the intensity of domestic conflicts.<sup>12</sup> In countries with greater ethnic or religious divisions, or stronger regional power structures,  $F(\beta)$  is concentrated on higher values of  $\beta$ . This admittedly reduced-form formalization allows us to keep the analysis of external wars tractable.

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:

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

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

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

<sup>11</sup>Acemoglu, Johnson, and Robinson (2005) show that "absolutist" states grew less in early modern Europe; Dincecco (2009) extends their analysis and finds similar negative effects.

<sup>12</sup>Cost  $2\beta_i \cdot (A_l - A_h)$  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. By contrast, if the ruler spends an amount  $I_i$ , he generates "offensive power"  $r_i I_i$ , where  $r_i$  is the effectiveness of the ruler's repression in district  $i$ . Here  $z_i$  may capture the power holder's distaste for the central ruler while  $d_i/r_i$  proxies his relative strength. 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 using the resources in a 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 into our model.

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

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

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>13</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  $t = 0, 1, 2$ . He finances the reform cost out of his domain income  $D > 0$ , which he receives at  $t = 0$ . The ruler’s consumption at  $t = 0$  is thus equal to  $D - C(\kappa)$ , his consumption at  $t = 1$  and  $t = 2$  is equal to the fiscal revenues generated in these periods.<sup>14</sup>

We can view the ruler as choosing the fiscal revenue  $R$  at  $t = 1, 2$  rather than centralization  $\kappa$ . Given Equation (4), revenue  $R$  uniquely pins down centralization as  $\kappa(R) = R / (A_m - A_h)$ . By plugging this expression into (6), we can see that the ruler solves:

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

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  $t = 0$ . Optimal reform in autarky is equal to:

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

If  $B(A_l - A_h) \leq (A_m - A_h)$ , domestic divisions  $B$  or power holders’ rents  $(A_l - A_h)$  are so low relative to the ruler’s revenue gain  $(A_m - A_h)$  that he centralizes fully, setting  $R_{aut} = (A_m - A_h)$  (and thus  $\kappa = 1$ ). If instead  $B(A_l - A_h) > (A_m - A_h)$ , domestic opposition is strong enough that the ruler centralizes only partially, setting  $R_{aut} < (A_m - A_h)$ .

State formation is shaped by the tension between the benefit of creating a national market and the opposition against central rulers created by a myriad of local princes, cities, principalities, and estates. Stronger opposition (i.e., higher  $B$ ) reduce the ruler’s ability to extend his power into the periphery, stifling state building. By contrast, state building increases when it causes a larger gain in district revenue owing to higher productivity  $A_m/A_l$  of market production.

Before moving on, note that when  $B > (A_m - A_h) / (A_l - A_h)$ , which we assume throughout, Equation (8) allows us to rewrite - with slight abuse of notation - the cost of centralization as:

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

<sup>13</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 a bang bang solution of the ruler’s centralization decision.

<sup>14</sup>We are implicitly assuming that domain income  $D$  is only received at  $t = 0$  and it is sufficient to pay for the reform cost, i.e.  $D > C(1)$ . This simplifies the analysis of state building when external war is present. Little would change if the ruler receives  $D$  also at  $t = 1$  and at  $t = 2$ . In particular, owing to linear utility, the marginal value of centralization does not change with  $D$ .

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  $R_{aut}$  as proxies for the cost of centralization.

## 2.4 External Conflict and Incentives to Reform

There are two-countries, “home”  $H$  and “foreign”  $F$ . At  $t = 1$  they exogenously enter armed conflict with probability  $\theta$ , where  $\theta$  captures the belligerence of the environment. If  $\theta = 0$ , we are back to 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. Section 5.2 allows 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.<sup>15</sup> 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. 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 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 arise, the ruler consumes  $2R_J$  over  $t = 1, 2$ . If war erupts, the ruler spends his  $t = 1$  revenues to wage the war; at  $t = 2$  then, he consumes nothing if he loses while he consumes  $R_H + R_F$  if he wins.

The war outcome is stochastic. Ruler  $H$  wins with probability  $p(R_H, R_F)$ , ruler  $F$  with probability  $1 - p(R_H, R_F)$ . Function  $p(R_H, R_F)$  is a contest function of the kind used in the theory of conflict (see, for example, Dixit, 1987; Skaperdas, 1992, for a review). A ruler is more likely to win if his tax revenues are higher, for this allows him to finance a stronger army, but war spending has decreasing - or not too increasing - returns. As shown in the Proof of Proposition 1, this ensures concavity of the ruler’s objective function. Formally, function  $p(R_H, R_F)$  is continuous, differentiable and features  $p_H > 0$ ,  $p_F < 0$ , and  $p_{HH} \leq Z$  and  $p_{FF} \geq Z$ , where  $p_J$  and  $p_{J,K}$  ( $J, K = H, F$ ) denote the function’s first and second derivatives with respect to  $R_H$  and  $R_F$  and  $Z > 0$  is a suitable bound on second derivatives.

The sensitivity of the war outcome to fiscal revenues  $|p_J|$  is a key driver of centralization. When  $|p_J|$  is high, money is crucial to win the war. To see this, suppose that country  $J$ ’s military strength takes the Cobb-Douglas form  $L_J^\alpha R_J^\lambda$ , where  $L_J$  is the country’s population. Parameters  $\alpha, \lambda \geq 0$  respectively measure the extent to which military might is driven by labor and capital. Holding  $\alpha$  constant, a higher  $\lambda$  captures both a greater intensity of war in financial capital, as well as greater returns to scale to the military technology. We view the military revolution as an increase in  $\lambda$ . The introduction of fortifications, gunpowder, portable firearms, and large navies made war more costly and increased the returns to building an effective army.

Suppose then that the probability with which ruler  $H$  wins the war increases in his relative military

<sup>15</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 of Section 4.2. The results are available upon request.

strength with respect to ruler  $B$  according to the following expression:

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

Then, the sensitivity of war to a country's fiscal revenues is equal to:

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

which increases, for given  $(p, R_J)$ , in the money sensitivity  $\lambda$ .<sup>16</sup> In the theory of conflict,  $\lambda$  is called “decisiveness parameter” and Hirshleifer (1995) associates its increase to a breakdown of anarchy. For simplicity, we keep labor inputs  $(L_H, L_F)$  fixed, but labor-money complementarity can generate a positive comovement between state building and the rise of mass armies.

While we obtain some results using a general contest function  $p(R_H, R_F)$ , we will often use Equation (10) as a reference, and to obtain intuitive closed form solutions we employ a linearized version of it. The timing of the model is as follows:

### Figure 3 here

Given these preliminaries, ruler  $H$  chooses revenue  $R_H$  so as to solve:

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

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

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

Relative to autarky, the war threat ( $\theta > 0$ ) changes the marginal value of fiscal revenues at  $t = 1, 2$ . There are two effects. First, war creates a risk for rulers of foresaking their fiscal revenues  $2R_J$ , in financing and in losing the war. This discourages state building. Second, war creates the opportunity for rulers to enjoy  $(R_F + R_H)$  in case of victory. This encourages state building.

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>17</sup> and it can differ across countries, owing to

<sup>16</sup>Equation (10) can be microfounded by assuming that, for given population and revenues, there is a random shock  $\epsilon$  to the relative military strength of country  $F$ , so that country  $H$  wins the war provided:

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

where the natural logarithm of  $\epsilon$  follows a logistic distribution with mean 0 and location 1.

<sup>17</sup>This is because in our model external threats do not affect the severity of domestic divisions. There are two reasons for this. First, powerholders are atomistic. Hence, their opposition to centralization does not affect the outcome of war. Second, powerholders are equally "exploited" by the two rulers (as war just rallocates fiscal revenues across the latter), so they see no

differences in domestic conflict  $B_J$  among contestants (this the source of heterogeneity that we will focus on) or to differences in the efficiency of market production  $A_{m,J}/A_{l,J}$ .

### 3 War and State Building

#### 3.1 The Basic Strategic Effects

Equilibrium reforms 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 (we focus on parameter ranges where this is the case), an equilibrium is identified by the first order conditions:

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

for country  $H$ , and:

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

for country  $F$ . The war threat ( $\theta > 0$ ) exerts three *direct* effects, which are included in square brackets above. First, it boosts the incentive to centralize because higher fiscal revenues enhance the probability of winning the war. This is the first term in square brackets (as  $p_H > 0$ , and  $p_F < 0$ ). Second, war lowers the benefit of centralization by creating the risk that fiscal revenues are lost in the war. This is the second (negative) term in square brackets. 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.

Equations (14) and (15) identify two reaction functions  $R_H(R_F | \theta, c_H)$  and  $R_F(R_H | \theta, c_F)$  linking state building in the two countries. These functions depend on the severity of the war threat  $\theta$  and on a country's cost of reform  $c_J$ , where the latter captures political and economic domestic conditions. An equilibrium  $(R_H^*, R_F^*)$  occurs where the two reaction curves intersect. Appendix 2 proves:

**Proposition 1.** *If an interior equilibrium  $(R_H^*, R_F^*)$  exists, it fulfills the following properties:*

a) *A more severe war threat (i.e. higher  $\theta$ ) boosts reform incentives in country  $J = H, F$  if and only if war is sufficiently sensitive to fiscal revenues, namely:*

$$\frac{dR_J(R_{-J} | \theta, c_J)}{d\theta} > 0 \quad \text{if and only if } |p_J| \text{ is sufficiently large.} \quad (16)$$

---

systematic reason for standing in support or against the incumbent. Of course, in reality conflict may affect domestic opposition, but the systematic analysis of this possibility is beyond the scope of the current paper. See Magalhaes and Giovannoni (2012) for a model of these effects.

b) A higher marginal cost of reform  $c_J$  dampens reform incentives in  $J = H, F$ , namely:

$$\frac{dR_J(R_{-J}|\theta, c_J)}{dc_J} < 0. \quad (17)$$

c) At  $(R_H^*, R_F^*)$ , the reaction functions of countries  $J = H, F$  and  $-J \neq J$  have opposite slopes, namely:

$$\frac{dR_J(R_{-J}^*|\theta, c_J)}{dR_{-J}} > 0 \text{ if and only if } \frac{dR_{-J}(R_J^*|\theta, c_{-J})}{dR_J} < 0. \quad (18)$$

For a general contest success function, these results show what factors shape centralization. The military technology plays a key role. In point a), external wars boost the incentive to centralize if and only if the war outcome is very sensitive to fiscal revenues. When war-making requires large technological/organizational investments, centralization does not only increase a ruler's revenues for consumption, it also boosts his chances to prey upon his opponent. By contrast, when these investments are less important, the ruler realizes that centralization makes him richer in peaceful times but it also makes him a better prey during wartime. This induces less centralization than in autarky.

