The Economic Origins of the Territorial State*

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Abstract

This paper challenges the long standing belief that changes in patterns of war and war-making caused the emergence of large territorial states. Using new data describing the universe of European states between 1100 and 1790 I find that small political units continued to thrive well into the "age of the territorial state," an era during which some argue changes in the production of violence led to the dominance of geographically large political units. In contrast, I find evidence that variation in patterns of economic development and urban growth caused fragmented political authority in some places and the construction of geographically large territorial states in others. Exploiting random climatic variation in the propensity of certain pieces of geography to support large populations, I show via an instrumental variables approach that the emergence of towns and cities caused the formation of small and independent states. Last, I explore how changes in economic forces interacted with patterns of war-making, demonstrating that the effect of urban development was greatest in periods associated with declines in the costs of producing large-scale military force.

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For the nearly forty years since the publication of *The Formation of National States in Western Europe* (Tilly 1975) questions of the territorial state's origin have aroused the interest of scholars spanning comparative politics, international relations, and historical sociology. Yet despite an extensive scholarship on the topic, there has been little work aimed at explicitly testing competing theories of state formation.[1] Bringing to bear new data describing the entire universe of European states I fill this gap by explaining variation in the number and size of states between 1100 and 1790. In doing so, my results question several commonly held beliefs about the relationship between war-making and the origins of the territorial state. In contrast to theories that emphasize the role of war, I provide evidence that changes in urban growth and the revival of commerce caused observed temporal and spatial variation in the geographic scale of political organization.

The first half of this paper casts doubt on what I call the "bellicist" approach to state formation. Heavily influenced by the work of Charles Tilly and dating to German sociologists Otto Hintze and Max Weber, this line of scholarship attributes the development of the state to changes in patterns of war and war-making (Hintze 1906; 1975, Weber 1968, Tilly 1975; 1985; 1990, Downing 1992, Ertman 1997). In these theories "war made states" through a Darwinian process. Large states could easily raise the manpower and finance required to field the increasingly large standing armies and increasingly dear technologies of coercion necessary to survive an era of endemic warfare. Technological shocks to the production of violence requiring increasing numbers of soldiers and more expensive armaments selected states most capable of adapting to these changes (Roberts 1956, Parker 1976; 1996, Black 1991, Rogers 1995). Though a number of possible military innovations are identified, according to this logic the most fit states were those that maintained an advantage in the form of substantial populations, larger tax bases, and greater access to natural resources (Bean 1973, Finer 1975, McNeill 1984, Tilly 1975; 1985; 1990). Because of these endowments bellicists argue large states were more capable than their smaller counterparts of meeting the demands of war and, therefore, were more likely to survive.

[1] However, several attempts have been made using agent based approaches to examine theories of state formation. For two examples, see Cederman (1997) and Boix, Codenotti and Resta (2011).

After introducing a new dataset encompassing the entire universe of European states between 1100 and 1790, I show that several key empirical predictions of war making theories are not borne out. Namely, I demonstrate that the military revolution, a sequence of dramatic changes to the production of violence, did not significantly alter the number or typical size of states. In contrast to the predictions of these bellicist theories, the typical state *declined* in size and the number of independent states remained roughly constant during the period associated with these large scale changes. Moreover, I show that the relationship between geographic scale and survival probability is the opposite of what war-making theories predict. Specifically, over this span small states were *more* likely to survive than their larger counterparts and this relationship was invariant across time. In other words, rather than being "an age of the territorial state (De Lagarde 1937)," the period between 1500 and 1800 was one in which small political communities not only persisted but remained the typical form of political organization.

The second half of this paper provides evidence in favor of the set of what I call "economic" theories. This scholarship reemerged with the work of Hendrik Spruyt (Spruyt 1994*a*;*b*) and builds upon the political sociology of Stein Rokkan and economic history of Henri Pirenne in viewing the development of the territorial state in some places (and its absence in others) as the consequence of variation in the dominant social coalitions that formed from changing patterns of trade and economic development (Eisenstadt and Rokkan 1973, Rokkan 1975; 1980, Rokkan and Urwin 1982, North and Thomas 1973, Anderson 1974). Broadly, these theories find that economic changes which empowered new social groups relative to existing actors can best explain observed patterns of European state formation. The re-emergence of the Eastern trade and the revival of urban life during the last half of the tenth century created in some places new commercial classes (Pirenne and Clegg 1937, Pirenne 1969, Lopez 1976, Cipolla 1994). Where towns formed and burghers could bargain for or force their rights upon princes and kings, smaller and more numerous political units came into existence. Common to these accounts is the idea that variation in the economic resources available to groups explain the type and size of state capable of existing. Indeed, recent work has shown that geographically small and urban city-states could far easier and earlier construct financial instruments necessary to purchase the means of defense required to survive interstate competition

(Stasavage 2011a;b).

