Castles

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Abstract

Castles are an iconic element of how we view medieval Europe. Many of these castles were private – the possession of feudal barons, rather than of a central state. From the conventional perspective, the prevalence of private castles prevented the monopolization of violence and is thus a sign of state weakness. Drawing on the insights of James C. Scott (1999), we challenge this state-centric perspective. We model the role of castles in the feudal world, in which political order was not maintained by a state but, rather, a coalition of king and barons who each had their own economic and military resources. The most important resource of the baron was the castle, which rendered his holdings less legible to the king and harder to appropriate, thereby increasing his bargaining power relative to the king. This, then, served as a primary check to the king's abuses and rendered his promises more credible. Castles, then, did not weaken, but rather strengthened, the feudal king's rule.

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1 Introduction

> "Castles became indispensable elements within this emerging vocabulary of lordship, the ordering of their structures and settings used actively to create, perpetuate and reinforce a culture of nobility. Crucially, all the key aspects of noble identity coalesced in the idea of the castle" (Creighton, 2012, 3).

Medieval Europe was littered with hundreds of castles. Moreover, many of these castles were the private possession of feudal lords and not under the direct control of the king or the state. From the perspective of the literature on the modern state, these private castles represent a case of state weakness: the failure to achieve a monopoly of force within a given territory.

Drawing on the work of James C. Scott and our previous work on feudal political economy, we provide an alternative framework for understanding the role castles played in medieval Europe. We demonstrate that the political economy of the feudal world followed a quite different logic from that of the modern state. Under feudalism, there was no monopoly of violence and each feudal lord had the ability to withhold his allegiance to the king, at least under certain circumstances. We show that in this environment, the proliferation of private castles cannot be simply interpreted as a measure of state weakness or failure. Rather private castles, by strengthening the ability of lords to bargain with the king, allowed the king to consolidate a larger territory and provided the preconditions for the emergence of beneficial bargains between the king and the lords.

In *Seeing like a State*, Scott's central interest was in the modern state mission to render the world *legible* to government officials and administrators. Premodern states were "partially blind" about their subjects and their environment. Seen from this perspective:

> ... much of early modern European statecraft seemed similarly devoted to rationalizing and standardizing what was a social hieroglyph into a legible and administratively more convenient format. The social simplifications thus introduced not only permitted a more finely tuned system of taxation and conscription but also greatly enhanced state capacity" (Scott, 1999, 3).

Scott's critique of the ambitious state-led projects provides a cautionary note that remains relevant

for these discussions. As Scott argued, discussions of state-building and state capacity carry normative weight. Accounts of the development of modern states risk becoming "Whig" histories in which everything that contributes to the eventual emergence of modern, bureaucratic nation states in the nineteenth or twentieth centuries becomes retrospectively justified.

Inspired by Scott, we seek to show that the role that private castles played in medieval Europe did not simply reflect the absence of the modern state. Rather, there was a distinctive logic to their spread and to their resilience. This was the logic of the feudal world.[1]

Our perspective on medieval castles contradicts the dominant state-centric approach. Under feudalism, the king could not rule alone, but needed to form and maintain a coalition with other lords or barons. To be in the coalition, the baron agrees to contribute, or to pledge to the king, his own resources, in exchange for a share in the control of the realm. Such sharing agreement is non-binding—the king can subsequently violate the agreement by decreasing the share of the baron. What keeps the king in check, however, is that the baron can rebel by taking back as much of his pledged resources as he can. For this reason, the most important kind of resource that the baron can own is his castle, as he can use it to secure and defend his resources from the king. Thus, a baron who rebels can take back or withdraw his castle and all resources therein and nearby. This induces the king to prevent rebellions by honoring sharing agreements, and therefore encourages a baron to join and stay in the coalition. In equilibrium, the proliferation of baronial castles not only makes the feudal realm large, as it encourages many barons to join the king's coalition, but it also stabilizes or consolidates the realm, as it discourages barons from rebelling once they are in the coalition.

We formally demonstrate this logic in a game-theoretic model of coalition formation which emphasizes the role of baronial castles. In so doing, we also make sense of several unique characteristics of medieval castles and to resolve several empirical puzzles in the historical literature on castles. A formal approach is required because the insight that our model generates contradicts the received wisdom among social scientists. For generations, scholars of state formation have viewed private fortifications as obstacles to political order, barriers that centralizing rulers needed

[1]We are not in fact the first scholars to apply Scott's insights to the medieval world. **?** also connects feudal governance to Scott's concept of legibility (p. 451). Similarly, **?** draws on Scott's studies of culture of resistance.

to overcome.

This paper relates to several literatures. First, we engage with the literature on state capacity in economic history. State capacity is seen as a critical part of the explananda across a range of questions including why certain countries have experienced sustained economic growth while others remained mired in poverty and conflict (Besley and Persson, 2011; Johnson and Koyama, 2017). Nonetheless, many aspects of state capacity as a concept remain contested: How do states acquire or build state capacity? What prevents state capacity being used for repressive purposes?[2]

We investigate how European states in the Middle Ages and early modern period built state capacity through the lens of a particularly important military and administrative technology and institution: the castle. Scholars of the modern state have long supposed that it was in the interests of governments and rulers to consolidate military capacity and to prohibit private warfare. Why then did medieval rulers permit their barons and lords to erect and control their own private fortification?

Second, this paper is part of our broader project on the distinctive institutions of European feudalism. While most research has focused on developments after 1500, several strands of scholarship stress the importance of the Middle Ages. Blaydes and Chaney (2013) provide evidence for increased political stability in Europe after 1100 that they attribute to European feudalism. Salter and Young (2023) argue that medieval institutions played a crucial role in constraining arbitrary state power by aligning political rights with residual claimancy.

Hall (2025), for example, examines the practice of itinerant kingship that was ubiquitous in medieval Europe. He argues that itinerant kingship was a means of feudal monarchs to build and maintain their coalitions. Empirically, he finds that kings were more likely to visit barons who were more central to the overall baronial network.

Desierto and Koyama (2025) formally model the process of coalition formation among armed elites in a feudal environment. Desierto, Hall, and Koyama (2023) build on this model to study the formation of a rebel coalition in opposition to King John during the Magna Carta crisis of

[2]For examples of the dark side of state capacity see, for instance: Heldring (2023) on the Prussian bureaucracy under the Nazis; Heldring and Robinson (2023) for Rwandan genocide. Also see the discussion in Johnson and Koyama (2019).

1215.

Finally, while there is a vast literature on the building of castles and their military function, there is little social scientific research on their importance.[3] The most important exception to this is a recent paper by Cappelen and Hariri (2022) who argue that by using the share of castles within a territory owned by the crown, they can document the monopolization of violence over time. They argue that private castles were a "threat to the ruler's effort to centralize power" and that "in the process of state formation, rulers therefore prohibited private castle construction, conquered private castles or demolished them" (Cappelen and Hariri, 2022, 9). In contrast to Cappelen and Hariri (2022), we argue that conventional views about the role of private castles misunderstand the distinctive role they played in the political economy of European feudalism.[4]

2 The Castles Puzzle

To begin with, we need to explain what was distinctive about the medieval castle. Several elements stand out: one is that a castle was a fortified residence. It was not simply a military fortification, and nor was it a simple walled structure. Castles as they were understood by contemporaries from the tenth and eleventh centuries onwards had to have fortified walls of a certain height, defensive ditches and above all else a fortified keep or *donjon* (Brown, 2004, 4).

The medieval castle was also a legal and political institution. It was the fortified residence of a great lord but not necessarily a king or prince. As Brown (2004, 2) writes: the castle thus understood was "a characteristic institution of that society which we call feudal, and which was dominated by a military and militant aristocracy, at the apex of which the king sat in majesty but not unique in his lordship".

[3]Brauer and Tuyll (2008), for instance, draw on economic principles to explain the ubiquity of castles in the Middle Ages. They explain why castles despite being so costly were sensible strategic investments given the technological and economic constraints facing medieval rulers.

[4]The term feudalism typically refers to the system of political organization, military recruitment, and landownership prevalent in Europe from roughly the ninth century through to the thirteenth or fifteenth century (depending on which part of Europe we are referring to). For our perspective, the most important feature of feudalism was that it involved military decentralization. The term feudalism remains contested and somewhat controversial among historians. Mid-twentieth-century scholars like Bloch and Ganshof (1951) focused on a legal definition of feudalism. This has been criticized by Reynolds (1994). Nonetheless, many scholars, including ourselves find value in the concept.

As such the medieval castle appears to be a unique historical phenomenon to be distinguished from Roman walls or later star forts. How and why did they come about? And what was their political significance?

2.1 The rise of the medieval castle

To understand why castles proliferated in medieval Europe, we have to appreciate the military threats that European societies faced and to account for the rise of powerful aristocratic families who could act independently of the king.

Two preconditions were important in the proliferation of private castles across medieval Europe: (i) external invasions and raids; and (ii) the collapse of public authority over much of Western Europe.

The settled and relatively densely populated agrarian lands of Western Europe and the Mediterranean had long been threatened by the migration of more warlike, nomadic or semi-nomadic peoples from the North and East.

Raids from Scandinavia intensified after around 800 CE. These were made possible by innovations in longship design which meant that raiders from Scandinavia posed a threat to the rulers of sedentary populations across Europe. Their ability to choose where and when to attack, to navigate river-ways and penetrate deep inland rendered static defenses ineffective.[5]

In addition to Viking raids, there were intensified attacks from the Eurasian Steppe. Nomads like the Magyars possessed comparable mobility across land and conducted lightning raids hundreds of miles from their base in the Hungarian plain.

These raids strained the resources and capabilities of rulers because it was impossible for the king and his field army to be in all places at once. The natural response to these threats was therefore decentralization and defense-in-depth. Ko, Koyama, and Sng (2018) build a model in which they demonstrate that the multiplicity of threats in medieval Europe made political centralization infeasible.[6]

[5]Examples of such static fortifications include those built by King Offa of Mercia to defend against the Welsh which were ineffective against these threats.

[6]Ko, Koyama, and Sng (2018) contrast this situation to China, where the main military threat came only from one direction: the steppe.

Defense-in-depth required self-contained fortifications that could hold up invaders, prevent them from raiding the nearby countryside, and provide time for a reinforced defense force to be assembled. While the threat of external invasion explains the need for fortifications and defense in-depth, it does not account for why so many of the fortifications of the Middle Ages were private fortifications. After all, the fortifications of the late Roman empire were built and controlled by a centralized state.[7] Why did private castles rise in prominence, proliferating in the 11th and 12th centuries?

One reason is that decentralized defense also meant a more dispersed and flexible military organization. Authority and military command had to be delegated to the local lord on the spot, rather than being coordinated by the king or emperor. As Bloch writes:

> "the most successful resistance came rather from the regional powers which, stronger than the kingdoms because they were nearer to the human material and less preoccupied with inordinate ambitions, slowly emerged from among the clutter of petty lordships." (Bloch, 1961, 56).

Political authority thus came to be vested in these lordships.

This brings us to the second precondition: the collapse of centralized political authority. The fall of the Western Roman empire in the fifth century had been accompanied by the decentralization of political and military authority. During the eighth century, the Franks under the Carolingian dynasty restored a measure of public authority. But their empire lacked strong fiscal or administrative foundations and in response to the raids of invaders and internal conflict, real power devolved from the royal court to a new provincial aristocracy.