Property b) says that the incentive to centralize is high when  $c_J$  is low. 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, by facing a high reform cost  $c_J$ , 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.

Finally, property c) illustrates the role of strategic effects. The ruler with a positively sloped reaction function reacts to reform abroad by increasing his own reform stance. We call this ruler an "aggressive reformer". The ruler with a negatively sloped reaction function reforms less as reform abroad gets stronger. We call this ruler a "timid reformer". When facing an aggressive reformer a weak reformer moderates his reform stance. Figure 4 plots the effect of a drop in the cost of reform in the aggressive reformer  $H$ .

#### Figure 4 here

As the cost of reform in  $H$  falls, the reaction function of its ruler shifts outward. Ruler  $H$  reforms more aggressively and ruler  $F$  reduces his reform. Strategic effects here create strong divergence across countries.

In Appendix 3, we show that Proposition 1 pins down the comparative statics of reforms at an interior equilibrium. Intuitively, reform in a country increases if the cost of reform in the same country drops. Furthermore, if the cost of reform drops abroad, reform at home goes up if and only if home is the aggressive reformer. To study the link between the war technology and state building, we now consider the tractable case of a linear approximation of Equation (10). We study the power specification in Appendix 3.

### 3.2 Linear(ized) Contest Success Function

By linearizing (10) around the point in which both countries win with probability 1/2 we obtain:<sup>18</sup>

$$p(R_H, R_F) = \frac{1}{2} + \lambda(R_H - \gamma R_F), \quad (19)$$

Recall that parameter  $\lambda$  is the money sensitivity of the war outcome. Parameter  $\gamma$  - which captures the relative effectiveness of  $F$  at warmaking - is equal to  $(L_F/L_H)^{\alpha/\lambda}$ . The relative effectiveness of  $F$  increases in the country's relative size. Owing to money-labor complementarity, the larger is  $L_F/L_H$ , the more productive are the investments of  $F$  relative to  $H$ . Without loss of generality, we assume that  $F$  is less populous than  $H$ , namely  $\gamma \leq 1$ , so that  $H$  has a comparative advantage at warmaking.

Denote autarky revenues in the two countries by  $(R_{H,aut}, R_{F,aut})$ .<sup>19</sup> We assume that  $\theta\lambda \max [R_{H,aut}, \gamma R_{F,aut}] < 1$ , which ensures that the rulers' objectives are concave. Then, an interior equilibrium occurs at the intersection of the reaction functions:

$$R_H(R_F | \theta, c_H) = \left( \frac{1 - 3\theta/4}{1 - \theta\lambda/c_H} \right) \cdot R_{H,aut} + \frac{\theta(1 - \gamma)\lambda/c_H}{1 - \theta\lambda/c_H} \cdot R_F, \quad (20)$$

$$R_F(R_H | \theta, c_F) = \left( \frac{1 - 3\theta/4}{1 - \theta\lambda\gamma/c_F} \right) \cdot R_{F,aut} - \frac{\theta(1 - \gamma)\lambda/c_F}{1 - \theta\lambda\gamma/c_F} \cdot R_H. \quad (21)$$

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  $H$ , the country having a military advantage, is the aggressive reformer because its optimal reform increases with  $R_F$ .  $F$  is the timid reformer because its reform decreases with  $R_H$ .

Consider the equilibrium prevailing when  $H$  and  $F$  are equally sized, namely  $L_H = L_F$  so that  $\gamma = 1$ . In this case, there is no strategic interaction between reforms in different countries. This allows us to isolate the role of properties a) and b) of Proposition 1, abstracting from c). Appendix 2 then proves:

**Proposition 2.** *Under some technical conditions, if  $\gamma = 1$  the unique equilibrium features:*

$$R_J^* = \min \left[ \frac{1 - 3\theta/4}{1 - \lambda\theta/c_J} R_{J,aut}, A_{m,J} - A_{h,J} \right] \quad \text{for } J = H, F. \quad (22)$$

The equilibrium  $(R_H^*, R_F^*)$  displays the following properties:

i) Centralization  $\kappa_J^* = R_J^*/R_c$  increases in the importance of money for military success  $\lambda$  for all  $J = H, F$ . In country  $J$ , centralization increases with the frequency of external conflict  $\theta$  if and only if  $\lambda$  is large relative

<sup>18</sup>The revenues  $(R_{H,0}, R_{F,0})$  around which (10) is linearized therefore fulfill  $L_H^\alpha R_{H,0}^\lambda = L_F^\alpha R_{F,0}^\lambda$ , where for convenience  $R_{H,0}$  is normalized to 1. Focusing on cases in which the military strength of contestants is evenly matched allows us to see the divergence created by the threat of war

<sup>19</sup>Autarky revenues are allowed to differ from the values  $(R_{H,0}, R_{F,0})$  around which the reaction function is linearized. We could allow  $(R_{H,aut}, R_{F,aut})$  to coincide with  $(R_{H,0}, R_{F,0})$ , but in such case the analysis should be carried out by taking into account the further restriction  $L_H^\alpha R_{H,aut}^\lambda = L_F^\alpha R_{F,aut}^\lambda$ .

to the marginal cost of reform, namely

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

ii) If centralization is partial in all countries, namely  $\kappa_J^* < 1$  for  $J = H, F$ , we have that:

$$\frac{R_H^*}{R_F^*} = \frac{R_{H,aut}}{R_{F,aut}} \cdot \frac{1 - \lambda\theta/c_F}{1 - \lambda\theta/c_H}, \quad (23)$$

so that  $R_H^*/R_F^* > R_{H,aut}/R_{F,aut}$  if and only if  $c_H < c_F$ .

Optimal centralization  $\kappa_J^*$  increases with the importance of money for military success  $\lambda$ . 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  $\lambda > 3 \cdot c_J/4$ . Crucially, result ii) shows that the presence of a war threat *amplifies* inequality in state building relative to autarky. As the internally divided country perceives a strong risk of becoming a prey, its incentive to centralize is stunted.

Suppose now that countries  $H$  and  $F$  only differ because domestic divisions  $B_J$  are higher in  $F$  than in  $H$ , i.e.  $B_H < B_F$ . Denote by  $R_{aut}$  the autarky reform in  $H$ , so that autarky reform in  $F$  is  $R_{F,aut} = (B_H/B_F)R_{aut}$ . Figure 5 plots the pattern of state building in the two countries.

### Figure 5 here

Along the horizontal axis, a higher  $R_{aut}$  can capture a global boost in the efficiency of market production, due to increasing commercialization, which reduces  $c_J = 1/R_{J,aut}$  in all countries. The vertical axis reports  $\lambda$ . In the southwest region, the gains from increasing fiscal revenues are so low relative to the cost of reform 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 while still the ruler of  $F$  cannot do so, owing to domestic divisions. Here external war creates inequality in state building across countries. As the sensitivity of war to fiscal revenues becomes very large, we move to the northeast region in which the war threat boosts centralization even in country  $F$ . Eventually, both countries centralize fully, i.e.  $\kappa_H^* = \kappa_F^* = 1$ .

The case where  $\gamma = 1$  leaves out the strategic effects of Proposition 1 (property c) and of Corollary 1:

**Proposition 3.** *When  $\gamma \leq 1$  equilibrium reforms fulfill:*

$$\frac{R_H^*}{R_F^*} = \frac{R_{H,aut}}{R_{F,aut}} \cdot \frac{1 + \theta\lambda(1 - 2\gamma)/c_F}{1 - \theta\lambda(2 - \gamma)/c_H}. \quad (24)$$

$R_H/R_F$  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.

In Appendix 3 we study the model under the contest function of equation (10). The algebra is more involved, but external war continues to boost state building only when  $\lambda$  is high. Accordingly, differences in domestic conflicts trigger divergence in state building across countries.

### 3.3 Comment

Our model shows that three patterns of state consolidation should occur as the costliness of military technology  $\lambda$  increases. To visualize them, consider again Figure 6.

In the first phase, the sensitivity of war to fiscal revenues is low relative to the cost of reform, 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 does not lead to the emergence of a strong centralized power. Marginal increases in the cost of war make rulers more hungry for fiscal revenues. They thus increasingly centralize their power and streamline tax administration. Taxes become less distortionary, which spurs growth and commerce. As the tax base expands, so do the stakes involved in warmaking, 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 cost of war becomes intermediate, 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 the cost of war becomes very high, 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 productions is highest.

## 4 Institutions, Centralization 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 rulers' decision to create institutional constraints limiting their own prerogatives as well as for their endogenous choice of whether or not to go to war.

### 4.1 Institutions and Centralization

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, in country  $J = H, F$  institutions set the share  $(1 - \pi_J) \in [0, 1]$  of tax revenues that the ruler can appropriate in a *centralized* district. The remaining share  $\pi_J$  of taxes goes to the power holder. As before, fiscal revenues in decentralized districts are retained completely by the power holder. In our previous analysis,  $\pi_J = 0$  and the ruler is unconstrained. When  $\pi_J > 0$ , institutions are stronger, owing to the greater power of legislative assemblies,

constitutional review, and so forth.<sup>20</sup>

#### 4.1.1 Institutions and the Ruler's Decision to Centralize

Given a total amount  $R_J = \kappa_J \cdot (A_m - A_h)$  of fiscal revenues collected in centralized districts, the ruler can only keep a share  $(1 - \pi_J)$  of them for himself, for a total revenue equal to  $\tilde{R}_J = (1 - \pi_J) \cdot R_J$ . The power holder of a centralized district then obtains  $2\pi_J (A_m - A_h)$  over two periods. As a result, his loss in moving from decentralization to centralization is equal to  $2[(A_l - A_h) - \pi_J (A_m - A_h)]$ . When

$$\pi_J \geq \hat{\pi}_J \equiv \frac{(A_l - A_h)}{(A_m - A_h)}, \quad (25)$$

institutions are so strong that the power holder gains from centralization! The ruler can commit to a mutually advantageous revenue-sharing arrangement with power holders, so there is no opposition to state building.

The interesting case arises when  $\pi_J < \hat{\pi}_J$ . Now there is some opposition to reform, but the severity of such opposition decreases in the strength of institutions  $\pi_J$ . To see how this affects centralization, replace  $R_J$  with  $\tilde{R}_J$  in the maximization problems (12) and (13). By noting that  $\kappa_J = \tilde{R}_J / (A_m - A_h) \cdot \pi_J$ , it is easy to see that in order to obtain a fiscal revenue  $\tilde{R}_J = (1 - \pi_J) \cdot R_J$  the ruler must bear the cost:

$$C_J(\tilde{R}_J) = \tilde{c}_J \cdot \tilde{R}_J^2, \text{ where } \tilde{c}_J \equiv \frac{1}{\tilde{R}_{J,aut}}, \quad (26)$$

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

$$\tilde{R}_{J,aut} = (1 - \pi_J) \cdot R_c \cdot \min \left[ \frac{(1 - \pi_J)}{(A_l - A_h) - \pi_J (A_m - A_h)} \frac{(A_m - A_h)}{B_J}, 1 \right]. \quad (27)$$

Stronger institutions exert two conflicting effects on  $\tilde{R}_{J,aut}$ . On the one hand, higher  $\pi_J$  reduces opposition to reform, increasing fiscal revenues. On the other hand, higher  $\pi_J$  reduces the share of fiscal revenues appropriated by the ruler. If the efficiency gains of centralization are large (i.e.  $(A_m - A_h) > 2(A_l - A_h)$ ), which we assume throughout, the first effect dominates and better institutions reduce the cost of centralization.

Since in our model stronger institutions correspond to a reduction in the cost of state building, country  $H$  has a lower cost of centralization than  $F$ , that is  $\tilde{c}_H \leq \tilde{c}_F$ , provided:

$$\frac{(1 - \pi_H)}{(A_{l,H} - A_{h,H}) - \pi_H (A_{m,H} - A_{h,H})} \cdot \frac{1}{B_H} \geq \frac{(1 - \pi_F)}{(A_{l,F} - A_{h,F}) - \pi_F (A_{m,F} - A_{h,F})} \cdot \frac{1}{B_F}. \quad (28)$$

<sup>20</sup>This arrangement can be viewed as giving to a representative assembly some control over both taxation and spending, where  $\pi_J$  is the share of spending going to the benefit of local elites.

We have also solved the model under the alternative assumption that a representative assembly of power holders from centralized districts has the right to vote to decide whether to give all of their fiscal revenues to the central ruler or not. We assumed that local powerholders lose the fixed amount  $L > 0$  when their country is defeated, which implies that they have some incentive to let the central ruler grab fiscal revenue if a war threat is present. In this case, under a linear contest success function, the assembly hands 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.

Even if country  $H$  is more divided than  $F$  (i.e.  $B_H > B_F$ ) its ruler faces weaker opposition if institutions constrain him sufficiently more than his competitor.

The impact of institutions on centralization then directly follows from Propositions 2 and 3. War *amplifies* differences in the domestic cost of reform. Thus, the country having relatively better institutions centralizes more than the country having worse institutions. In a sense, institutions turn state building into a common interest public good. The statistical analysis in Dincecco (2009) - who shows that centralized and constrained governments in Europe taxed more than fragmented or “absolutist” entities between 1650 and 1913 – is fully in line with the predictions of our model here.

#### 4.1.2 External Wars, Centralization and Institutional Change

Consider now the link between external wars and institutional change. Suppose that rulers - before centralizing - can strengthen their institutions at some cost. At the outset  $\pi_{0,J} = 0$  and ruler  $J$  can upgrade his institution to a level  $\pi_J > 0$  by spending  $K(\pi_J)$ , where  $K(\cdot)$  is an increasing and convex function. Appendix 2 then proves that for any contest success function satisfying the general properties stated in Section 3.3:

**Proposition 4.** *Denote by  $W_J(\pi_J, B_J)$  the equilibrium welfare of ruler  $J = H, F$ . At a common level of institutions  $\pi_H = \pi_F = \pi$  ruler  $H$  benefits more than ruler  $F$  from institutional improvements, i.e.  $\frac{\partial W_H}{\partial \pi_H} \Big|_{\pi_H=\pi} > \frac{\partial W_F}{\partial \pi_F} \Big|_{\pi_F=\pi}$  if and only if:*

$$\frac{\tilde{R}_H^*/\tilde{R}_{H,aut}}{\tilde{R}_F^*/\tilde{R}_{F,aut}} \cdot \frac{\tilde{R}_H^*}{\tilde{R}_F^*} > 1. \quad (29)$$

To see this result, suppose there is no external war. In this case,  $\tilde{R}_J^* = \tilde{R}_{J,aut}$  and the first factor on the left hand side of Equation (29) drops out. According to the second factor, then, country  $H$  benefits more than  $F$  from institutional upgrading if and only if it is less divided than  $F$  to begin with (i.e., if  $\tilde{R}_{H,aut} > \tilde{R}_{F,aut}$ ). The intuition is that a marginal improvement in institutions appeases few opponents in countries that are highly fragmented (i.e. have higher  $B_J$ ). In contrast, in countries where domestic conflict is less marked, domestic opposition is very “elastic” to an increase in  $\pi_J$  so that higher  $\pi_J$  greatly boosts state building. These effects amplify inequality among countries, favouring institutional upgrades in the cohesive country.<sup>21</sup>

In the presence of war, the first term in (29) does not drop out because  $\tilde{R}_J^* \neq \tilde{R}_{J,aut}$ .<sup>22</sup> The less divided country  $H$  is then more eager to upgrade institutions relative to  $F$  precisely if war boosts divergence in centralization. That is, provided  $\tilde{R}_H^*/\tilde{R}_F^* > \tilde{R}_{H,aut}/\tilde{R}_{F,aut}$ . If war instead induces convergence in centralization, it also dampens cross-country differences in institutions. Wars boost inequality in institutional development when they increase inequality in state building.

<sup>21</sup>The higher elasticity of domestic opposition in more cohesive countries is due to the uniform distribution of  $\beta$ . Recall in this regard that we realistically assume that in all countries conflicts are sufficiently strong that in 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.  $\pi_J < \hat{\pi}_J$ ).

<sup>22</sup>With respect to the second term, provided the contest success function is symmetric (which is our main case of study) it is still true that  $\tilde{R}_H^* > \tilde{R}_F^*$  if  $H$  is less divided than  $F$ . Hence, the second factor in (29) continues to enhance the benefit of institutional upgrading in the less divided country.

We can now characterize the patterns of institutional upgrading prevailing in the linear and symmetric contest success function of Proposition 2:

**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  $\theta > 0$ ). We then have*

- 1) *Institutions and centralization in  $J$  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 institutions - cluster together. In a cohesive country, the ruler invests in institutional upgrades, particularly when he must centralize to meet an external war threat. In a highly divided country instead, only a huge institutional upgrading can reduce opposition to centralization. This discourages the ruler from undertaking both institutional upgrading and state building, stifling all reforms.

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 institutions, generating strong divergence. A very large  $\lambda$  leads to the emergence of strong and accountable states everywhere.

## 4.2 The Choice to Go to War

So far the outbreak of war was exogenous. In reality, going to war reflects political choices. To study this possibility, 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, each ruler enjoys the future revenues of both countries with some probability, and nothing otherwise. War destroys a share  $(1 - \sigma) > 0$  of revenues at  $t = 2$  in all countries. This implies that: i) it is impossible for both rulers to expect to gain from war, and ii) there may be circumstances where both rulers lose, so that war does not always occur. Indeed, when  $\sigma < 1$  it would be welfare improving to negotiate the war away, but we realistically assume that such negotiations are impossible because rulers cannot commit to make the necessary transfers.

This setup implies that if at  $t = 1$  both rulers expect to lose from the war, military conflict is averted. If instead either ruler expects to gain, military conflict erupts. Clearly, the possibility of not going to war affects also the decision of how much to centralize ex-ante, which depends on the (now endogenous) probability of going to war at  $t = 1$ .

Let us solve the model backwards. 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:

$$p(R_H^*, R_F^*) \cdot \sigma \cdot (R_H^* + R_F^*) \geq R_H^*, \quad (30)$$

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

$$[1 - p(R_H^*, R_F^*)] \cdot \sigma \cdot (R_H^* + R_F^*) \geq R_F^*. \quad (31)$$

War is averted if and only if none of the above conditions holds. Intuitively, (30) and (31) 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 a symmetric contest success function [i.e. such that  $p(R, R) = 1/2$ ], war cannot occur when revenues are identical ( $R_H = R_F$ ); in this case, the war is a coin toss and no ruler cannot win more than his own revenue on average. In fact, since  $\sigma < 1$ , both rulers expect to lose. Hence, when  $R_H = R_F$  both rulers prefer peace. The incentive to go to war arises 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. Appendix 3 shows that with a linear contest success function we find:

**Proposition 5.** *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  $\lambda \leq \lambda^*$  state building 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 less wealthy ruler expects to benefit from it*
- 2) *If  $\lambda \in (\lambda_0, \lambda_1)$ , the equilibrium is in mixed strategies and war occurs with probability  $\omega \in [0, 1)$ .*
- 3) *If  $\lambda \geq \lambda_1$ , war occurs with probability one and the wealthier 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. Because at low  $\lambda$  the less wealthy country wins with non-negligible probability, so that the prospect of conquering a more wealthy opponent acts as an inducement to conflict.<sup>23</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 countries to smaller ones, 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.

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<sup>23</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 the Appendix for details.

## 5 Empirical Evidence

We now shed light on the patterns of state consolidation in early modern Europe by focusing on the two key driving factors of centralization stressed by our model: the increasing importance of money for determining military success and cross-country differences in domestic conflicts.

### 5.1 England versus Spain: a study in contrasts

To begin, we compare state building in early modern Britain and Spain. During the period 1500-1800, both were at one point dominant powers at the height of their influence; both fought numerous wars, and both accumulated large quantities of debt. And yet, Spain quickly declined as a European power, while Britain dominated the European concert of powers for centuries and assembled the greatest empire in history.

While many scholars have examined the success of Britain and the failure of Spain, the divergence in state capacity deserves to be underlined. Spain during the 16th century was the superpower of its age. In 1550, it had more men under arms than any other power in Europe. At its height, under Philip II, the empire was so large that the sun literally never set on it. And yet, Spain declined quickly as a European power. By 1700, a mere century and a half after its apogee, its armed forces were less than half as big as they had been in 1550. In Spain, some of the earlier successes in state-building had gone into reverse by the 17th century; the country's decline as a European power paralleled the reduction in fiscal and other resources of the Crown.