As military and judicial power localized, the power of the king was hollowed out. This process reached its culmination in eleventh century Francia, or France, where the early kings of the Capetian dynasty became equivalent in power to many of the territorial lords. This period of weakening central authority is associated with the rise of feudalism.

[7] Indeed, the fortifications built in England by Alfred the Great (r. 871-899) to defend against Viking raids were built and controlled by the king. These fortifications, known as burhs, provided a point of refuge for the population from raiders. They were initially state-driven efforts, described as "a public works programme of unparalleled magnitude" (Jones, 1993, 669).

By all measures state capacity was low during the early Middle Ages. The lack of economic complexity characteristic of much of the European economy in the early Middle Ages meant that it was difficult for rulers to tax (see Wickham, 2009). To use Scott's terminology, it lacked legibility.

To be legible for Scott means to be easier for the state to assess and tax. Since its earliest history, the state's objective has been to render the rest of society and economy legible. This explains, for example, the drive of the ninth century French state to eradicate local vernaculars (Scott, 1999, 72), or the desire to standardize weights and measures. There are important economic benefits to this legibility, as Scott always acknowledged: "A thoroughly legible society eliminates local monopolies of information and creates a kind of national transparency through the uniformity of codes, identities, statistics, regulations, and measures" (Scott, 1999, 78).

Low legibility inhibited the ability of medieval rulers to build coherent states. Regional lords or barons could use their castles to shield their resources, thereby making them illegible to the state. As a consequence, the fiscal and administrative capacity of polities could not develop. As Thomas Bisson writes:

> "It is not easy to imagine the aggregate of European lands as their rulers viewed it in the later eleventh century. Counties and castellanies lay thick on the ground; no kingdom, not even England, had very tough or definite boundaries; no lay lord dared overlook his neighbour's power, few could really see beyond it" (Bisson, 2009, 85).

It has been natural therefore for scholars to associate the proliferation of baronial castles with state weakness and to see the power of the lords as the inverse of that of the nascent states that were being established by the monarchies of England and France (and later Castile and Aragon).

2.2 The state-centric perspective on castles

There is thus a well-established narrative about this period of European history. This perspective sees this period as characterized by endemic state-weakness. The proliferation of private or baronial castles in this period is taken as strong evidence for the weakness of centralized states.

We call this conventional perspective on state-building "state-centric" because it takes as its benchmark the modern Europe nation-state that emerged after 1600. This state possessed a

fiscal system and a monopoly over legitimate violence. It built and controlled fortifications on its borders that served a public purpose, that of defense. As Scott (1999) notes, from the normative perspective of the modern state, many prior or alternative forms of social organization appear deviant or inexplicable.

Tilly (1976) exemplifies the state-centric perspective:

> "In 1500, no full-fledged national state with unquestioned priority over the other governments within its territory existed anywhere in the West. England was probably the closest approximation ... [But] .... It still harbored a number of great lords who controlled their own bands of armed retainers. Government itself consisted largely of shifting, competing coalitions among great magnates and their retinues, the king being the greatest magnate of the strongest coalition [before] ... Henry Tudor began the large work of statemaking which Henry VIII and Elizabeth so vigorously pursued." (Tilly, 1976, 370).

The monopoly of violence that modernizing rulers aspired to was clearly incompatible with the existence of large-scale fortifications in private hands. From the perspective of the modern state, private castles were aberrant: a source of disorder.

To the extent that they are mentioned, accounts of the rise of the state see baronial castles as barriers to progress: objects that needed to be removed for the state to become what it was ultimately destined to become. Rulers such as Louis XIII in France reduced private castles and built new state controlled fortifications on the frontiers. Describing this policy at the turn of the twentieth century, the American congressmen and historian James Breck Perkins wrote: "the destruction of fortresses scattered through the interior of the country marked the close of an era of internal disorder and private warfare. It was an outward sign that the robber-baron and the noble highwayman had ceased to exist" (Perkins, 1904, 13). This quote can stand in for the dominant way historians and political scientists have viewed the process of state centralization and modernization after 1500. Private violence was suppressed in favor of state-controlled violence.

Cappelen and Hariri (2022) provide a systematic articulation of this argument and novel evidence. They compile a new dataset of castles across pre-modern Europe which they use to trace

the state's gradual monopolization of violence from the late medieval period onwards. Using the share of castles within a territory owned by the crown, they document the monopolization of violence when and as it actually happened. From the state-centric perspective, this provides a critical measure of growing state strength over time.

2.3 Problems with the state-centric perspective

Nonetheless, despite this apparent scholarly consensus, problems have been visible for some time.

First, the traditional account of the rise and fall of baronial castles is highly teleological. It posits the modern centralized state as the natural and logical end-point of political evolution. However, historians have become skeptical of teleological narratives, and for good reasons. Teleological accounts are built on unstated normative assumptions about the desirability of one form of political order over another. Indeed this was a central point in Scott's work on non-state actors in South-East Asia (Scott, 2009).

Moreover, the negative view of private castles derives from historical sources which were hardly neutral observers. For the Middle Ages, we typically rely on chroniclers written by clerics who were critical of the feudal nobility and favored royal power. This perspective is evident in the various clerical accounts of the rise of the French monarchy such as Abbot Suger's biography of the French King Louis VII and Rigord's account of Philip Augustus. The foremost contemporary political theorists such as John of Salisbury also favored monarchical power. They recognized that kings could become tyrants but they favored moral and spiritual suasion as a means of checking royal power (see Sunderland, 2017).

While the clerical writers of the Middle Ages, tended to favor royal government, in the early modern period, secular writers – often lawyers with positions in government, developed further arguments in favor of what was now understood to be state power. The most famous of these was Jean Bodin, the French jurist who was critical of restrictions (including that of the Church) on the sovereign power of the state (Franklin, 1973). Many of the lawyers who argued for royal absolutism themselves held positions in government. Charles Coulson quotes the seventeenth century jurist Denis de Salvaing who epitomized this view, describing baronial castles as "grains of sand and gall-stones in the bowels of the State" (1668) (quoted in Coulson, 2003, 32). In the nineteenth

century, professional historians incorporated their views into their nationalistic and state-centric histories. As a consequence, historians such as Coulson contend that an anti-feudal "mentality constantly taints the 'private castle' with the slur of illicit violence" (Coulson, 2003, 98).

The distinction between the public realm and the private sphere is also a product of the modernizing and centralizing state. From this perspective, state-owned defenses are public — there to provide defense against external invasion, whereas baronial castles are private and therefore associated with the selfish interests of individual lords. Specialists, however reject precisely this dichotomy, noting that "a rigid distinction between 'private' and 'public' traditions of defence does not represent the reality of the early Middle Ages" (Creighton, 2012, 49).

Private or baronial castles were not fully private in the modern sense in that the lord did not possess unconditional rights of exclusion. Rather, they were subject to the principle of renderability, defined by Coulson as follows:

> "...the perpetual liability specific to the fortress to be handed over (*tradere, reddere*) on demand to the lord from whom (with the fief to which it was the caput) it was held" (Coulson, 1998, 121).

In other words, a feudal overlord had the right to use one of his baron's *private* castles if there was a "reasonable cause". Thus during an invasion, a baron's castle would be available to the king if needed.[8]

If baronial castles were available to the feudal overlord, what was the difference between baronial and royal castles? And why did they matter at all? The baronial/royal distinction was not a dichotomous private/public one but two different roles within the feudal ordering. Royal castles were often placed in the hands of castellans who operate independently of the king (though with less independence than a baron in possession of his own castle).[9]

In summary, the state-centric approach views the proportion of castles in royal rather than baronial hands as a measure of state power and capacity. However, this does not accord with how

[8] The principle of renderability is best attested to for France. It may have been less formally articulated in other parts of the feudal world. This is an issue discussed in the specialist literature.

[9] "As Coulson puts it: royal castles "were merely 'baronial' castles writ large" because baronial castles were "scarcely 'private' in any case" (Coulson, 2003, 145).

specialists on the subject now understand the role played by the baronial castle.

2.4 Our alternative approach

If we accept this skepticism towards received narratives about the rise of modernizing states, we should be open to criticisms of the received wisdom about baronial castles. In the next section, we introduce a formal model explicating our alternative approach. Before doing so, we need to discuss some of the key points of emphasis in our model.

The king's coalition First, we analyze medieval polities using a coalition-based framework. This reflects the fluid and informal character of feudal kingdoms. At any point in time, a baron who belongs to the king's coalition can exit it by rebelling against the king. Feudal polities recognized a king whose authority and powers were wide-ranging, but who ruled through his lords and barons. Kings ruled with the military and economic resources of these lords but they were expected to act in conformity with custom and to treat the major lords with due respect.

What did this mean in practice? Kings had to allocate patronage resources carefully. Rewarding particular favorites with land or titles meant that there were fewer resources to go to other lords. Inevitably, some lords would become disgruntled if their expectations of rewards went unmet. A king who failed to do this, like King John (r. 1199-1216), was referred to as "a tyrant rather than a king" (quoted Burt and Partington, 2024, 19). Feudal monarchs were thus continuously managing a potentially volatile coalition and thus often involved them in conflict.

Lords swore oaths of fealty and owed the king their obedience, but this was not unconditional. Kings had to govern in a manner that was consistent with custom and law. In particular, they could not mistreat their lords or barons. Lords who felt mistreated could withdraw from the king's coalition, retreat to their castles, and even raid or attack the king's lands. Such an open declaration or withdrawal of allegiance was not necessarily seen as an act of treason.[10]

Medieval revolts by the nobility against the king worked within carefully prescribed parameters as discussed by Sunderland (2017). The rebellious lord did not aim to depose or kill the king; rather he wished to make it costly for the king to mistreat him: they "were widespread, principled,

[10]See King (2010, 86-87).

and planned, and need to be differentiated from seditious attempts to topple regimes and rulers. The nobles, highly placed individuals, were naturally invested in hierarchy, and thus aimed at reform of the political order guaranteed by the king, assuming that the king could eventually be corrected without troubling his rule or the structures authorized by it, including that of hereditary nobility, which licensed the barons' own position (Sunderland, 2017, 56). We develop this thesis about the distinct characteristics of feudal rebellion and the role in played in the medieval world in a related paper (Desierto and Koyama, 2026).

Thus, our model not only depicts how a baron joins the king's coalition, but also allows for the possibility that the baron rebels at any subsequent period.

No public/private distinction Second, as discussed above, to understand the feudal world we cannot apply concepts intended to capture the realities of Weberian states.

Monarchs in the Middle Ages did not distinguish the possessions of the state from their own private possessions. Many elements of medieval government emerged from the household of the monarch. Similarly, under feudalism, the king had the right to the military resources of his lords for legitimate purposes such as defense of the realm or a legitimate external war. Thus, in our model, the baron – provided that he is not in rebellion, pledges his resources to the king, which the king can use when going into battle.

Resources and castles This brings us to a third important feature of the feudal world. In the event of a rebellion, a lord could retreat to his castle and this castle would offer a measure of protection to his nearby lands and possessions.

Baronial castles thus played a particularly important role in the feudal order. They were the possession of the baron but they not purely private either. As discussed above, the doctrine of renderability meant in times of war or general emergency baronial castles were available to the king. But outside of these clearly defined exigencies, and especially during rebellion, they were the possession of the baron. And the state of military technology, meant that this gave the baron the possibility of safeguarding his lands (or at least making it very costly for the king to attack them).

Castles were of critical importance in controlling and protecting territory. As Norman Pounds observed: in "the minds of contemporaries control of England consisted in the mastery of its more important castles" (Pounds, 1990, 114-115). The presence of a castle deterred enemies from occupying the nearby land. To perform this function, a "castle did not have to be impregnable, it merely had to be strong enough and sufficiently provisioned to withstand a few months' siege" (Warren, 1973, 233).

Nor was the value of a castle purely defensive. It provided a base for raiding and could be used to provide an offensive force. As R. Allen Brown noted the offensive capabilities of the castle were more important than the defensive as "it was the offensive capacity of the castle, its function as a base, heavily defended, for active operations by means of which the surrounding countryside could be controlled, that gave it much of its value in war, made it the prized object of attack" (Brown, 2004, 123). In discussing the role castles played in consolidating Fulk Nerra's control of Anjou, France notes "that the building of a castle was never a simple defensive act because it was always also a challenge to the enemies of its builder" (France, 2006, xvi).

Castles allowed barons to protect their lands and resources in the event of a dispute with the king or in the extreme case violent rebellion. This is what Pounds (1990, 117) meant when he stated that the "pretensions of the barons hinged on their control of castles": the military, economic and political independence of the lords was made possible because their castles gave them the ability to defend their lands even from the king. We operationalize this in our model by allowing nobles to withhold or withdraw, whenever they are in rebellion, a fraction of the total resources that they had pledged, specifically the value of their castles.

The centrality of castles to the feudal system has long been emphasized by historians. An important illustration of their significance comes from the fact that when they occupied the Levant, the Crusaders brought the institution of the castle with them. And the castles they built were not just on the borders with the Muslim kingdoms, but deep within the Crusade states. The model we now introduce provides the underlying logic for this oft-commented upon importance of feudal castles.

3 The Model

3.1 Setup

There is a territory inhabited by a set of elites $\{k, \{t\}\}$, where t indexes a baron, of which there are N, i.e. $t = 1, 2, \ldots, N$, and k denotes a king – a feudal overlord who wants to unite all barons into one coalition under k's rule, and thereby form a feudal realm. Each baron has some desire to remain independent. Specifically, a baron t will never want to be ruled by the king unless the king lets him control at least a share $\sigma_t \in (0, 1)$ of the realm. In this sense, σ_t is baron t's *reservation* share. Thus, for the coalition to include, at most, all the N barons and the king, we let $\sum_{t=1}^{N} \sigma_t < 1$. This means that the king's share of the realm, which is the residual share after all shares are allocated to the barons in the coalition, can never be below $(1 - \sum_{t=1}^{N} \sigma_t) > 0$.[11]

Now at every time period (also indexed by t), baron t possesses his own endowment, i.e. economic and military resources, valued at $e_t \in \mathbb{R}_{\geq 0}$, of which $c_t \in [0, e_t]$ is the value of any castles that t owns.[12] (The king can also have his own endowment, which can include castles, but we ignore them here as they are not necessary to generate our results.)

If baron t joins the coalition, he pledges or contributes his entire endowment e_t to the king at every time period that the baron remains in the coalition, in exchange for (reservation) share σ_t of the total resources of the realm. At any time period at which the king violates this agreement, that is, if he lowers the baron's share to anything below his reservation, the baron rebels. He exits the coalition and takes with him the resources he would have otherwise continued to pledge to the king. However, he can only take back what he can defend, which is the value of his castles.

To be precise, consider a time period in which there is rebellion, and denote a baron who is already in the coalition as baron i. Let the probability that baron i is one of the rebels be denoted by $\rho_i \in (0, 1)$. This is also the extent to which the king violates his agreement with i and reacquires some of baron i's share of the realm. Thus, during a time period in which there is

[11] Since baron t requires at least share σ_t to join the coalition, the king, who gets the residual share of the realm, will never want to give baron t more than σ_t.

[12] We assume a Malthusian economy in which there is no growth. All economic production simply replenishes endowments. Thus, in each time period t, baron t has endowment e_t, which can include castles. The value c_t of these castles can include not just the castle itself, but also all resources therein and nearby.

rebellion, baron i only has share $\rho_i\sigma_i$ of the resources of the realm (instead of σ_i), but withdraws $\rho_i c_i$ and keeps it for himself.

Finally, at any time period t, the resources of the realm, E, is simply the sum of all pledged endowments, minus those withdrawn by rebel barons.

3.2 Sequence of Events

Consider, then, a game in which the following events occur N times, that is, at every time period $t = 1, 2, ..., N$.

1. The king k proposes to baron t that the latter join the coalition by pledging to the king, at each t, his endowment e_t in exchange for a share σ_t in the resources of the realm. The king takes σ_t either out of the king's own share, or out of the shares of any of the barons already in the coalition. The latter option we denote as R as it induces rebellion, while the former we denote as L since all coalition members remain loyal. Thus, in proposing to baron t, the king chooses either action L or action R.

2. After observing L or R, baron t chooses either to accept (A) the king's proposal, or to reject it, in which case he fights (F) or battles the king to remain independent. If baron t chooses A, he (peacefully) joins the coalition, in which case he contributes, at t, e_t in exchange for share σ_t of the resources of the realm. At each subsequent time period in which there is no rebellion, he also contributes e_t in exchange for σ_t. Otherwise, he contributes $\rho_i c_i$ in exchange for $\rho_i\sigma_i$, with ρ_i the probability that baron $t = i$ is one of the rebels.

   If baron t instead chooses F and he wins against k in battle, he remains independent from t until N, in which case his endowment e_t accrues to him in every time period from t to N. If he loses, he joins the coalition and faces the same consequences as that from choosing A in the first place.

   When fighting, the adversaries can use all the resources at their disposal to try to win the battle. Thus, baron t can use up to e_t. The king, by virtue of being ruler, can use all the resources of the realm, i.e. E. Recall, however, that E is smaller when there is rebellion –

in this case the king will not be able to use the castles withdrawn by the rebels to fight with baron t.

Thus, denote as E^L the resources of the realm when there is currently no rebellion, and E^R if there is, where $E^L > E^R$. Baron t wins in battle against the king if $e_t \geq E + \gamma$, where $E = \{E^L, E^R\}$ and $\gamma \in \mathbb{R}$ a random variable with a density function that exists everywhere and is differentiable, single-peaked and symmetric around zero. Then the probability that baron t wins in battles against k when there is no rebellion and when there is, i.e. $p_t = \{p_t^L, p_t^R\}$, is $p_t = \Pr[\gamma \leq (e_t - E)]$. Note, then, that $p_t^R > p_t^L$ since $E^R < E^L$.

3. Resources accrue to the king k and barons $t, t-1, t-2, ..., 1$. That is, k gets residual share of the resources of the realm. If baron t is in the coalition, he gets share σ_t of the resources of the realm. If he is not in it, he gets his endowment e_t. Barons $t-1, t-2, ..., 1$ each get their (reservation) share of the resources of the realm when there is no rebellion; otherwise, they each get share $\rho_i \sigma_i$ of the resources of the realm, plus what each has withdrawn, i.e. $\rho_i c_i$.

3.3 Equilibrium

The set of players in the game are the king and the barons: $\{k, \{t\}\}$, with $t = 1, 2, ..., N$. Since the king interacts once with each baron t, and there are N barons, the game involves N pairwise interactions in which the king chooses between two actions (L, R) and a baron chooses between two actions (A, F). Let α be the probability that the king chooses L and μ the probability that the baron chooses A. The game generates N pairs of actions: $(\alpha_1, \mu_1), (\alpha_2, \mu_2), ..., (\alpha_N, \mu_N)$.

Thus, a strategy profile Σ is a collection $\{(\alpha, \mu)_t\} \equiv (\alpha_1, \mu_1), (\alpha_2, \mu_2), ..., (\alpha_N, \mu_N)$ of N pairs of respective actions of the king at t and baron t, which induces expected payoffs for the king at each t and for baron t.

Each player is concerned with the value of resources accruing to him from period t to period N. Thus, a player's expected payoff at t is simply the stream of resources that the player expects to accrue to him from t until N. First consider baron t. When he interacts with k at t, he takes as given the existing composition of the king's coalition and the existing resources of the realm,

both of which are the outcome of all past pairwise interactions. He also anticipates that each future pairwise interaction will affect the composition of the king's coalition and the resources of the realm at each future time period, which together determine the value of resources that accrue to him at each future time period until N.

Thus, let $\{(\alpha,\mu)_{-t}\} \equiv (\alpha_1,\mu_1),(\alpha_2,\mu_2),...,(\alpha_{t-1},\mu_{t-1}),(\alpha_{t+1},\mu_{t+1}),(\alpha_{t+2},\mu_{t+2}),...,(\alpha_N,\mu_N)$ denote the collection of pairs of actions at all periods prior to t and all periods after t. Baron t's expected payoff from accepting k's offer α_t is $V_t(\{(\alpha,\mu)_{-t}\},\alpha_t,\mu_t=1)$, while his expected payoff from rejecting it is $V_t(\{(\alpha,\mu)_{-t}\},\alpha_t,\mu_t=0)$.

The king's expected payoff at t can be similarly written, as he takes as given all past pairwise interactions prior to t, and anticipates baron t's response to his offer and all future pairwise interactions. Thus, k's expected payoff at t from choosing L is $V_k^t(\{(\alpha,\mu)_{-t}\},\alpha_t=1,\mu_t)$, while his expected payoff at t from choosing R is $V_k^t(\{(\alpha,\mu)_{-t}\},\alpha_t=0,\mu_t)$.

These expected payoffs determine the optimal actions at each t. Specifically, a pair of actions $(\alpha,\mu)_t$ at t is optimal if: (a) $\alpha_t=1$ whenever $V_k^t(\{(\alpha,\mu)_{-t}\},\alpha_t=1,\mu_t) \geq V_k^t(\{(\alpha,\mu)_{-t}\},\alpha_t=0,\mu_t)$, and $\alpha_t=0$ otherwise; and (b) $\mu_t=1$ whenever $V_t(\{(\alpha,\mu)_{-t}\},\alpha_t,\mu_t=1) \geq V_t(\{(\alpha,\mu)_{-t}\},\alpha_t,\mu_t=0)$, and $\mu_t=0$ otherwise.

We simply define equilibria in terms of optimal action pairs. That is, an equilibrium of the game is a strategy profile $\Sigma^* = \{(\alpha^*,\mu^*)_t\} \equiv (\alpha_1^*,\mu_1^*),(\alpha_2^*,\mu_2^*),...,(\alpha_N^*,\mu_N^*)$, where $(\alpha^*,\mu^*)_t$ is an optimal pair of actions at t.

3.4 Results

It is apparent from our definition of optimal action pairs that the game has a unique equilibrium. What is not obvious is that such equilibrium is determined by the value of castles in the territory. We demonstrate this by explicitly constructing the expected payoffs, starting that of a baron t.