As predicted by our model, internal fragmentation was a key constraint: Castile was heavily taxed, but other regions hardly contributed at all to Madrid's revenues. Spain failed to overcome this challenge. Aggressive attempts to levy taxes outside Castile typically came to nothing (such as, for example, under the Count-Duke Olivares during the Thirty Years War). Cities and entire kingdoms successfully claimed tax exemptions. Internal customs barriers continued to undermine market integration (Grafe, 2012). Not even the Crown's monopoly over military resources was successfully asserted: By the 17th century, the arsenals of grandees, such as the one of the Duke of Medina-Sidonia, were once more sufficient to equip a small army (Anderson, 1988).

Britain, on the other hand, gradually evolved into a highly centralized and effective state. Armed force was concentrated in the hands of the central authority. Taxation became uniform and relatively effective. Total revenue surged as the Customs and Excise took over the collection of indirect taxes after 1690. Eventually, Britain introduced the first successfully income tax in history. Its finances were also solid enough to sustain an enormous accumulation of debt – over 200 percent of GDP by 1820. During the period 1500 to 1815, England went from marginal player to the dominant power in Europe, largely as a result of its superior fiscal capacity (Brewer, 1988; Ferguson, 2002). The Royal Navy ruled the sea; it eventually built the largest empire in history.

As Figure A1.2 illustrates, despite the greater underlying heterogeneity of Spain, the two countries were similarly effective at raising revenues in 1500. Strong divergence between Britain and Spain only emerged in the second half of the 17th century, which is precisely when the military revolution's effects became particularly strong. Although both countries faced the same increase in the cost of conflict, the

consequences were quite different.

Consistent with our model, differences in internal fragmentation became problematic for Spain precisely when state capacity became crucial for military success.<sup>24</sup> We emphasize the importance of starting conditions. Spain emerged from the Union of Crowns, joining Castile and Aragon – just as Britain emerged from the Union of Crowns between Scotland and England. In the British case, however, an Act of Union followed the Union of Crowns – Scotland was integrated into Britain administratively, in terms of taxes, and in terms of jurisdiction.<sup>25</sup> Even at the beginning of the early modern period, the kings of England faced a much less fragmented and heterogeneous realm than their competitors on the Iberian peninsula. Apart from Wales, cultural and linguistic fragmentation was relatively limited; cities were not represented directly in parliament. In Spain, every Royal territory continued to have its own laws, customs barriers separated Madrid from Pamplona and Barcelona, and many veto players insisted on their ancient freedoms. Indeed, constitutional theory in many parts of the peninsula held that the king’s position depended on the upholding of medieval customary rights. In this way, new laws and edicts that tried to reduce privileges could be legitimately ignored by officials and citizens alike (Grafe, 2012).

One ready indicator of fragmentation is the frequency and ease of rebellion. While England succeeded in extending tax jurisdiction to Wales and Scotland, Castile failed at the same task. When a serious attempt was made (under Olivares, the so-called "Union de Armas"), armed rebellion in Catalunya, Portugal, and Naples followed. Even if only one of these succeeded, the centralizing agenda in Spain suffered a permanent setback. Rebellious territories, even after being defeated, kept most of their ancient rights. As John Elliott (1969) put it: “Such strength as it [the Spanish Monarchy] possessed derived from its weakness.”<sup>26</sup>

Consistent with our model, the divergent paths of England and Spain also hold a lesson about the co-evolution of institutional change and state building. England’s ability to raise revenue was not impressive until after the “Glorious Revolution” in 1688 (North and Weingast, 1989). We are not the first to note that the 1688 allowed a “grand bargain” to be struck between Crown and parliament, allowing more oversight and control by the latter in exchange for far greater revenue-raising by the former. By strengthening constraints on the executive in a fairly unified country, the optimum rate of centralization actually increased markedly. Our model offers a perspective for why this bargain could be struck – and why it resulted in much greater fiscal centralization and revenue raising – in England than elsewhere.

In sum, the contrast between Spain and England offers powerful support for the predictions of our model. Faced with the same shock - the rise in the cost of armed conflict due to the Military Revolution - one of them succeeded in building a centralized, highly capable state apparatus, while the other failed. Differences in starting conditions, especially in terms of political and ethnic fragmentation, were crucial for divergence.

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<sup>24</sup>Here, we differ from the classification in Dincecco (2009), who characterizes Britain before 1690 as centralized and absolutist. For our purposes, fragmentation in tax collection - with delegation of tax powers to the cities - is what matters, and it was broadly similar in Britain and Spain. Only after the introduction of the Customs and Excise does the collection of indirect taxation become more centralized.

<sup>25</sup>Several provisions of the Act of Union were actually ignored, such as tax exemptions for the kirk.

<sup>26</sup>In the 18th century, the Bourbon kings made another attempt at centralization. While they succeeded in eliminating ancient "freedoms" in Catalunya, they did not succeed in permanently centralizing and consolidating power. For example, internal customs barriers were quickly re-erected (Grafe, 2012).

## 5.2 The Military Revolution, Fragmentation and State Building in Early Modern Europe

We now provide some statistical evidence on the mechanism highlighted by our model for a cross section of early modern European countries. The goal of this analysis is not to identify the causal impact of the changing war technology and domestic divisions on state building, but rather to see whether the basic correlations in the data are consistent with our theory.

### 5.2.1 Money and military success

We first provide evidence on 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 entire period of the military revolution and the centuries during which state consolidation in Europe accelerated, reaching a substantial level by the end of the period. The principal sources for our data are Jaques (2007), who developed a dataset of battles in history, combined with information by Landers (2003) on the outcomes of conflicts. We also use fiscal data from the European State Finance Database (ESFD; Bonney, 1996), as compiled and summarized by Karaman and Pamuk (2010).<sup>27</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 data sources we use in this Section are all described in the data Appendix.

#### Table 3 here

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 on an increasing scale. As Table 3 shows, the odds of success were on average some 16 percent (29 percent for land battles only) 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 60 to 70 percent higher than those of poorer belligerents.

Table 3 examines the odds of the richer contestant winning without using information on the revenue gap between contestants. To account not just for which power is fiscally stronger, but to measure the impact of revenue differences, we next estimate the likelihood of success for the richer power as a function of the revenue ratio between both sides:

$$S_{H,t} = C + \widehat{\lambda}_1 T_{H,t} + \widehat{\lambda}_2 T_{L,t} + \epsilon_{H,t} \quad (32)$$

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

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<sup>27</sup>We go beyond the Karaman and Pamuk dataset by including observations from the ESFD on smaller countries.

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>28</sup> We cluster standard errors 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 statistical 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 gives 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 well-approximated by a coin flip. 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). 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. It changes 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 is large and highly significant (column 5). In column 6, we pool all observations and interact the post-1650 dummy with the revenue difference. The post-1650 dummy is highly significant, indicating that the chances of success for the fiscally stronger power were markedly higher after that point in time. The probability of success for fiscally stronger power after 1650 as implied by column 4 is 0.7 without taking the size of the revenue gap into account. We find that the estimated coefficient on the revenue differential is positive and large, but not tightly estimated; the odds are heavily stacked in favor of the stronger power after 1650, but there is no significant evidence that the size of the revenue gap in addition is closely related with the chances of success.

#### **Table 4 here**

In Appendix 4, we show that our basic result holds if we drop battles where allies were involved, and if we use probit estimation (Tables A4.1 and A4.2). The results also do not depend on the particular functional form that we chose. As Table A4.3 shows, results are very similar if we use the share of combined revenues controlled by the richer power as the explanatory variable. We therefore conclude that after 1650, fiscal revenue became a much better predictor of battlefield success. This is consistent with the main driving

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<sup>28</sup>We present (largely unchanged) results using probit in Appendix 4.

force behind state building in the theoretical part: an increase in the sensitivity of the war outcome to fiscal revenues.

### 5.2.2 *Fragmentation, the Military Revolution and State Building*

Our model predicts that a state's ability to raise taxes depends on domestic conflicts. We use data on fiscal revenues per capita over the period 1500-1800, measured as grams of silver per capita.<sup>29</sup> To measure deeper, structural constraints that undermined a prince's ability to pursue a state-building agenda, 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, 1969).

#### **Figure 6 here**

In Figure 6, we examine how tax-raising interacted with prior territorial divisions in Europe after 1500, by tercile of the distribution of the number of predecessor states. The size of each box indicates the 25th and 75th percentiles, while the median is indicated inside it. 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 quintiles are ordered from 1st (lowest number of prior states) to 5 (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 is a necessary, but not a sufficient condition for raising revenues.

#### **Table 5 here**

Next, we examine if the relationships plotted in Figure 6 is statistically significant and of a meaningful magnitude. In Table 5, we estimate

$$R_{i,t} = C + \beta \cdot B_{i,t} + \delta D_{post1650} + \rho B_{i,t} D_{post1650} + \epsilon_{i,t}$$

where  $R_{i,t}$  is tax revenue (grams of silver per capita), which serves as our measure of fiscal capacity,  $B_{i,t}$  is our measure of underlying fragmentation (in this case, the number of predecessor states),  $D_{post1650}$  is

<sup>29</sup>The data come from Karaman and Pamuk (2010), augmented by information from the European State Finance Database.

a dummy that takes the value of unity if observations are from years after 1650, and zero otherwise. We use either robust standard errors (to deal with potential heteroscedasticity) or clustered standard errors (at the level of the country). We obtain a significant, large and negative effect, independent of which standard errors we use. States with a one standard deviation higher number of predecessor states see tax collection that is, on average 18 grams of silver per capita lower, equivalent to half of the dependent variable's mean. Table 5 also shows that the result is driven by observations after 1650, when the military revolution made itself fully felt. For the period before 1650, the coefficient is negative, but small and insignificant. Thereafter, it increases eightfold in size and becomes highly significant. As column 4 demonstrates, the difference between the period before and after 1650 is highly significant.