3.4.1 Optimal Action of a Baron

A baron t's expected payoff from accepting k's offer α_t – his expected payoff from choosing action A, is $V_t(\{(\alpha,\mu)_{-t}\},\alpha_t,\mu_t=1)$, which is the value of resources that he expects to accrue to him

from t until N. At t, he expects to get

$$U_t \equiv \alpha_t[\sigma_t(E_{t-1} + e_t)] + (1 - \alpha_t)[\sigma_t(E_{t-1} - \sum_{i=1}^{t-1} \rho_i c_i + e_t)].$$

That is, when he accepts the offer he contributes at t his own endowment e_t to the existing resources of the realm, in exchange for a share σ_t. Now the existing resources of the realm is E_{t-1} if there is no rebellion at t, and $(E_{t-1} - \sum_{i=1}^{t-1} \rho_i c_i)$ if there is, where $\sum_{i=1}^{t-1} \rho_i c_i$ is the value of the castles that are withdrawn by the rebels at t. The probability that there is rebellion at t is the probability $(1 - \alpha_t)$ that the king chooses R, with ρ_i the probability that a baron who has interacted with k prior to t is part of the rebellion at t.[13]

Now what baron t gets in the next period, $t + 1$, depends on whether or not he is in rebellion at $t + 1$. If he is not, then he still gets share σ_t of the resources of the realm at t, which is equal to $(E_t + \hat{e}_{t+1})$ if $\alpha_{t+1} = 1$ (i.e. no rebellion at $t + 1$) and $(E_t - \sum_{i=1}^{t} \rho_i c_i + \hat{e}_{t+1})$ if $\alpha_{t+1} = 0$, and where $\hat{e}_{t+1}$ is the expected contribution of the $(t+1)^{th}$ baron to the resources of the realm, which therefore depends on α_{t+1} and μ_{t+1}.

If baron t is in rebellion at $t + 1$, he gets zero share of the realm's resources at $t + 1$, and gets only the value he has withdrawn from the realm. Since baron t has probability ρ_t^{t+1} of being in rebellion at $t + 1$, then he expects to get, at $t + 1$, $U_{t+1} \equiv (1 - \rho_t^{t+1})\sigma_t[\alpha_{t+1}(E_t + \hat{e}_{t+1}) + (1 - \alpha_{t+1})(E_t - \sum_{i=1}^{t} \rho_i c_i + \hat{e}_{t+1})] + \rho_t^{t+1} c_t$.

His payoffs at $t+2$, $t+3$, ..., N are analogously constructed. Thus, in each future time period until N, he gets

$$U_{t+h} \equiv (1 - \rho_t^{t+h})\sigma_t[\alpha_{t+h}(E_{t-1+h} + \hat{e}_{t+h}) + (1 - \alpha_{t+h})(E_{t-1+h} - \sum_{i=1}^{t-1+h} \rho_i c_i + \hat{e}_{t+h})] + \rho_t^{t+h} c_t,$$

where $h = 1, 2, ..., N - t$.

Thus, baron t's expected payoff from choosing action A is:[14]

$$V_t(\{(\alpha, \mu)_{-t}\}, \alpha_t, \mu_t = 1) = U_t + \sum_{h=1}^{N-t} U_{t+h}. \quad (1)$$

[13] A baron who has interacted with k and remained independent is simply assigned $\rho = 0$.

[14] To simplify and without loss of generality, all future values are undiscounted.

On the other hand, if baron t rejects the king's offer α_t, they fight. If the baron loses he is included in the king's coalition and therefore gets payoff equal to (1). If he wins, he remains independent and gets all of his endowment e_t at each t until N. The probability that the baron wins is p_t^L if there is no rebellion at t, i.e. if $\alpha_t = 1$, and p_t^R if there is rebellion.

Thus, let $U \equiv U_t + \sum_{h=1}^{N-t} U_{t+h}$. Baron t's expected payoff from choosing F is:

$$V_t(\{(\alpha,\mu)_{-t}\}, \alpha_t, \mu_t = 0) = \alpha_t[(1-p_t^L)U + p_t^L e_t(N-t)] + (1-\alpha_t)[(1-p_t^R)U + p_t^R e_t(N-t)]. \quad (2)$$

Baron t's optimal action is A ($\mu_t = 1$) whenever the expression in (1) is at least as large as the expression in (2). Now the value of these expressions depend on the value of *all* the castles in the territory, and not just those owned by baron t. That is, U_t is a function of the value of castles held by barons 1 to $t-1$, U_{t+h} a function of the value of castles held by baron t and barons $t+1$ to N.[15]

It can thus be shown that the likelihood that baron t's optimal action is A depends on the value of the castles held by each baron. That is:

Lemma 1 *Let $\boldsymbol{c} \equiv (c_1, c_2, ..., c_N)$ denote the values of the castles owned by barons $t = 1, 2, ..., N$. There exists a collection of threshold values $\{(\underline{c}_t)_t\} \equiv (\underline{c}_{1,t}, \underline{c}_{2,t}, ..., \underline{c}_{N,t})$ for each baron t such that baron t's optimal action is A if $\boldsymbol{c} \geq \{(\underline{c}_t)_t\}$. (In this case we say that baron t's threshold is met.) Otherwise, baron t's optimal action is F.*

Proof All proofs are in the Appendix.

Lemma 1 thus implies that it becomes more likely for a baron t to accept the king's offer the larger the value of the castles owned by all the barons. Furthermore, noting that each baron has different thresholds, it is possible that $c_1, c_2, ..., c_N$ are so large such that each of them is at least as large as the largest threshold value for $c_1, c_2, ..., c_N$. If this is the case, the thresholds of all the barons are met, which means all barons choose A. That is, all N barons become a member of the king's coalition. Formally:

Corollary 1 *There exists a collection of maximum threshold values $\{(\underline{c}_t^{\max})_t\} \equiv (\max\{(\underline{c}_{1,t})\}, \max\{(\underline{c}_{2,t})\},$ $..., \max\{(\underline{c}_{N,t})\})$ such that if $\boldsymbol{c} \geq \{(\underline{c}_t^{\max})_t\}$, then the optimal action of **every baron** is A.*

[15] In addition, the value of castles held by barons 1 to $t-1$ decreases p_t^R relative to p_t^L inasmuch as they decrease the king's resources when there is rebellion.

3.4.2 Optimal Action of the King at t

To analyze the optimal action of the king at t, we construct his expected payoffs at t, that is, when facing baron t.

The king's expected payoff from offering L at t, given that baron t would accept with probability μ_t, is also the sum of the value of resources that k expects to accrue to him from t to N. At t, he expects to get

$$U_k^t \equiv \mu_t[(1-\sum_{g=0}^{t-1}\sigma_{t-g})(E_{t-1}+e_t)]+(1-\mu_t)[(1-p_t^L)(1-\sum_{g=0}^{t-1}\sigma_{t-g})(E_{t-1}+e_t)+p_t^L(1-\sum_{g=0}^{t-2}\sigma_{t-g})E_{t-1}].$$

That is, with no rebellion, the king honors sharing agreements and gives baron t share σ_t of the total resources of the realm, which is $(E_{t-1}+e_t)$ if baron t joins the king's coalition and E_{t-1} if baron t remains independent (with probability p_t^L). The king thus gets residual share $(1-\sum_{g=0}^{t-1}\sigma_{t-g})$ of the total resources of the realm if baron t joins, and $(1-\sum_{g=0}^{t-2}\sigma_{t-g})$ if baron t remains independent.

At any time period after t, i.e. at $t+h$, $h=1,2,...,N-t$, the resources of the realm grow from the existing resources E_{t-1+h} to $(E_{t-1+h}+e_{t+h})$, where e_{t+h} is the endowment of the $(t+h)^{th}$ baron, if the latter joins, i.e. if $\mu_{t+h}=1$. Otherwise, if $\mu_{t+h}=0$ there is fighting, and the resources of the realm grow to $[(1-p_t^L)(E_{t-1+h}+e_{t+h})+p_t^L E_{t-1+h}]$ if $\alpha_{t+h}=1$ (no rebellion at $t+h$), and $[(1-p_t^R)(E_{t-1+h}-\sum_{i=1}^{t+h}\rho_i c_i+e_{t+h})+p_t^R(E_{t-1+h}-\sum_{i=1}^{t+h}\rho_i c_i)]$ if $\alpha_{t+h}=1$, where $\sum_{i=1}^{t+h}\rho_i c_i$ is the value of the castles withdrawn by the rebels at $t+h$.

Now the king's (residual) share of the total resources of the realm is $(1-\sum_{g=0}^{t-1}\sigma_{t-g+h})$ if $\mu_{t+h}=1$. Otherwise, if $\mu_{t+h}=0$, his residual share is $[(1-p_t^L)(1-\sum_{g=0}^{t-1}\sigma_{t-g+h})+p_t^L(1-\sum_{g=0}^{t-2}\sigma_{t-g+h})]$ if $\alpha_{t+h}=1$, and $[(1-p_t^R)(1-\sum_{g=0}^{t-1}\sigma_{t-g+h})+p_t^R(1-\sum_{g=0}^{t-2}\sigma_{t-g+h})]$ if $\alpha_{t+h}=0$.

Thus, at $t+h$, the king expects to get

$$\begin{aligned}U_k^{t+h} \equiv \mu_{t+h}[(1-\sum_{g=0}^{t-1}\sigma_{t-g+h})(E_{t-1+h}+e_{t+h})]+(1-\mu_{t+h})\Big[\alpha_{t+h}[(1-p_t^L)(1-\sum_{g=0}^{t-1}\sigma_{t-g+h})(E_{t-1+h}+e_{t+h})\\ +p_t^L(1-\sum_{g=0}^{t-2}\sigma_{t-g+h})E_{t-1+h}]+(1-\alpha_{t+h})[(1-p_t^R)(1-\sum_{g=0}^{t-1}\sigma_{t-g+h})(E_{t-1+h}-\sum_{i=1}^{t+h}\rho_i c_i+e_{t+h})\\ +p_t^R(1-\sum_{g=0}^{t-2}\sigma_{t-g+h})(E_{t-1+h}-\sum_{i=1}^{t+h}\rho_i c_i)]\Big]\end{aligned}$$

The king's expected payoff from choosing action L at t is:

$$V_k^t(\{(\alpha,\mu)_{-t}\},\alpha_t=1,\mu_t)=U_k^t+\sum_{h=1}^{N-t}U_k^{t+h}. \tag{3}$$

On the other hand, if the king chooses R, he takes back a proportion of the share of any rebel at the time of rebellion, specifically $\rho_i\sigma_i$, where i denotes a baron who is in rebellion at that time. The resources of the realm also decrease by the value of the castles withdrawn by the rebels and, if there is fighting, the probability that baron t wins is higher, i.e. at $p_t^R > p_t^L$. Thus, at t, he expects to get

$$W_k^t \equiv \mu_t[(1-\sum_{g=0}^{t-1}\sigma_{t-g}+\sum_{i=1}^{t-1}\rho_i\sigma_i)(E_{t-1}-\sum_{i=1}^{t-1}\rho_i c_i+e_t)]$$

$$+(1-\mu_t)[(1-p_t^R)(1-\sum_{g=0}^{t-1}\sigma_{t-g}+\sum_{i=1}^{t-1}\rho_i\sigma_i)(E_{t-1}-\sum_{i=1}^{t-1}\rho_i c_i+e_t)+p_t^R(1-\sum_{g=0}^{t-2}\sigma_{t-g})(E_{t-1}-\sum_{i=1}^{t-1}\rho_i c_i)].$$

Now because each rebellion occurs in one period, rebellions in other periods do not depend on the king's choice of R in the current period. This means that at the beginning of the period $t+h$, there is no rebellion (unless the king chooses R at $t+h$). Thus, if the king chooses R at t, he expects to get at any period $t+h$, the same as what he would get had he chosen L at t, i.e. U_k^{t+h}.

The king's expected payoff from choosing action R is therefore:

$$V_k^t(\{(\alpha,\mu)_{-t}\},\alpha_t=0,\mu_t)=W_k^t+\sum_{h=1}^{N-t}U_k^{t+h}. \tag{4}$$

The king's optimal action at t is L ($\alpha_t=1$) whenever the expression in (3) is at least as large as the expression in (4), or whenever $U_k^t \geq W_k^t$. It is clear, then, the king's optimal action at t depends on the value of castles owned by the barons who can potentially rebel at t. Since $\sum_{i=1}^{t-1}\rho_i c_i$ unambiguously decreases W_k^t (but has no effect on U_k^t), the following result is immediate.

Lemma 2 *Let $\mathbf{c}_{t-1}=(c_1,c_2,...,c_{t-1})$ denote the values of the castles owned by barons $t=1,2,...,t-1$. There exists a collection of threshold values $\{(\underline{c}_k^t)_{t-1}\}\equiv(\underline{c}_{k,1}^t,\underline{c}_{k,2}^t,...,\underline{c}_{k,t-1}^t)$ at each t such that the king's optimal action at t is L if $\mathbf{c}_{t-1}\geq\{(\underline{c}_k^t)_{t-1}\}$. (In this case we say that the king's threshold at t is met.) Otherwise, the king's optimal action at t is R.*

Lemma 2 implies that the larger the value of the castles owned by the barons in the king's coalition, the more likely that the king honors his commitments (shares of the realm) to these barons to prevent rebellion. Furthermore, if the castles of each baron in the territory are very valuable such that the thresholds of the king at each t is met, then L is the optimal action of the king at each t. In this case, no rebellion ever occurs. Formally:

Corollary 2 *There exists a collection of maximum threshold values* $\{(\underline{c}_k^{\max})_t\} \equiv (\max\{(\underline{c}_{k,1}^t)\}, \max\{(\underline{c}_{k,2}^t), \}, ..., \max\{(\underline{c}_{k,N-1}^N)\}, 0)$ *such that if* $\boldsymbol{c} \geq \{(\underline{c}_k^{\max})_t\}$*, then the king's optimal action* ***at every*** t *is* L*.*

3.4.3 Types of Feudal Realms

It is now clear from the foregoing that the equilibrium of the game, inasmuch as it is determined by the optimal actions of k at each t and of each baron t, depends on the value of the baronial castles in the territory.

Theorem 1 *Let* T_k^t *be an indicator variable equal to one if, for the king at* t*,* $\boldsymbol{c}_{t-1} \geq \{(\underline{c}_k^t)_{t-1}\}$*, and zero otherwise. Let* T_t *be an indicator variable equal to one if, for a baron* t*,* $\boldsymbol{c} \geq \{(\underline{c}_t)_t\}$*, and zero otherwise. Then the game has a unique equilibrium* $\Sigma^* = \{(\alpha^*, \mu^*)_t\} \equiv (\alpha_1^*, \mu_1^*), (\alpha_2^*, \mu_2^*), ..., (\alpha_N^*, \mu_N^*)$ *where*

$$\alpha_t^* = \begin{cases} 1 & \text{if } T_k^t = 1 \\ 0 & \text{otherwise} \end{cases}$$

$$\mu_t^* = \begin{cases} 1 & \text{if } T_t = 1 \\ 0 & \text{otherwise} \end{cases}$$

A baron for whom $T_t = 1$ accepts the king's offer to join his coalition. For him, all baronial castles in the territory are sufficiently valuable such that he is willing to enter the king's coalition, that is, without fighting. The reason is that his exit option is valuable. Baronial castles make rebellion costly for the king – not only would the king lose resources, but his fighting capacity would also decrease, which would impede his ability to include more barons into his coalition.

This makes the baron confident that the king would honor sharing agreements, and he is therefore willing to enter into such agreement with the king.

Corollary 1, in fact, implies that with very valuable baronial castles, all barons are willing to join the king's coalition. In equilibrium, the feudal realm is large, as it includes all barons in the territory.

Similarly, corollary 2 implies that with very valuable baronial castles, the king would choose to honor all agreements at all time periods. Once a baron joins his coalition, the king will always give him his reservation share σ, and no less. Thus, no rebellion occurs – the feudal realm is, in this sense, consolidated.

The equilibrium of the game thus characterizes the size and extent of consolidation of the feudal realm. When the values of the baronial castles are at and above a certain set of threshold values, i.e. $\{\underline{c}_t^{\max})_t\}$, every baron accepts the king's proposal and therefore joins his coalition with probability 1. The feudal realm is large. Otherwise, some barons fight and remain independent with some probability p^L or p^R. The feudal realm is small. When the values of the baronial castles are at and above another set of threshold values, i.e. $\{\underline{c}_k^{\max})_t\}$, the king always honors all sharing agreements, and no rebellion occurs. The feudal realm is consolidated. Otherwise, the king violates some agreements, and some rebellions occur. The feudal realm is unconsolidated.

The following result is immediate.

Theorem 2 *Let $\mathbb{L}$ be an indicator variable equal to 1 if $\boldsymbol{c} \geq \{\underline{c}_t^{\max})_t\}$, and zero otherwise. Let $\mathbb{C}$ be an indicator variable equal to 1 if $\boldsymbol{c} \geq \{\underline{c}_k^{\max})_t\}$, and zero otherwise. There are four types of feudal realms in equilibrium:*

1. ***Large Consolidated Realm**, which is obtained if $\mathbb{L} = \mathbb{C} = 1$.*

2. ***Large Unconsolidated Realm**, which is obtained if $\mathbb{L} = 1, \mathbb{C} = 0$.*

3. ***Small Consolidated Realm**, which is obtained if $\mathbb{L} = 0, \mathbb{C} = 1$.*

4. ***Small Unconsolidated Realm**, which is obtained if $\mathbb{L} = \mathbb{C} = 0$.*

Theorem 2 thus implies that territories with many baronial castles are likely to form into larger feudal realms that experience few rebellions, while those with few castles are likely to form into smaller realms that experience more rebellions. Moderate numbers of castles give rise to either large but unconsolidated realms, or consolidated but small realms.

4 Applying the Model to History

We have provided a formal model that explicates the role castles played in holding together a feudal realm. The logic of this model is quite different to that found in the existing literature on state formation. Let us now return to the historical evidence armed with the insights of our model.

First, it is important to set out the scope conditions for our analysis. Specifically, our model applies to this feudal period following the breakdown of the Carolingian empire around 900. In particular, it is most relevant to the period between 900-1300 prior to the rise of more centralized states (though castles remained important through to the middle of the fifteenth century). The model can compass a wide range of feudal polities including France under the early Capetian dynasty where the king was often weaker in terms of resources and military manpower than the great territorial princes who often warred against him as well as Norman England where the monarch was powerful.[16] But the model does not apply to the Carolingian period itself. The Carolingian empire, though the largest polity in early medieval Western Europe, was not a feudal realm in the sense we model here. Carolingian governance relied on a different institutional framework: counts were royal officials holding offices rather than hereditary feudal lords, and the empire was administered through institutions such as the *missi dominici* that attempted to recreate centralized imperial authority. Crucially, Carolingian military organization differed fundamentally from the feudal model. As Bachrach (2001) demonstrates, the Carolingian military system relied heavily on the mobilization of large numbers of part-time militia soldiers drawn from the free population, rather than on the smaller forces of heavily armed, castle-based warrior elites characteristic of high medieval feudalism. The Carolingian system ultimately proved fragile:

[16]See discussions in Hallam and West (2020, 34-36).

lacking a robust fiscal base comparable to the Roman empire or contemporary Islamic caliphates, it depended on continued expansion and the distribution of booty. Once expansion ceased, the empire fragmented, and it was from this fragmentation that the feudal order—and the proliferation of private castles—emerged.

Our model is designed to explain the distinctive role castles played in the coalitional bargains that characterized feudal Europe. The account we provide can be contrasted with the state-centric perspective which associates baronial castles with state weakness and political disintegration. According to this argument, the elimination or acquisition of baronial castles by the king is a measure of state strength and consolidation. Before we proceed further it is important to assess how well the evidence fits this alternative account.

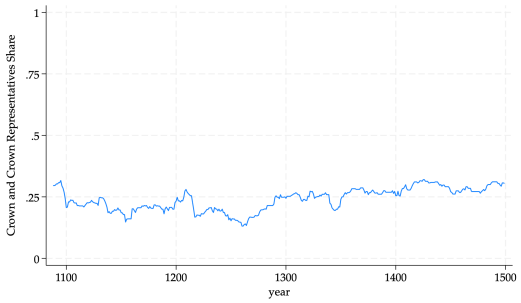
Using the data that Cappelen and Hariri have provided, we can track the number of royal castles over time and their share relative to those possessed by the barons. Figure 1d plots this data for three prominent feudal monarchies: England, France, and Castile for the period 1088-1500. The share of castles directly or indirectly controlled by the king remained fairly low and stable throughout this long period. The highest share that we observe is 39% for Castile. In general, the share of royal castles was lower in France (8 %) than in England (24%). The high share of baronial castles in France is consistent with it being the largest feudal realm.

From the point of view of assessing the state-centric argument, it is sufficient to note that these time series are stationary. There was no overall trend towards royal monopolization of castles over time. As we discuss below, strong feudal monarchs did not seek to eliminate baronial castles.

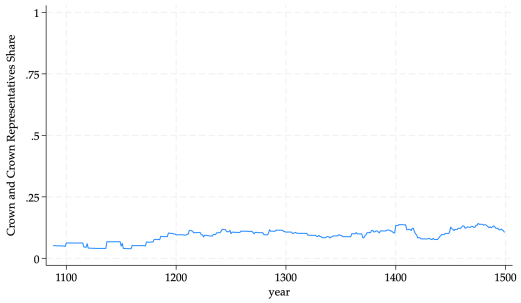
4.1 Did castles help consolidate feudal polities?

As we have discussed, in the state-centric view, baronial castles are associated with political weakness and fragmentation. This association seems sensible as they emerged and proliferated during a period of political decentralization. However, as our model makes clear if we take the feudal and decentralized military environment of medieval Europe as given, castles actually enabled larger feudal realms to consolidate.