Internal fragmentation in our model matters in a number of dimensions. It proxies for the potential strength of domestic opposition. To show that  $B$  – the strength of internal conflict faced by a centralizing ruler – matters empirically, we now show several variables are associated with lower revenues in the early modern period. First, we investigate the effect of ethnic heterogeneity. Ethnic divisions can undermine effective central control. We use the Alesina et al. measure of ethnic heterogeneity. Since it is calculated with contemporary data, we need to adapt it to our historical setting. This is done by using data from the migration matrix compiled by Putterman and Weil (2010).<sup>30</sup>

We find that ethnic heterogeneity acted as a considerable constraint on state-building in the early modern period. As Table 6, panel A shows, the effect is large and significant if we use robust standard errors; if we cluster at the country level, it is not significant. The effect gets bigger after 1650 (columns 2 and 3); in column 4, the interaction effect between the post1650-dummy and the ethnic divisions measure is large and negative, but marginally below standard levels of significance with clustered errors. The results in Table 6 strongly suggest that countries with populations that were more homogenous found it easier to raise taxes after 1500. The differential effect becomes stronger as the pressure to raise revenue escalates during the height of the military revolution, after 1650.

### **Table 6 here**

Domestic impediments to reforms do not only depend on ethnic or political divisions. Geography and the wealth of a region can also act as an impediment to centralization. The more remote and inaccessible a region, the harder it will typically be for a ruler to extend effective control. In an age of highly primitive road transport, this was particularly true if there was no water transport available. For a ruler to successfully raise taxes, there has to be surplus income. Cities are closely associated with high productivity in agriculture, and are often used as a proxy for overall output per capita (Wrigley, 1989). Voigtländer and Voth (2013) show that early modern rulers taxed a high percentage of this surplus income. Here, we will proxy it with the urban population that is easily accessible. In Panel B, we test these hypotheses explicitly. We use a variety of geographical variables that show both how much urban wealth there was to tax, and how easily a ruler could reach these population centers.

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<sup>30</sup>The data appendix details how this adjustment was performed.

In col 1, we use average terrain ruggedness (as in Nunn and Puga, 2012) as an explanatory variable. We find a marked effect of greater ruggedness – a one standard deviation increase is associated with declines in revenue collection. The same is true when using average slope and elevation; both measures similarly capture ruggedness. In col 4-6, we examine the impact of urban geography. In col 4, we introduce a new variable – effective distance. It is calculated as the direct distance connecting each city to the country’s capital, weighted by the ruggedness of the path (using a 10km-wide area of the most direct connection). This figure is then averaged over all city-capital pairs according to the formula in the appendix (cf Data Appendix). The greater the effective distance between the capital and the average city in a country, the lower revenue collection. The result is basically unchanged if we also correct for being located on a river or on the coast (which helps to overcome the effect of ruggedness), which reduces effective distance (col 5). In the final column, we calculate the share of the urban population within 300 km of the capital. As expected, it is strongly and positively associated with revenue collection. The effect of effective distance is also smaller before 1650 than thereafter – revenue collection in general is higher after 1650, but the effective distance of urban centers from the capital also matters more.<sup>31</sup>

Overall, our empirical results provide support for the following predictions of the model: First, the importance of money grew rapidly as the “Military Revolution” unfolded. In the beginning, the odds of a richer power winning were not significantly greater than those of the poorer power. By the end of the early modern period, richer belligerents won wars with much greater frequency. Second, the ease with which revenue could be raised depended to an important extent on pre-existing domestic divisions, such as the number of predecessor states on a territory, ethnic heterogeneity, and the ease with which rich, taxable populations could be reached from a capital. In combination, we conclude that there is substantial empirical support for the two key driving variables in our model –  $\lambda$ , the importance of money for winning in war, and  $B$ , the extent of domestic opposition to centralization.

## 6 Conclusion

Centralized, powerful states are a relatively recent invention. In many parts of the world, states do not have a monopoly of violence, collect only a small share of GDP as taxes, and provide few essential services. To understand how state capacity came to be high in some countries, we analyze the origins of European states in the early modern period. We build a model in which central rulers can invest in state capacity - centralizing tax collection, wresting control over tariffs from local princes, etc. Powers differ in their pre-existing levels of fragmentation. In a highly fragmented territory, the ruler will face substantial and costly opposition; centralizing a more homogenous territory will produce the same benefit for the ruler, but requires less investment to overcome the opposition of local magnates. Without the threat of war, princes simply trade off the revenue gains against the threat of rebellion.

The threat of war changes the calculus. On the one hand, monarchs now have to fear that they may be attacked, and territory (and treasure) taken from them. This reduces their incentive to invest in state

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<sup>31</sup>Cf Table A4.4 in the Appendix.

capacity. At the same time, the need to finance war makes money more valuable, increasing the incentive to raise state capacity. The strength of these two effects depends on how costly wars are. Everything else equal, expensive wars make it more attractive to invest in centralization.

In Europe after 1500, the cost of war grew exponentially - armies increased in size, equipping them became vastly more costly, and wars lasted longer. In our model, war can become so costly that at least the stronger, less fragmented power finds it worthwhile to invest in greater state capacity because of the threat of war. The fragmented power, on the other hand, may invest less, and can drop out of power competition altogether. As the cost of war increases even further, the importance of money for survival starts to outweigh the dangers of rebellion. Therefore, when wars are very costly, both the cohesive and the fragmented power invest in state capacity.

We apply our framework to the case of early modern Europe. By 1800, 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 argue that Europe's rise to global domination after 1500 reflects a benign externality of the intense struggle for supremacy in Europe. The exogenous shock that set off the rise of European state capacity was that wars became ever more costly after 1500, as a result of the "Military Revolution". As the cost of conflict rose, rulers taxed more and centralized revenue collection to ensure their independence. Some states succeeded by tearing up the ancient "liberties" of towns, clergy, and the nobility, ignored laws based on custom, imposed new legal norms uniformly, and abolished tax exemptions. Other, even more successful states, found ways to constrain the sovereign, in exchange for vastly greater tax powers.<sup>32</sup> Weaker powers mostly dropped out of the competition and in some cases disappeared from the map, leaving the field to their more potent competitors. In this way, in response to the rising cost of conflict, average state capacity in Europe grew dramatically, while only a few consolidated, powerful states survived.

In the empirical part of our paper, we examine the model's predictions. We first show how the importance of financial resources for military success changed. As the "Military Revolution" unfolded, richer powers won on the battlefield more often. Also, raising taxes was markedly more difficult in fragmented (and fractious) states: Where states were composed of numerous predecessor states, rulers found it more difficult to increase tax pressure. Similarly, where geographical constraints hindered centralizing efforts, the average tax take after 1500 grew markedly less.

Our model also casts light on how the growing importance of fiscal revenue for success on the battlefield interacted with incentives to improve institutions. The fundamental inefficiency at the heart of our model is that rulers could typically not commit to revenue sharing with local power holders. The right institutions can help to overcome resistance to reform by allowing the ruler to commit credibly. Under ideal circumstances, this led to the creation of a "consensually strong" state (Acemoglu, 2005), which becomes centralized and powerful precisely because the ruler is constrained. We interpret the rise of Britain after 1689 in this light, arguing that the rapidly rising cost of warfare increased the importance of revenue gener-

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<sup>32</sup>England is arguably a case in point. Cf. Acemoglu (2005) for the logic of strong and weak states, and North and Weingast (1989) on changes after the Glorious Revolution.

ation for the monarch. Since English initial levels of internal fragmentation were low, centralization could proceed apace – resulting in a highly efficient Customs & Excise administration, and the first successful income tax in history precisely because Crown and Parliament could come to an agreement.

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## Tables

Table 1: Frequency of War

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

Source: Tilly 1990.

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	342	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

Table 3: War and fiscal resources

	Richer wins? odds of success (richer power)				Richer wins? odds of success (richer power)		
	Y	N			Y	N	
1500-1800	199	171	1.16	1650-1700	34	26	1.31
1500-1550	4	14	0.29	1700-1750	35	34	1.03
1550-1600	3	9	0.33	1750-1775	31	19	1.63
1600-1650	7	20	0.35	1775-1800	85	49	1.73

Source: Based on Jacques 2007 and Landers 2003; cf. Data Appendix.

Table 4: Battlefield success and fiscal revenue

Explanatory variable	(1)	(2)	(3)	(4)	(5)	(6)
	All	All	All	Pre-1650	Post-1650	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)
$P^L$		-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
$adj. R^2$	0.0597	0.135	0.134	0.0631	0.0981	0.166

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

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

Table 5: Revenue raising and the number of predecessor states in 1300

	(1)	(2)	(3)	(4)
Explanatory variable	All	Before 1650	After 1650	Interaction
<i>predecessor1300</i>	-1.84**	-0.37	-2.76***	-0.37
	(2.27)	(1.15)	(2.4)	(1.16)
	[4.1]	[1.4]	[4.3]	[1.4]
<i>post1650</i>				60.2***
				(2.9)
				[4.1]
<i>predecessor * post1650</i>				-2.4***
				(2.3)
				[3.4]
N	67	25	42	67
<i>adj. R</i> <sup>2</sup>	0.15	0.04	0.27	0.34

t-statistics in parentheses (standard error clustered at country level) [robust standard errors]

Table 6: Revenue raising and fragmentation (dependent variable: revenue per capita in grams of silver p.a.)

Panel A: Alesina measure of ethnic heterogeneity (adjusted for population changes)				
	(1)	(2)	(3)	(4)
sample	all	before 1650	after 1650	interaction
<i>AEH</i>	-111.6	-5.02	-186.4	-5.02
	(1.3)	(0.1)	(1.4)	(0.1)
	[2.6]	[0.1]	[2.6]	[0.15]
<i>post1650</i>				68.97
				(2.3)
				[3.4]
<i>AEH * post1650</i>				-181.4
				(1.68)
				[2.3]
<i>N</i>	67	25	42	67
<i>adj. R<sup>2</sup></i>	0.066	0.001	0.12	0.22

*AEH*: Alesina ethnic heterogeneity (adjusted for post-1500 migrations)  
t-statistics in parentheses (standard error clustered at country level) [robust standard errors]; Constant included but not reported.

Panel B: Geographic constraints						
Explanatory variable	TRI	slope	elevation	Edist_10	Edist_c_10	Pshare_300
Evar	-0.14**	-7.66**	-0.058***	-0.00045**	-0.00035*	55.52*
	(-2.35)	-2.36	(-2.72)	(-2.08)	(-1.86)	(1.86)
	[-1.28]	[1.29]	[1.63]	[-1.2]	[-1.18]	[1.1]
Constant	60.98***	61.04***	66.52***	58.36***	52.63***	15.13*
	-4.38	-4.39	-4.58	-4.31	-4.66	-1.69
<i>N</i>	59	59	59	59	59	66
<i>adj. R<sup>2</sup></i>	0.053	0.055	0.081	0.051	0.022	0.071

Evar stands for the explanatory variable: TRI is terrain ruggedness; slope is the average slope of a country's terrain; elevation is average elevation above sea-level; Edist\_0 is the effective distance of urban centers to the capital (for details, cf Data Appendix); Edist\_c\_10 is the effective distance controlling for the presence of rivers; Pshare\_300 is the share of urban population within 300km of the capital.  
t-statistics in parentheses (standard error clustered at country level) [robust standard errors]; Constant not reported.

# Figures

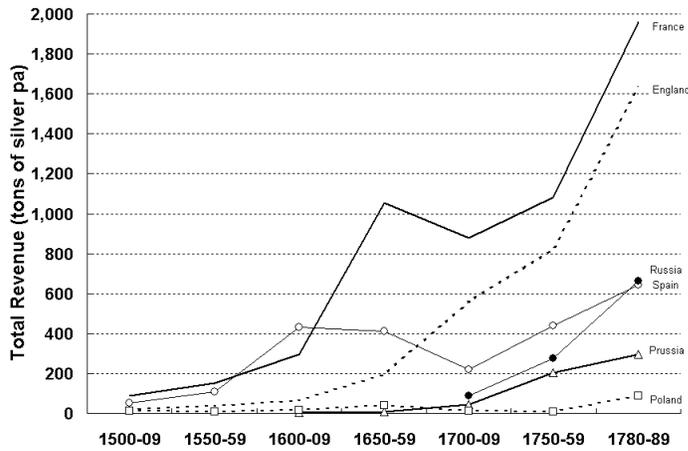


Figure 1: Fiscal Revenue in Europe, 1500-1780

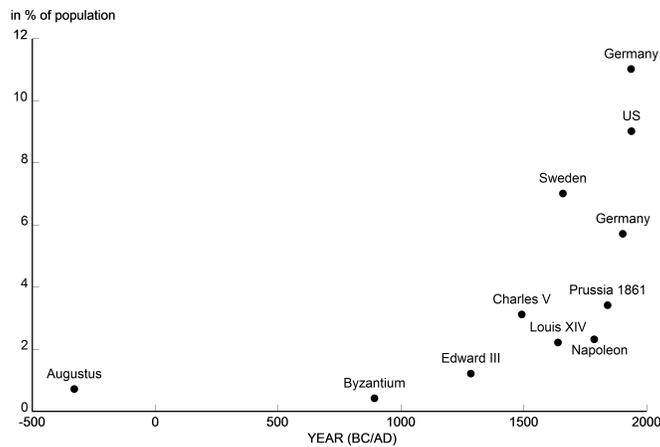


Figure 2: Army Size from Augustus to 1944

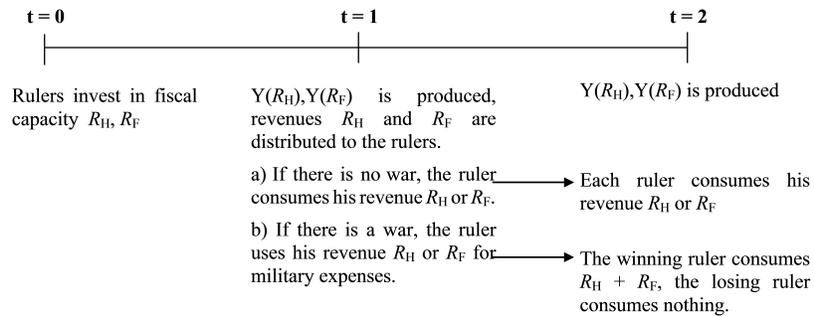


Figure 3: Timing

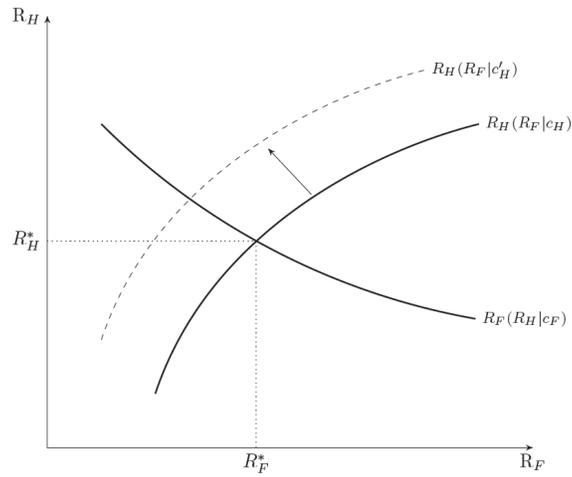


Figure 4: The effect of a reduction in the cost of reform  $c_H$  in the aggressive reformer  $H$ .

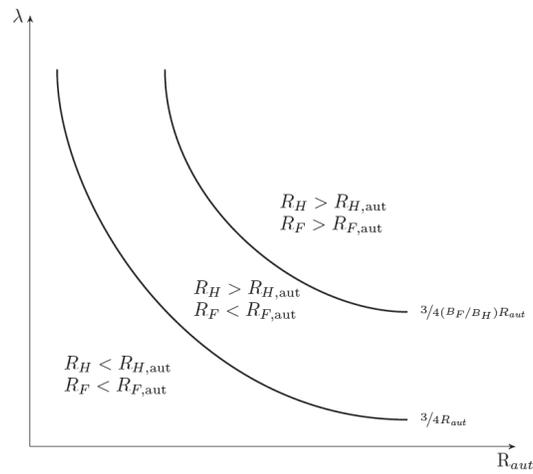


Figure 5: Capital Intensity, Domestic Conflict, and State Building

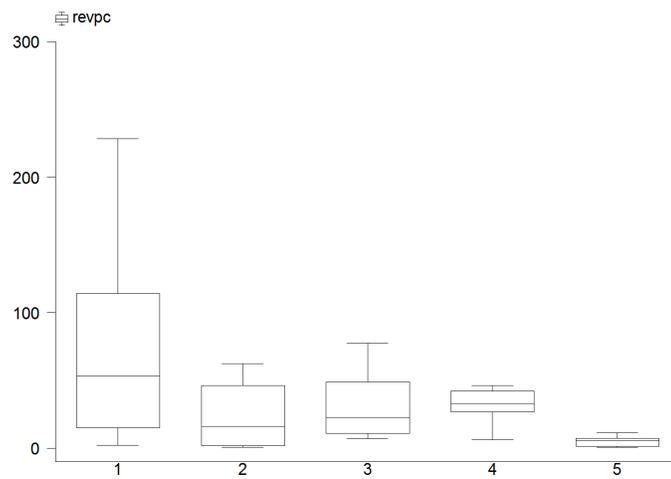


Figure 6: Revenue by number of predecessor states (by quintile; 1=lowest)

## A Appendix

### A.1 Additional Figures

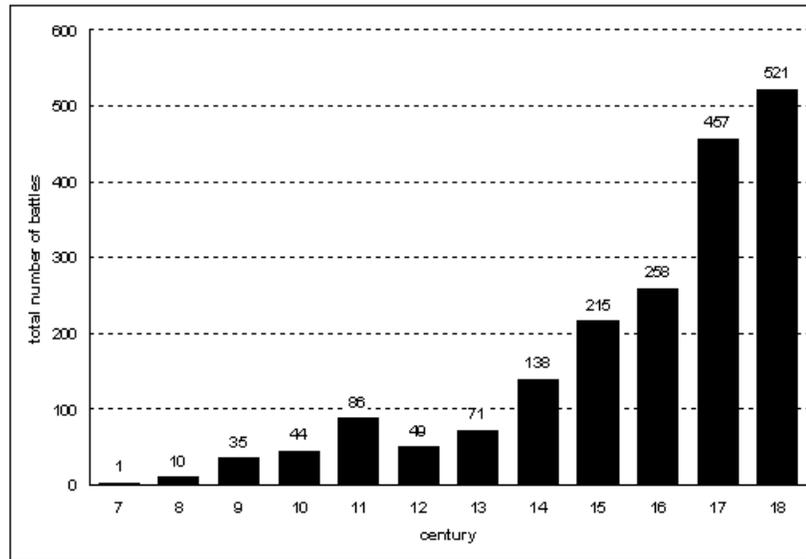


Figure A1.1: Number of Battles in Europe per Century

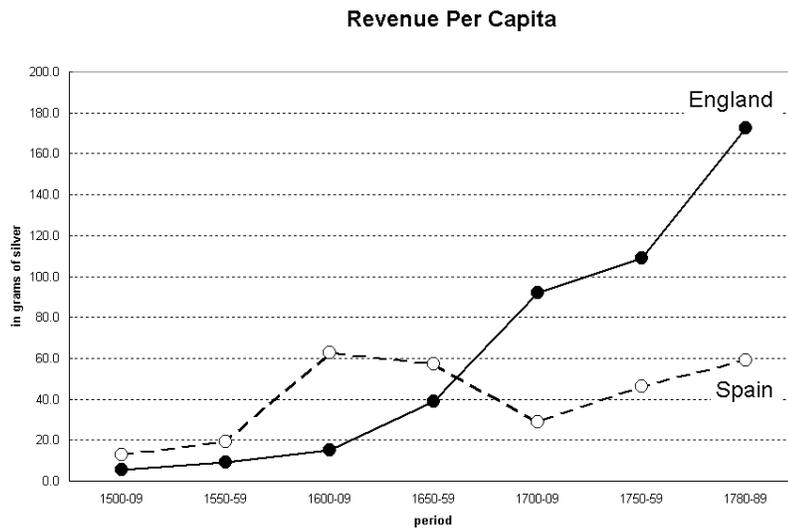


Figure A1.2: Revenue per capita, England and Spain

## A.2 Mathematical Appendix

*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  $\Pi^j(R_H, R_F)$  the payoff of ruler  $j = H, F$ . The rulers' first order conditions are then equal to  $\Pi_{R_j}^j(R_H, R_F) = 0$  for  $j = H, F$ , giving rise to Equations (14) and (15). These conditions guarantee an interior optimum if rulers' objective is concave, namely if  $\Pi_{R_j R_j}^j(R_H, R_F) < 0$  for  $j = H, F$ . Concavity is equivalent to having:

$$(\theta/2) [p_{HH}(R_H + R_F) + 2p_H] - 1/R_{H,out} < 0, \quad (\text{A.1})$$

$$(\theta/2) [-p_{FF}(R_H + R_F) - 2p_F] - 1/R_{F,out} < 0. \quad (\text{A.2})$$

Throughout, we assume that concavity is fulfilled to study the properties of interior equilibria, if they exist.