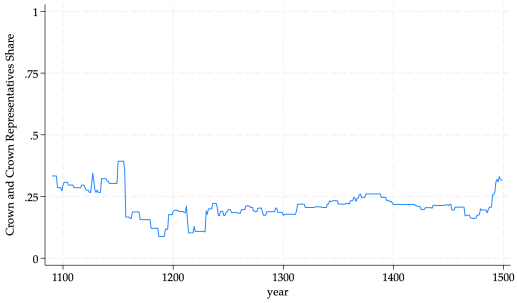
The existence of independent baronial castles made rebellions more costly for the king to suppress. Therefore, the offers that a king made to induce a baron to either join his kingdom or to



(a) England



(b) France



(c) Castile

(d) The share of royal castles over time. We use information on castles directly controlled by the king and indirectly controlled by crown representatives. Data source: Cappelen and Hariri (2022).

remain loyal were more credible if that baron had his own castle. Counter-intuitively, therefore, the presence of baronial castles (all else equal) should lead to fewer rebellions and more consolidated kingdoms.

Our reading of the historical evidence is supportive of this. In Norman England after the Conquest, castles were built across the country: by 1154 there were 225 baronial castles (compared to 49 royal castles) in England (Brown, 1959, 249). Baronial castles allowed the Dukes of Normandy to extend their authority over the far larger territory of Anglo-Saxon England.

Similarly, in the twelfth century Angevin rule expanded over much of France as semi-independent lords in Gascony accepted the lordship of Henry II. This realm was large but as scholars have long argued, it was much more loosely governed than the term "Angevin empire" would suggest.

4.2 Powerful medieval monarchs did not systematically suppress baronial castles

Powerful feudal rulers did not eliminate private castles because to have done so would have been incongruent with other features of feudal rule such as the decentralization of military capacity and the low level of fiscal capacity. Castles were costly to maintain and garrison. No king could aspire to possess all or even a majority of the castles in his realm.

Indeed, our model implies that had a feudal ruler sought to bring all baronial castles under royal control this would have destabilized and weakened their rule. Reducing the number of castles would have led to more rebellions and a smaller realm. The overall reliance on decentralized military capabilities precluded any attempt to consolidate fortresses in the hands of the sovereign. The king only possessed a relatively small force of household knights and retainers. In other respects, he relied on the military capabilities of the lords.

As Figures 1d indicates there was no systematic trend towards taking baronial castles into royal hands. Brown (2004, 166) argues that "[a]ny king worth his salt ... would look to the castles of his realm, look after his own, seek to ensure, by the exercise of his huge power of patronage, that as many castles as possible were in the hands of those he could trust". Powerful kings like Henry II (r. 1154-1189) and Philip Augustus (r. 1180-1223) did of course both augment that number of castles in royal possession and seek to disposed barons who openly opposed them. Henry II was said to have had a "castle strategy" (Warren, 1973, 234). For example, in rare instances, barons who rebelled might lose possession of their castles, as Hugh of Chester did following the rebellion against Henry II in 1173-4 (Vincent, 2008, 7). But medieval kings never attempted to bring all or even close to a majority of castles into royal hands.

Kings could influence who possessed castles but they could not freely allocate baronial castles according to whim. But the king could not deprive a lord of a baronial castle without good reason (Painter, 1961, 135).

We observe a similar pattern with Henry II's contemporary Philip Augustus. Philip Augustus was a formidable ruler who greatly expanded the royal domain, but he operated within the feudal framework rather than seeking to transcend it. As his modern biographer John Baldwin observes,

"As feudal seigneur Philip inherited an intricate web of customary rights and privileges over his vassals that reinforced his authority as monarch. Making few efforts to alter this traditional legacy, he was content to define more clearly and record more precisely the advantages offered to him" (Baldwin, 1986, 302). Coulson (1984, 357) similarly emphasizes that Philip "moved cautiously, affirming the fortress-rights of ecclesiastical franchises, acting on appeal or as arbitrator in castle-disputes, and as lord in the royal demesne, but taking no more than dominatio, with perhaps just a tincture of regalian prerogative, might justify." Of a general policy of restricting fortification, "which has received much misplaced attention, there is no sign" (Coulson, 1984, 360).

The key mechanism Philip employed was rendability—the feudal right to demand temporary access to a vassal's castle. When he granted castles to his lords, "it was specifically stipulated that the receivers of castles must return them at the king's express request" (Baldwin, 1986, 301). This was the doctrine of rendability in action: the king retained the rights of a feudal overlord without needing to hold all fortresses directly. This meant that in the event of war, he could make use of his subjects castles but it also gave those subjects control of military resources that could be used against him. Throughout the thirteenth century, strong French kings were permitted to build their own castles. Thibaut IV count of Champagne for example actively built castles in the 1250s without opposition from Louis IX (r. 1226–1270) (Bjerke, 2024, 452). As Coulson (1984, 360) notes, "Even the acquisitive Philippe le Bel, a century later, could not override mesne rights and directly take over fortresses in sub-fief." Physical fortifications might be destroyed, but the underlying lordly rights persisted: "Even major fortresses were quite quickly physically demolished, or at least made temporarily untenable, but local dispositions and lordly rights were more enduring and had to be conciliated. Defenses might come and go but castellaries were on almost for ever" (Coulson, 2003, 147).

Philip was celebrated for his masterly reconquest of Normandy and he did punish rebellious lords more harshly than his predecessors. But it is anachronistic to see in him an anticipation of the policies of early modern rulers who disarmed their nobility. Coulson (1984, 361) describes his reign after his defeat of the Angevins in 1214 as characterized by "a new degree of interventionism" but also emphasizes that there was "no monarchical leap forward, no Carolingian revivalism."

In fact, Philip Augustus's approach to castles is entirely in-keeping with our analysis. Baldwin observes that "not only did Philip acquire and build fortresses to consolidate the royal domain and his new acquisitions, he also *gave them away* when it best served his interests" (Baldwin, 1986, 301). This is clearly not the behavior of an early modern ruler seeking to monopolize military power. Baldwin notes that "As early as 1189, the king gave the castle of Montboissier in gage to the count of Auvergne. In this inaccessible region Bertrand de la Tour received three castles, the bishop of Clermont four, and the bishop of Le Puy five." Similarly, when Philip conquered Normandy he granted many castles to his vassals. The logic was simple and consistent with our model: Philip needed loyal lords with the military capacity to hold territory on his behalf.

4.3 Castles allowed barons to check despotic power

It also follows from our framework that castles enabled barons to limit abusive or tyrannical behavior by medieval rulers. We discussed above the accepted norm that feudal lords had limited rights of rebellion against the king. This was only possible if the barons themselves had sufficient military resources to check the king.

Scott focused on the arts of resistance practiced by the weak. In contrast, during the high-point of medieval feudalism, rebellious barons did have the economic and military resources to check royal power. Given the state of military technology, castles made it very costly for kings to bring rebellious subjects to heel.

Baronial castles were thus critical in the emergence of coalitions of barons who could check royal power. How does this relate to Lemma 2? We have argued that, at the aggregate level, valuable baronial castles make rebellions less frequent because kings are more likely to honor their commitments. But our analysis also has implications for what happens conditional on a rebellion occurring: which barons join?

Desierto, Hall, and Koyama (2023) address this question using a related but distinct model of coalition formation during the Magna Carta crisis of 1215. In this model, a rebel leader seeks to build a coalition of barons to oppose the king. Each baron deciding whether to join assesses the expected strength of the rebel coalition—in particular, the non-appropriable resources (castles) held by potential fellow rebels. A stronger rebel coalition increases the probability of success,

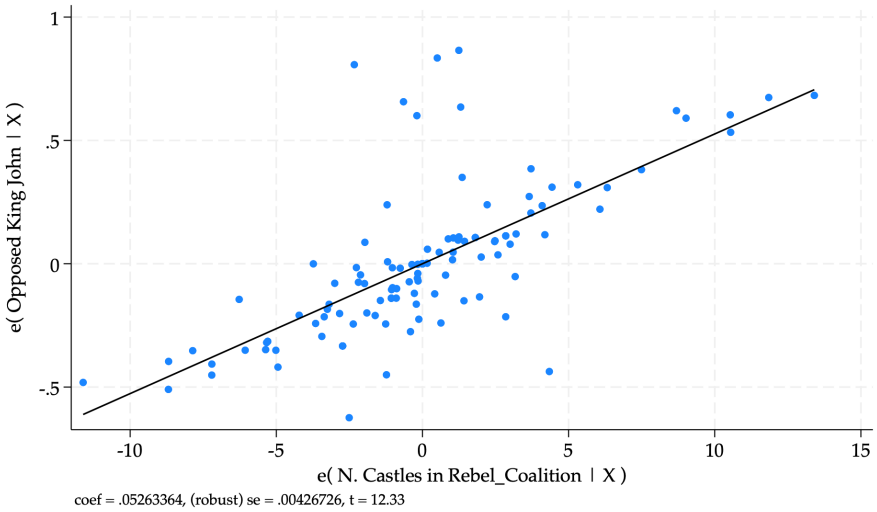


Figure 2: Baronial castles and checking royal power: the positive relationship between the number of castles owned by rebels in a baron's family network and that baron's probability of rebelling against King John in 1215. Data source: Desierto, Hall, and Koyama (2023).

making joining more attractive.

To establish this argument empirically, they construct a unique dataset comprising the universe of English barons in the early thirteenth century and their family networks. They use baronial castles as the main measure of non-appropriable resources and count the number of baronial castles held by rebels in each baron's family network. Across a range of specifications, they establish that the number of such baronial castles positively predicts a baron joining the rebellion against King John. Figure 2 summarizes these findings.[17] Desierto, Hall, and Koyama (2023) thus demonstrate that baronial castles played a critical role in imposing a baronial "bridle" on the king in the form of Magna Carta which would subsequently become a lodestone for those seeking to restrain the arbitrary power of the king.

[17]Note, one might think that there is an apparent tension between Lemma 2 and the empirical findings reported in Figure 2. This is not the case, however. Lemma 2 operates at the aggregate level: more baronial castles make the king more likely to honor commitments, reducing the frequency of rebellions. Figure 2 operates at the individual level: conditional on a rebellion occurring, barons with more rebel-affiliated castles in their network are more likely to join. High aggregate castle values reduce how often rebellions occur, but when rebellions do occur, the distribution of castles among potential rebels affects individual participation decisions.

4.4 Why did the baronial castles disappear?

We have articulated a distinctive logic for castles under feudalism. We have also shown that there was no tendency for the number of baronial castles to decline over time during the Middle Ages. But a question remains: why then did baronial castles eventually decline and ultimately disappear?

The answer is military technology, not the rising power of the state. Technological changes and the associated "military revolution" that took place beginning in the late Middle Ages reduced the value of medieval fortifications. The main technological innovation was the introduction and improvement of gunpowder weapons, which began in the fourteenth century but only really began to have a serious impact in the fifteenth century with the introduction of iron cannonballs. During the last stages of the Hundred Years War, the French employed an artillery train to rapidly reduce the castles and fortified towns that were left in English hands and in 1453 the Ottomans used cannon to breach the land-walls of Constantinople, previously considered impregnable. Gunpowder weapons took longer to affect the other branches of combat but by the sixteenth century the spread of first matchlock and then flint-lock muskets was enabling the recruitment of much larger armies than had previously been feasible.[18]

How did the new gunpowder artillery affect the feudal equilibrium? We can answer this by examining developments in England and France during the fifteenth century. *All else equal*, Theorem 2 predicts that a reduction in the value of castles should lead to the realm becoming less consolidated. In the medium to long run, of course, all else was not equal. Historians and social scientists have long associated the rise of gunpowder weapons with the consolidation of early modern states (Tilly, 1990; Ertman, 1997; van Creveld, 1999). But in the short run, before these secondary processes could play out we find strong support for this prediction.

The Wars of the Roses in England England experienced a large number of rebellions and civil wars between 1450 and 1500. These conflicts are conventionally grouped under the label of the Wars of the Roses (1455–1485), but the period of weak state capacity and frequent rebellion

[18]See Parker (1976, 1988) and Ayton and Price (1998).

extended from Jack Cade's uprising in 1450 through Perkin Warbeck's invasion and the Second Cornish Uprising in 1497. The causes of these rebellions were complex, multifaceted, and varied across cases. Nonetheless, the frequency of civil war during this period is consistent with our model's prediction that a decline in the military value of castles would destabilize feudal realms.

We can now document a relative decline in the military importance of castles that is consistent with our argument that it was changing technology that reduced the value of castles in maintaining what we have described as the "feudal equilibrium".

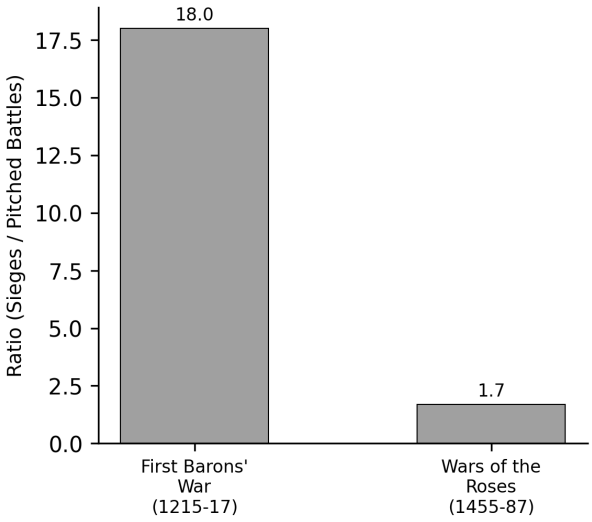
First, it is important to note that the control of castles had been central to earlier English civil wars. The Barons' Wars of the thirteenth century were largely wars of sieges (Cook, 1984; DeVries, 1998). In contrast, the Wars of the Roses was a conflict in which sieges were relatively unimportant. As Hicks (2003, 52) observes: "[t]here were however few sieges in the Wars of the Roses."

This was not initially apparent to contemporaries. At the onset of the conflict, the government "ordered a survey of castles and fortified towns to make sure they were in a good state of repair" (Cohen, 2022, 43), and in the early 1460s there were a series of campaigns for control of the Lancastrian-held castles in the north of England. But in 1464, Bamburgh Castle was quickly reduced with artillery—the first castle in England to fall to cannon (Cohen, 2022, 88). Thereafter, sieges did not play an important role in the conflict.

We now document this empirically in Figure 3. To create this we read a range of sources to construct what we believe is a comprehensive list of all battles in the First Barons' War (1215–1217) and the Wars of the Roses (1455–1487).

We then distinguish between pitched battles and sieges. While we tried our best to be consistent with the definition of a battle across the two conflicts, measurement error is certainly a possibility. Nonetheless, the scale of the difference in the proportion of pitched battles to sieges is striking. 3 of 60 engagements in the First Barons' War were pitched battles. In contrast, 20 of 54 engagements were pitched battles in the Wars of the Roses. It is telling that when Henry VII successfully invaded England in 1485 he did not conduct a single siege.

The reason for this was that both sides of the conflict had access to powerful siege artillery



Engagement Type	Proportion Barons'	Proportion Roses	z-stat	p-value
Pitched Battle	0.050	0.370	-4.26	< 0.001
	(0.028)	(0.066)		
Siege/Castle Event	0.900	0.630	3.44	< 0.001
	(0.039)	(0.066)		
N	60	54		

Figure 3: Comparison of military engagements: First Barons' War (1215–1217) vs. Wars of the Roses (1455–1487). Left panel: ratio of sieges to pitched battles. Right panel: two-sample proportion tests (standard errors in parentheses). The First Barons' War was dominated by sieges and castle-related events, while the Wars of the Roses featured a much higher proportion of pitched battles.

and this made the kingdom extremely vulnerable. Time and again during the Wars of the Roses, England was successfully invaded. As Hicks notes: "Naval defences were of limited value, and no invaders were ever intercepted, so it was possible to land almost anywhere, without resort to ports or regard to coastal castles, most of which were in decay, ungarrisoned and unmunitioned. Once ashore, invading armies could march freely wherever they chose" (Hicks, 2003, 89).

The frequency of rebellions and civil war in late fifteenth century England is important support for our thesis. We have argued that castles helped to glue together the feudal order and make credible the king's promises to his lords. This makes sense of the demise of this feudal equilibrium in the Wars of the Roses following the invention of artillery that greatly reduced the defensible value of existing fortifications. So long as both the king and feudal magnates possessed their own armies and siege trains capable of reducing fortifications, the feudal order was extremely unstable.

Historians note that the Wars of the Roses was characterized by a series of seemingly overwhelming and decisive victories such as Towton in 1461 or Tewkesbury in 1471 which ultimately did not result in a lasting peace. These battlefield victories—Towton was perhaps the largest battle ever fought on British soil—could not achieve peace because "[b]attles were decisive, however,

only for as long as the defeated party secured no new accretion of strength, English or foreign, or for as long as the victorious regime maintained its unity" (Hicks, 2003, 91). It was all too easy for perceived slights by the king to his lords such as Edward IV's treatment of the Earl of Warwick in the late 1460s or his treatment of the Marquess of Montagu in 1471 to spark violent rebellion. Consistent with this account of the breakdown of the feudal equilibrium, in contrast to earlier rebellions, by the mid-fifteenth century any rebel lord was likely to be executed rather than forgiven and brought back into the coalition.

France in the Late Fifteenth Century The story in France differs somewhat from that of England, as the French monarchy emerged battered but victorious from the Hundred Years War with its prestige enhanced. Nonetheless, the French experience is also consistent with our model.

The French were particularly celebrated for their artillery. This capability had originated in the reign of Charles VII (r. 1422–1461), who "developed a strong programme of gunpowder weapon acquisition and development" and "increased the royal budget to procure a larger number of new guns," adding "heavier new taxes to his kingdom's inhabitants to pay for this increase" (DeVries, 1998, 132). By the second half of the fifteenth century, similar to England, France experienced significant noble rebellions against the crown. The most important of these were the War of the Public Weal in 1465 and the Mad War of 1485—the last convulsions of the feudal world.

The War of the Public Weal "pitted the bulk of the princes of France—including the dukes of Berry, Bourbon, Brittany, Calabria and Nemours, and the counts of Armagnac, Dunois, Charolais and Saint-Pol—against the Valois monarch. Although the princes sought to depose the king and replace him with his more pliable brother, they justified their rebellion by claiming that they were acting to reform the government of the kingdom for the wider public weal" (Murphy, 2024, 1027). The onset of Louis XI's reign had provoked this discontent: "all the great lords, from the powerful Duke of Burgundy to the least noble, had been subjected to a pressure of crown claims they had never felt before" (Kendall, 1971, 138).

Unlike the Wars of the Roses, however, the French civil wars of the late fifteenth century were not dominated by pitched battles, and the French crown did not endure the endemic instability that afflicted England. A crucial difference was artillery. Whereas in England gunpowder weapons were

widely distributed among the nobility, in France the monarchy was able to concentrate artillery power in royal hands.[19]

The royal army in 1465 possessed an artillery train pulled by 1,200 horses that was claimed to stretch for twenty miles along the road (Kendall, 1971, 148). Unlike in previous conflicts, fortified towns and castles rapidly surrendered once invested by the king's army. At Gannat near Vichy, for example, Louis assaulted the castle with bombards and cannon and took it in a single day, a contemporary reporting that "in truth to one who did not see it, the operation would seem incredible, here they are fighting more with military engines than with manpower" (quoted in Kendall, 1971, 418).[20]

Through their control of artillery, the French monarchs were able to build an early modern fiscal state more rapidly than their English counterparts. As Potter (2008, 155) notes:

> In 1469 there were 40 *canoniers du roi*, in 1491 over 100 and by 1541 at least 275. These men were responsible for the manufacture of the royal ordnance. In 1442, 20,000 livres of gunpowder were needed for the year, in the 1490s, 100–150,000 and in 1544, 500,000.

This concentration of firepower in royal hands laid the foundation for the centralized fiscal state that emerged in France after 1500, while England lagged behind in this development.

In the medium and long-term, new types of fortification emerged in response to artillery, notably the *trace italienne*. These however, could not provide the same function as medieval castles.

The new fortifications were built by the state and located on the frontiers to protect against external invasion. They were vastly more expensive than their medieval predecessors, both to construct and to maintain. They required larger numbers of soldiers and cannon to defend. The costs were huge, and could only be borne by centralized states with access to regular tax revenues:

[19]DeVries (1998, 142) writes: "This is not to say that the English kings during the Wars of the Roses had no gunpowder weapons. In fact these kings, whether Lancastrian, such as Henry VI, Yorkist, such as Edward IV (1461–83) or Richard III (1483–85), or Tudor, such as Henry VII (1485–1509), tried diligently to strengthen their gunpowder weaponry stores and administration. But they simply never had strong royal control over these weapons similar to that held by their continental counterparts."

[20]Large and well-garrisoned cities such as Paris remained difficult for besiegers to capture. But artillery sharply reduced the defensive utility of isolated fortresses and castles, such as Gannat, which had previously served as critical lynchpins in military campaigns because they could be held by very small garrisons and provide launching pads for counter-attacks that threatened enemy supply lines.

"The cost, however, was stunning. The scheme to surround Rome with a belt of eighteen powerful bastions was abandoned in 1542 when the construction of one bastion alone was found to have cost 44,000 ducats (about £10,000)" (Parker, 1988, 12). They could not be built by private noblemen.

Castles remained in baronial hands but that was largely because they were now strategically unimportant. They did not have major military importance unless they could be modernized and equipped with sufficient cannon. It was only the royal government that had the resources to do this, and it concentrated resources on the coastal fortification facing France and the Scottish border. Henry VIII used the revenues he obtained from dissolving monasteries, Parliament and the debasement of the coinage to build fortifications along the south coast (a program known as "the King's device"), modernizing existing royal castles so that they could survive in the new age of artillery: walls had to be lowered and supported with earth to resist cannon fire, and gun emplacements had to be constructed (Merriman, 1991). Our argument is consistent with the finding that after the invention of gunpowder weapons the location of fortifications shifted to the frontier (Mangini and Petroff, 2024).

In the second part of the sixteenth century, far from amassing castles, Elizabeth I's government allowed them to go into decay: " Few were deliberately pulled down, but neglected buildings soon become prey to depredation, and by the end of the sixteenth century many of the royal castles were falling into a state of ruin actively assisted by the local inhabitants" (Colvin, 1968, 230). In 1609, the Exchequer listed 60 royal castles and "[w]ith only one or two exceptions, they were all described as 'very ruinous' or 'utterly decayed"' (Colvin, 1968, 233). The old medieval castles of the barons could be allowed to fall into disrepair because they were no longer relevant.