Applying the implicit function theorem to (14) and (15) we have that:

$$\frac{dR_H(R_F)}{dR_F} = \frac{\Pi_{R_F R_H}^H}{\left| \Pi_{R_H R_H}^H \right|} = \frac{(\theta/2) [p_{HF}(R_H + R_F) + p_H + p_F]}{|(\theta/2) [p_{HH}(R_H + R_F) + 2p_H] - 1/R_{H,aut}|}, \quad (\text{A.3})$$

$$\frac{dR_F(R_H)}{dR_H} = \frac{\Pi_{R_F R_H}^F}{\left| \Pi_{R_F R_F}^F \right|} = -\frac{(\theta/2) [p_{HF}(R_H + R_F) + p_H + p_F]}{|(\theta/2) [-p_{FF}(R_H + R_F) - 2p_F] - 1/R_{F,aut}|}. \quad (\text{A.4})$$

Thus, reaction functions have opposite sign, formally  $\text{sign} \left( \frac{dR_H(R_F|\cdot)}{dR_F} \right) = -\text{sign} \left( \frac{dR_F(R_H|\cdot)}{dR_H} \right)$ . We also have that:

$$\frac{dR_H(R_F)}{d\theta} = \frac{\Pi_{R_F, \theta}^H}{\left| \Pi_{R_H R_H}^H \right|} = \frac{(1/2) [p_H(R_H + R_F) - (1-p) - 1]}{|(\theta/2) [p_{HH}(R_H + R_F) + 2p_H] - 1/R_{H,aut}|}, \quad (\text{A.5})$$

$$\frac{dR_F(R_H)}{d\theta} = \frac{\Pi_{R_F, \theta}^F}{\left| \Pi_{R_F R_F}^F \right|} = \frac{(1/2) [-p_F(R_H + R_F) - p - 1]}{|(\theta/2) [-p_{FF}(R_H + R_F) - 2p_F] - 1/R_{F,aut}|}. \quad (\text{A.6})$$

An interior equilibrium  $(R_H^*, R_F^*)$  is then identified by the equation:

$$\{1 + (\theta/2) [-p_F(R_H(R_F^*) + R_F^*) - p - 1]\} - \frac{R_F^*}{R_{F,aut}} = 0, \quad (\text{A.7})$$

together with  $R_H^* = R_H(R_F^*)$ . The above condition is obtained by replacing  $H$ 's reaction function  $R_H(R_F)$  obtained from (14) into (15). It is useful to consider the slope of (A.7) with respect to  $R_F$ . To do so, rewrite (A.7) as  $\Pi_{R_F}^F(R_H(R_F), R_F) = 0$ . By exploiting (A.3) and (A.4), we can find that the derivative of the left hand side of (A.7) 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  $(R_H^*, R_F^*)$ , 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 an interior optimum the problem is concave, namely  $\Pi_{R_F R_F}^F < 0$ . To ensure existence, it must be the case that  $\Pi_{R_F}^F(R_H(0), 0) > 0$  and  $\Pi_{R_F}^F(R_H(A_m - A_h), A_m - A_h) < 0$ , together with the concavity of the rulers' objective functions.  $\square$

*Proof of Corollary 0.* We now prove the following comparative statics properties of the model. If an interior equilibrium  $(R_H^*, R_F^*)$  exists, it features the following properties:

- 1) A lower  $c_J$  increases equilibrium reform  $R_{c_J}^*$  in country  $J$ .
- 2) If country  $J$  is the aggressive reformer, namely  $\frac{dR_J(R_{-J}|\theta, R_{J,aut})}{dR_{-J}} > 0$ , then a marginal drop in  $c_J$  decreases reform  $R_{c_{-J}}^*$  in country  $-J$  while a marginal drop in  $c_{-J}$  increases reform  $R_{c_J}^*$  in country  $J$ .

To prove these comparative statics, let us differentiate the rulers' first order conditions with respect to

reform costs. We then obtain:

$$\Pi_{R_H R_H}^H dR_H + \Pi_{R_H R_F}^H dR_F = R_H dc_H, \quad (\text{A.8})$$

$$\Pi_{R_F R_H}^F dR_H + \Pi_{R_F R_F}^F dR_F = R_F dc_F. \quad (\text{A.9})$$

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

$$dR_H = -\varphi R_H dc_H - \varphi \frac{\Pi_{R_H R_F}^H}{\left| \Pi_{R_F R_F}^F \right|} R_F dc_F, \quad (\text{A.10})$$

$$dR_F = -\varphi \frac{\left| \Pi_{R_H R_H}^H \right| \left| \Pi_{R_F R_F}^F \right|}{\left| \Pi_{R_F R_F}^F \right|^2} R_F dc_F + \varphi \frac{\Pi_{R_F R_H}^F}{\left| \Pi_{R_F R_F}^F \right|} R_H dc_H \quad (\text{A.11})$$

where  $\varphi = \frac{\left| \Pi_{R_F R_F}^F \right|}{\left| \Pi_{R_H R_H}^H \Pi_{R_F R_F}^F \right| + \left| \Pi_{R_H R_F}^H \Pi_{R_F R_H}^F \right|} > 0$ . Clearly,  $\frac{dR_H}{dc_H} < 0$ ,  $\frac{dR_F}{dc_F} < 0$ , and  $\frac{dR_H}{dc_F} < 0$  if and only if  $\frac{dR_H(R_F)}{dR_F} > 0$ , and  $\frac{dR_F}{dc_H} > 0$  if and only if  $\frac{dR_H(R_F)}{dR_F} > 0$ .  $\square$

*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  $\gamma = 1$  from the reaction functions we obtain:

$$R_J^* = \left( \frac{1 - 3\theta/4}{1 - \theta\lambda R_{J,aut}} \right) \cdot R_{J,aut}, \quad (\text{A.12})$$

which a maximum provided  $\theta < \hat{\theta} \equiv 1/\lambda \max_J R_{J,aut}$ . We will always consider the case where  $\theta$  is sufficiently low that in the range of variation of  $\lambda$  of interest [the one where not all countries have fully centralized, formally  $\min_J R_J^* < R_c$ ] the condition is always met. 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;

$$2\lambda(1 - 3\theta/4)(\max_J R_{J,aut} - \min_J R_{J,aut}) \leq (1 - \theta\lambda R_{H,aut})(1 - \theta\lambda R_{F,aut}), \quad (\text{A.13})$$

which we also assume by focusing on similar country pairs (i.e. where  $\max_J R_{J,aut} - \min_J R_{J,aut}$  is small). If the two countries are sufficiently similar, condition (A.13) is fulfilled for all  $\lambda$ . The remaining properties then follow by inspection of the first order condition.  $\square$

*Proof of Proposition 3.* By a suitable choice of nonnegative coefficients  $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$  we can write Equations (20) and (21) 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:

$$\frac{R_H^*}{R_F^*} = \frac{R_{H,aut}}{R_{F,aut}} \cdot \frac{1 + \theta\lambda R_{F,aut}(1 - 2\gamma)}{1 - \theta\lambda R_{H,aut}(2 - \gamma)}. \quad (\text{A.14})$$

The other properties immediately follow by inspection.  $\square$

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

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

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:

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

It is then easy to see that :

$$\left. \frac{\partial W_H}{\partial \pi_H} \right|_{\pi_H=\pi} > \left. \frac{\partial W_F}{\partial \pi_F} \right|_{\pi_F=\pi} \Leftrightarrow \left( \frac{\tilde{R}_H^*}{\tilde{R}_F^*} \right)^2 > \frac{\tilde{R}_{H,aut}}{\tilde{R}_{F,aut}}. \quad (\text{A.15})$$

$\square$

*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, (30) can be rewritten as:

$$\left[ \frac{1}{2} + \lambda(R_H^* - R_F^*) \right] \cdot \sigma \cdot (R_H^* + R_F^*) \geq R_H^*, \quad (\text{A.16})$$

$$\Leftrightarrow \lambda\sigma \left[ (R_H^*)^2 - (R_F^*)^2 \right] - (1 - \sigma)R_H^* \geq \frac{\sigma(R_H^* - R_F^*)}{2}. \quad (\text{A.17})$$

Given the symmetry of the contest success function, (A.17) 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 (A.17) becomes:

$$\lambda\sigma(R_H^* + R_F^*) - (1 - \sigma)\frac{R_H^*}{R_H^* - R_F^*} \geq \frac{\sigma}{2}. \quad (\text{A.18})$$

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 (A.18) 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, (A.18) is violated.

Suppose now that  $F$  is the weak ruler, namely  $R_H^* < R_F^*$ . Then (A.17) becomes:

$$\lambda\sigma(R_F^* + R_H^*) + (1 - \sigma)\frac{R_H^*}{R_F^* - R_H^*} \leq \frac{\sigma}{2}. \quad (\text{A.19})$$

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  $\hat{\sigma} < 1$  such that, for  $\sigma \geq \hat{\sigma}$ , there exists a  $\lambda_0$  such that for  $\lambda \leq \lambda_0$  condition (A.19) is met. For  $\sigma < \hat{\sigma}$ , 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  $\lambda = 3/4R_{J,aut}$ , 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  $\lambda < 3/4R_{J,aut}$ . 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  $\omega$ ).  $\square$

### A.3 Power Contest Success Function

We now study the model under Equation (10). We focus on the case where the two countries are equally sized, namely  $L_H = L_F$ . This implies that:

$$p(R_H, R_F) = \frac{R_H^\lambda}{R_H^\lambda + R_F^\lambda}. \quad (\text{A.20})$$

When  $\lambda = 0$  the war outcome is determined by a coin toss, i.e.  $p = 1/2$ . When  $\lambda = 1$  a country wins the war with odds equal to its relative fiscal revenue. When  $\lambda \rightarrow \infty$  the richer country wins for sure. By plugging Equations (11) and (A.20) into Equations (14) and (15) it is easy to find:

**Lemma 2.** *When countries are symmetric,  $R_{F,aut} = R_{H,aut} = R_{aut}$ , the equilibrium is interior and unique. In this equilibrium, we have that:*

$$R_H^* = R_F^* = R_{aut} \left[ 1 + \frac{\theta}{4}(\lambda - 3) \right]. \quad (\text{A.21})$$

*Higher  $\theta$  boosts state building relative to autarky if and only if the sensitivity of the war outcome to fiscal revenues is sufficiently high, namely  $\lambda > 3$ .*

*Suppose now that  $\lambda \leq 1$ . then, if countries are asymmetric, namely  $c_H \neq c_F$ , in an interior equilibrium we have that  $R_H^* > R_F^*$  if and only if  $c_H < c_F$ .*

*Proof.* By using  $|\partial p(R_H, R_F)/\partial R_J| = \lambda \cdot p(1-p)/R_J$ , (A.20), the first order conditions become:

$$\begin{aligned} R_H^* &= R_{H,aut} \cdot \left\{ 1 + (\theta/2) \left[ \lambda \cdot p(1-p) \frac{R_H^* + R_F^*}{R_H^*} - (1-p) - 1 \right] \right\}, \\ R_F^* &= R_{F,aut} \cdot \left\{ 1 + (\theta/2) \left[ \lambda \cdot p(1-p) \frac{(R_H^* + R_F^*)}{R_F^*} - p - 1 \right] \right\}. \end{aligned}$$

When  $R_{H,aut} = R_{F,aut} = R_{aut}$  the equilibrium is symmetric,  $p = 1/2$ , so that:

$$R_H^* = R_F^* = R_{aut} \left[ 1 + \frac{\theta}{4}(\lambda - 3) \right]. \quad (\text{A.22})$$

At a symmetric equilibrium, the rulers' objectives are concave, so (A.22) is indeed an optimum. To see this, consider the concavity of  $H$ . In the case of the power function (A.20), the second order condition (A.1) becomes:

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

It is immediate to see that at a symmetric equilibrium the term in square bracket becomes equal to zero, so that the second order condition is fulfilled.