In France, there was a more active policy of demolishing internal fortifications, particularly in the reign of Louis XIII (r. 1610-1643) who as Tilly (1990) noted "probably tore down more fortresses than he constructed. But he built at the frontiers, and destroyed in the interior". Initially, the policy of demolishing private castles was stated in the Treaty of Paris in 1626 but it was only put into serious effect after the defeat of the French Protestants in 1629. This is consistent with the chronology of our argument. It was only after the end of the feudal period and in an era of state centralization that kings pursued a systemic policy of reducing private castles.

5 Concluding Comments

We have provided a novel analysis of the role castles played in the political economy of medieval Europe. At its heart our account is a credible commitment story. The king would benefit from being able to commit ex ante to honoring his sharing agreements with barons. Such commitment would make it easier to recruit barons and expand the realm. But in the medieval world, no formal mechanisms existed to bind the king's future actions: there were no constitutional constraints, no independent courts that could enforce agreements against the crown, and no third-party guarantors. Once a baron joined the coalition and contributed his resources, the king faced a temptation to renege—the classic hold-up problem that is central to the political economy of premodern states. Baronial castles provided a solution to this commitment problem. By making rebellion costly—rebels withdrew valuable defensive resources and weakened the king's military position—castles altered the king's incentives, ensuring it was incentive-compatible for him to honor his commitments.

There are modern parallels to the medieval castle. Large corporations and the very rich can protect their assets through forms of ownership that are illegible to the modern state. For example, they can be based in overseas tax shelters (such as the Cayman Islands) and globalization has made them highly mobile relative to their pre-modern antecedents who could more easily be expropriated by the state. The first part of our argument applies to these modern financial "castles": such institutional arrangements can benefit both parties if they enhance the ability of the state to make credible promises and not to expropriate private resources. However, there is a crucial difference. The mobile or illegible wealth of contemporary firms and billionaires cannot be used for military action against the state. We live in an environment where the state does possess a monopoly (or near-monopoly) over legitimate violence and has high state capacity. As such, private firms or rich individuals are not meaningful checks on governance and have very limited ability to constrain the actions of the state.

James Scott was highly critical of "the hegemony, in this past century, of the nation-state as the standard and nearly exclusive unit of sovereignty" (Scott, 2009, 11). In this spirit, this paper challenges the conventional state-centric view that sees private or baronial castles as signs

of state weakness in medieval Europe. Private castles have been widely portrayed as impediments to political order, grains of sand in the machinery of the state that needed to be eliminated for functional modern states to emerge. However, we argue that this interpretation fundamentally misunderstands the nature of feudal political organization and the role castles played within it.

In contrast, using a formal model, we have uncovered a distinctive logic for the prevalence of private castles throughout the Middle Ages. Castles gave barons independent resources and the ability to protect their lands from the king. In turn, this gave the king a greater incentive to honor his commitments to the barons, making his promises to them more credible. This made barons more willing to enter the king's coalition and thus enabled him to expand the kingdom. Under feudalism, precisely because the king could not rule alone, our argument is that the presence of castles should be associated with more and not less political consolidation.

Our argument thus makes sense of William of Newburgh's statement that castles were "the bones of the kingdom" (*regni ossibus, id est, munitionibus regiis*)(discussed in Strickland, 2003; Oakes, 2014).[21] Finally, it follows from the logic of the argument here that baronial castles played an important role in the development of constitutional checks on monarchical power. This is an argument we develop in other ongoing research (see Desierto, Hall, and Koyama, 2023).

A Appendix (to be published)

A.1 Proofs

A.1.1 Proof of Lemma 1

Since the expressions in (1) and (2) are both greater than zero, there are values that the variables can take, specifically, values of the castles $\mathbf{c} \equiv c_1, c_2, ..., c_N$, such that the expressions are exactly equal to each other. Thus, at these threshold values, which we denote as $\{(\underline{c}_t)_t\} \equiv \underline{c}_{1,t}, \underline{c}_{2,t}, ..., \underline{c}_{N,t}$, baron t's expected payoff from A is equal to his expected payoff from F, which means that the optimal action of baron t is A. It remains to show that values above the threshold make baron t's expected payoff from A larger than his expected payoff from F, which also makes A the optimal

[21] In making this statement, Newburgh did not distinguish between royal and baronial castles. Both were critical to the defense and governance of the realm.

action of baron t.

To demonstrate this, note that $\mathbf{c} \equiv (c_1, c_2, ..., c_N)$ decreases U and therefore decreases both expressions (1) and (2). In addition, $\mathbf{c}$ has a non-positive effect on p_t^R – in particular, $c_1, c_2, ..., c_{t-1}$ decrease p_t^R, while $c_{t+h}, h = 1, 2, ..., N-t$ have no effect. To get the net effect of $\mathbf{c}$, one can write the latter's effect on expression (1) as (i) $\frac{\partial U}{\partial \mathbf{c}}$, and its effect on (2) as (ii) $\frac{\partial U}{\partial \mathbf{c}}[\alpha_t(1-p_t^L) + (1-\alpha_t)(1-p_t^R)] - \frac{\partial p_t^R}{\partial \mathbf{c}}[U + e_t(N-t)]$. Now both (i) and (ii) are less than zero, but the absolute value of (ii) is larger. Thus, $\mathbf{c}$ decreases (2) by more than it does (1), which implies that on net, $\mathbf{c}$ tends to make the expected payoff from A relatively larger than the expected payoff from F.

Thus, at and above the thresholds, i.e. $c_1 \geq \underline{c}_{1,t}, c_2 \geq \underline{c}_{2,t}, ...,$ and $c_N \geq \underline{c}_{N,t}$, the optimal action of baron t is A.

A.1.2 Proof of Corollary 1

Take all the values of $\underline{c}_{1,t}$ (one from each baron t's threshold), and denote the largest value as $\max\{(\underline{c}_{1,t})\}$. Do the same for $\underline{c}_{2,t}, \underline{c}_{3,t}, ..., \underline{c}_{N,t}$. Now if $c_1 \geq \max\{(\underline{c}_{1,t})\}$, then c_1 is greater than any value of $\underline{c}_{1,t}$. If $c_2 \geq \max\{(\underline{c}_{2,t})\}$, then c_2 is greater than any value of $\underline{c}_{2,t}$. And so on until c_N. This means that each baron t's threshold is met. Each baron's optimal action is A.

A.1.3 Proof of Lemma 2

Since U_k^t and W_k^t are both greater than zero, there are values that the variables can take, specifically, values of the castles $\mathbf{c}_{t-1} \equiv c_1, c_2, ..., c_{t-1}$, such that U_k^t and W_k^t are exactly equal to each other. Thus, at these threshold values, which we denote as $\underline{c}_{k,1}^t, \underline{c}_{k,2}^t, ..., \underline{c}_{k,t-1}^t$, the king's expected payoff from choosing L at t is equal to his expected payoff from choosing R, which means that the optimal action of the king at t is L. Since $\mathbf{c}_{t-1} \equiv c_1, c_2, ..., c_{t-1}$ decrease W_k^t but has no effect on U_k^t, it is obvious that values above the thresholds $\underline{c}_{k,1}^t, \underline{c}_{k,2}^t, ..., \underline{c}_{k,t-1}^t$ make the king's expected payoff from L larger than his expected payoff from R, which also makes L the optimal action of the king at t.

Thus, at and above the thresholds, i.e. $c_1 \geq \underline{c}_{k,1}^t, c_2 \geq \underline{c}_{k,2}^t ...,$ and $c_{t-1} \geq \underline{c}_{k,t-1}^t$ the optimal action of the king at t is L.

A.1.4 Proof of Corollary 2

Take all the values of $\underline{c}^t_{k,1}$, i.e. one value at each t, and denote the largest value as $\max\{(\underline{c}^t_{k,1})\}$. Do the same for $\underline{c}^t_{k,2}, \underline{c}^t_{k,3}, ..., \underline{c}^t_{k,N-1}$. Now if $c_1 \geq \max\{(\underline{c}^t_{k,1})\}$, then c_1 is greater than any value of $\underline{c}^t_{k,1}$. If $c_2 \geq \max\{(\underline{c}^t_{k,2})\}$, then c_2 is greater than any value of $\underline{c}^t_{k,2}$. And so on until c_{N-1}. (At any period t, $c_t, c_{t+1}, c_{t+2}, ...$ are not yet relevant, so one can simply set the threshold at zero for these. At some time period after t they will successively become relevant, in which case, their threshold values can be greater than zero. Thus, their maximum values can be greater than zero. The exception is c_N, which is never relevant, and so we the threshold at each t for c_N is zero and, hence, $\max\{(\underline{c}^t_{k,N})\}) = 0$.) This means that the king's threshold at each t is met His optimal action at each t is L.

A.1.5 Proof of Theorem 1

The proof is immediate from Lemmas 1 and 2, using the definition of optimal action pairs and equilibrium.

A.1.6 Proof of Theorem 2

The proof is in the text, immediately preceding the theorem.

A.2 Data on the Share of Royal Castles (Figure 1)

The data on the share of royal castles over time presented in Figure 1d are drawn from Cappelen and Hariri (2022). Cappelen and Hariri compiled comprehensive data on castle ownership across medieval Europe, recording information on whether each castle was directly controlled by the crown, held by crown representatives, or owned by barons (including ecclesiastical lords). For each country-year observation, we calculated the share of castles under royal control (either directly or through crown representatives) relative to the total number of castles. The dataset covers England, France, and Castile for the period 1088–1500, allowing us to track long-run trends in the distribution of fortifications between kings and barons. For further details on the construction of the dataset and coding decisions, see Cappelen and Hariri (2022).

A.3 Data on Baronial Castles and Rebellion (Figure 2)

The data on the relationship between baronial castle ownership and rebellion presented in Figure 2 are drawn from Desierto et al. (2023). Desierto, Hall, and Koyama constructed a comprehensive dataset comprising the universe of all English barons in the early thirteenth century, including information on their family networks and castle holdings. Baronial castles serve as the primary measure of non-appropriable military resources—that is, resources that could not easily be seized by the king. For each baron, they calculated the total number of castles held by rebels within that baron's family network. The figure plots the relationship between this network castle count and the probability that a baron joined the rebellion against King John in 1215, which culminated in Magna Carta. Across a range of specifications, they find that barons with more rebel-held castles in their family networks were significantly more likely to rebel. For further details on data sources, variable construction, and regression specifications, see Desierto et al. (2023).

A.4 Data Sources for Siege-Battle Comparison (Figure 3)

We compiled lists of military engagements for the First Barons' War (1215–1217) and the Wars of the Roses (1455–1487), classifying each as either a pitched battle or a siege/castle-related engagement. For the Wars of the Roses, we drew on Cohen (2022), Hicks (2003), and Cook (1984). For the First Barons' War, we relied on Carpenter (2020) and McGlynn (2011). We double checked these compilations against both Wikipedia and other online sources and found that them to be comprehensive. In the First Barons' War, castle-related engagements (sieges, captures, and surrenders of fortifications) constituted the overwhelming majority of military events—approximately 55 out of 61 recorded engagements involved castles or fortified places. By contrast, in the Wars of the Roses, pitched battles were far more prominent relative to sieges. Of approximately 55 recorded engagements, only around 30 were sieges or castle-related, with the remainder being pitched battles. This shift in the ratio of sieges to battles is consistent with the declining military importance of castles by the mid-fifteenth century.

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