Consider now the asymmetric case where  $c_H \neq c_F$ . In this case, one can show that an interior equilib-

rium exists provided  $\theta$  is sufficiently small and  $c_J$  is sufficiently large for  $J = H, F$ . In this case, we know from Equations (14) and (15) that in equilibrium we have:

$$c_H = \frac{1 + \frac{\theta}{2} \left[ \frac{\lambda p(1-p)}{R_H} (R_H + R_F) - 2 + p \right]}{R_H} \quad (\text{A.23})$$

$$c_F = \frac{1 + \frac{\theta}{2} \left[ \frac{\lambda p(1-p)}{R_F} (R_H + R_F) - 1 - p \right]}{R_F} \quad (\text{A.24})$$

When  $c_H < c_F$ , it must be that the right hand side of (A.23) is smaller than the right hand side of (A.24). After some algebra, one can show that this condition is equivalent to:

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

One can check that for  $\lambda \leq 1$  the above condition cannot be met if  $R_H \leq R_F$ . This implies that when  $c_H < c_F$ , in an interior equilibrium it must also be that  $R_H > R_F$ .  $\square$

The main findings obtained under the linear specification are preserved under the exponential contest success function (A.20). In particular, the war threat ( $\theta > 0$ ) boosts centralization if and only if  $\lambda$  is sufficiently large. Equation (A.21) formally proves this for the case where the two countries are identical because it is difficult to fully solve the case where countries are asymmetric under the power contest success function. It also continues to be the case that the external war threat exerts an asymmetric effect across countries, favouring the country,  $H$ , with a lower domestic cost of reform.

#### A.4 Additional Regression Results

Table A4.1: Battlefield results, battles without allies only

Explanatory variable	(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)
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
$adj. R^2$	0.0275	0.123	0.123	0.160	0.0865	0.152

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

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

Table A4.2: Battlefield results, probit

Explanatory variable	(1) All	(2) All	(3) All	(4) Pre-1650	(5) Post-1650	(6) 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

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

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

Table A4.3: Robustness - Battlefield success and revenue shares

	1	2	3	4	5
sample	All	All	Pre-1650	Post-1650	Interaction
$[TR^H]/[TR^H + TR^F]$	0.0571	0.109*	0.0742	0.127*	0.0190
	(0.0357)	(0.0481)	(0.0584)	(0.0520)	(0.0562)
<i>post1650</i>					0.300***
					(0.0781)
$[TR^H]/[TR^H + TR^F] * post1650$					0.0447
					(0.0679)
$P^H/[P^H + P^F]$		-0.0187	-0.0446	-0.0152	
		(0.0414)	(0.0589)	(0.0379)	
Constant	0.480***	0.455***	0.187***	0.499***	0.227***
	(0.0560)	(0.0702)	(0.0427)	(0.0582)	(0.0591)
N	374	257	42	215	374
<i>adj. R</i> <sup>2</sup>	0.0130	0.0313	0.0180	0.0437	0.0763

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

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

Table A4.4: Additional Geography Results

	1	2	3	4	5	6
Explanatory variable	TRI	Slope	elevation	Edist_10	Edist_c_10	Pshare300
<i>post1650</i>	54.47***	54.67***	62.10***	58.55***	49.82***	-4.655
	-2.91	-2.91	-3.12	-3.14	-3	(-0.29)
<i>Evar</i>	0.0207	1.079	0.00103	5.1E-05	-8E-06	7.252
	-0.49	-0.48	-0.08	-0.39	(-0.06)	-0.53
Interaction ( <i>Evar * post1650</i> )	-0.153*	-8.412*	-0.0678**	-0.000631**	-0.0005	100.3*
	(-1.74)	(-1.76)	(-2.17)	(-2.11)	(-1.56)	-1.94
Constant	12.99*	13.09*	15.20**	14.04**	15.81***	12.54**
	-1.84	-1.88	-2.24	-2.14	-2.78	-2.21
N	66	66	66	66	66	66
<i>adj. R</i> <sup>2</sup>	0.127	0.129	0.163	0.167	0.129	0.254

Dependent variable: revenue per capita (in grams of silver); TRI is terrain ruggedness; slope is the average slope of a country's terrain; elevation is average elevation above sea-level; Edist\_0 is the effective distance of urban centers to the capital (for details, cf Data Appendix); Edist\_c\_10 is the effective distance controlling for the presence of rivers; Pshare\_300 is the share of urban population within 300km of the capital. t-statistics in parentheses (standard error clustered at country level) [robust standard errors]

## A.5 Data Appendix

### OVERVIEW OF VARIABLES USED

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

<b>Variable</b>	<b>Description and Source</b>
Battle outcome	Dummy variable that takes the value of 1 if the fiscally stronger power wins (Landers 2003). The source for battle data is Jacques (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 us with 374 battles. Of these, 80 were fought at sea.
$TR^H$	Annual average of the richer power's total revenue, in tons of silver. Source: Karaman and Pamuk (2010) and European State Finance Database (Bonney 1989).
$TR^F$	Annual average of the poorer's power's total revenue, in tons of silver. Source: Karaman 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: Mc Evedy and Jones (1978).
$p^F$	Population of poorer power, in millions, at the beginning of the period to which the fiscal data refers. Source: Mc Evedy and Jones (1978).
Predecessor1300	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>
AEH	The ethnic fractionalization measure of Alesina et al. (2003), adjusted for migration between 1500 and 2000. All migratory movements are taken from Putterman and Weil (2010). Details on the approximation used for the migration adjustment are in Appendix 5.

<b>Variable</b>	<b>Description and Source</b>
Elevation	Calculated from a grid of elevation points, each point representing the mean elevation of a 30 by 30 arc-seconds resolution cell, this measure is an average (in meters) over each state's surface. Data are from the U.S. Geological Survey (USGS) and the National Geospatial-Intelligence Agency's (NGA) Global Multi-Resolution Terrain Elevation Data and information on the borders of European countries in 1500 from Euratlas.
Slope	First derivative of elevation at a grid point, relative to the values of the 8 surrounding points, measured in degrees of inclination and averaged over each country's surface.
TRI	Terrain Ruggedness Index, from Riley, DeGloria and Elliot (1999) averaged across each state's surface.
Edist_10	The index is equal to $\sum_{i \in I} \left( \frac{\text{pop}_i}{\sum_{j \in I} \text{pop}_j} \text{Rug}_i d_i \right)$ , where $\frac{\text{pop}_i}{\sum_{j \in I} \text{pop}_j}$ is city i's share of the country's predicted urban population, $\text{Rug}_i$ is the average Terrain Ruggedness Index in the area of 10 km width around the shortest distance path connecting i with the country's capital and $d_i$ is the distance (in kilometers) between city i and the capital.
Edist_c_10	As above, with $\text{Rug}_i$ set to zero when city i is on the same major river as the capital or when both city i and the capital are on the coast.
Pshare_300	Percentage of urban population within 300 km of the capital. The country borders and cities are based on the data of www.euratlas.net and reflect the year 1500. Since the euratlas dataset classifies cities in 5 different size categories without supplying actual population figures, we augment it with the estimates from Bairoch et al. (1988). More precisely, we obtain mean population values for each size category using a subsample for which the two datasets overlap and which we can match with high certainty. These population estimates are then also applied to those cities for which Bairoch et al. does not contain any values.

## DETAILS ON THE CONSTRUCTION OF THE ADJUSTED FRACTIONALIZATION MEASURE

The purpose of the adjustment is to derive a measure of fractionalization in 1500. We start with the data by Alesina et al. (2003), and use the Putterman-Weil (2010) on population flows to derive a corrected measure. The procedure applies is as follows:

- by the definition of the migration matrix  $M$  we have:  $frac_{2000} = M * frac_{1500}$ , where  $frac_{2000}$  is the Alesina et al. (2003) measure of fractionalization, assuming that changes in fractionalization between 1500 and 2000 are only driven by migratory movements and country-borders did not change.
- this system of equation could be solved for  $frac_{1500}$  if  $M$  were invertible, but this is not the case

An approximate solution is obtained in our case by

1. selecting only a subset  $S$  of countries for which we require the  $frac_{1500}$  measure (in our case a sample of European countries)
2. identifying ALL countries  $A$  from where humans migrated from this subset of interest  $S$
3. selecting only the block  $M^A$  of the matrix  $M$  and the elements  $frac_{2000}^A$  of  $frac_{2000}$  that correspond to  $A$
4. check if the smaller system  $frac_{2000}^A = M^A * frac_{1500}^A$  has a solution and compute if  $M^A$  is invertible.

The intuition behind this approach is as follows: If we care only about a small number of those countries contained in the original set, we may not need to solve the entire system. There is such an approximate solution for the subset of countries considered, but this is not always the case; for other sets of countries, the migration matrix may again be non-invertible. We find that the approximated 1500 measure is virtually identical to the 2000 version. The only country in the considered subset  $A$  whose level of fractionalization was notably affected by migratory movements between 1500 and 2000 is Equatorial Guinea. Migratory movements alone seem to be rather unimportant for the fractionlization measure, at least for the European countries we examine.