Since the relationship between patterns of state formation and urban growth is likely affected by unobservable confounders and, moreover, because the direction of causality runs in both directions, I take an instrumental variables approach to identify the effect of changes in patterns of urban development on the size and number of states within some defined geography. To show that political fragmentation was caused by the uneven re-emergence of urban life I exploit random climatic variation in propensity of some pieces of geography to sustain large populations. Treating the optimal growing temperature for cereals like wheat as an instrument for the development of towns and cities, I show that variation in urban growth caused political fragmentation. Where commerce and urban life reclaimed a foothold, where cities re-emerged from the Dark-Age nadir, small independent political communities formed. In those places where cities and urban life did not emerge, large territorial states took shape.

Last, I explore how the mechanisms of economic and war-making theories might be reconciled. To do this, I show that the effect of urban growth was greatest in periods matched by a concurrent decline in the costs of producing large scale military force, suggesting an interaction between the constraints of war and changes in patterns of economic development. In other words, when the costs of war were low, new social groups created by changing patterns of trade and urban growth were most capable of claiming and defending independence. More concretely, the period of the commercial revolution, an era during which there was a sharp increase in the number of independent states, coincided with the decline in the military dominance of expensive shock calvary and the rise of armies consisting of comparatively inexpensive infantry armed with pike or bow. In this era, I show that the effect of urban growth was greatest.

1 What States Are (And Aren't)

Before any analysis can be conducted, data describing the outcome of interest must be systematically collected and defined. To do this in a theoretically satisfying manner it is crucial for my object of inquiry, the state, to be clearly defined and carefully operationalized. This section first defines a minimalist Weberian definition of the state. Then, I outline three observable criteria that allow for the systematic and replicable coding of political units as states or not. Next, I argue that this way of understanding statehood is both reasonable from a historical standpoint and, moreover, captures the crucial distinction others have highlighted between alternative institutional forms like the Holy Roman Empire, leagues of city-states, and territorial states.

1.1 A Definition of the State

As a start, I turn to Weber's treatment of states as political communities that "(successfully) claim a monopoly on the legitimate use of physical force within a given territory (Weber 1972)." However, to reflect empirically observable phenomena rather than a non-existent ideal type I alter this definition, defining states as *the organizations that maintain a quasi-monopoly of violence over a fixed territory.* That is, states are the organizations that have a clear preponderance of the coercive means over some geographically defined unit.

To systematically measure this quasi-monopoly of coercion I provide three necessary observable criteria to distinguish states from non-states.

1. **Direct Military Occupation**

   If a political unit is militarily occupied by a foreign power, according to my coding scheme it ceases to exist as an independent state. Similarly, if a political unit successfully conquers a piece of territory, this newly occupied territory is treated as a part of the conquering state. For example, when the Ezzelino or Pallavicini families were able to effectively wield military control over several Italian city-states I code the amalgamation of these units as a single state. Analogously, when military orders like the Teutonic Knights or the Knights Hospitaller conquered well defined territories these new units are coded as independent states. Similarly, when the Castilian-Aragonese state drove the Moors from Grenada, the Emirate of Grenada ceases to be coded as an independent state and its territory gets coded as part of Castile.

2. **The Capacity To Tax**

   Expropriative power, the ability to take from another that which she owns, is the coercive authority most associated with statehood. Formal expositions of states as wealth maximizing actors, as "stationary bandits" or organized criminal organizations, underscore this crucial aspect of state violence: states "steal" from those they govern. Moreover, the ability to extract is the key feature of state power driving several recent and influential theories of political transitions (Boix 2003, Acemoglu and Robinson 2006). In these theories it is precisely the ability of the state to extract that actors - economic classes in these models - enter into conflict to control. As such, I take the capacity to tax as evidence of the state's quasi-monopoly of coercion. So, for example, when Worms (1184) or Lubeck (1226) demonstrably gained rights to collect taxes and tolls within their boundaries I code them as independent states.

3. **A Common Executive**

   Recognizing that many states during the time period studied were "composite" entities, composed of political units which maintained semi-independent bureaucracies, parliaments, and other separate political institutions (Nexon 2011), I treat those sharing a common executive as a single state. Coding states this way treats the holdings of Imperial families as a common state rather than distinct units. So, for example, all of the territory held by the head of the Wittelsbach family - at various points including the Counties of Holland, Hainaut and Zeeland, as well as the Duchies of Jülich and Berg - all get coded as a single state. However, as the family split territory amongst its various component branches - first between the Bavarian and Palatinate and then the numerous further divisions - each is treated as a distinct state. However, when, as in 1777 the Bavarian line died out and merged with the Palatinate branch they again get treated as a single state.

1.2 Relation To Other Definitions of the State

The definition of states as quasi-monopolists of violence recognizes the fact that political communities that reasonable coders would identify as states existed before juridical notions of sovereignty. This is not a claim that juridical statehood is unimportant for the study of politics but, rather, that such a coding scheme would fail to capture political organizations like France, Venice and England let alone older polities like the Roman or the Han Empires that existed as coercion monopolizing entities long before 1648 or 1555.[2] In the words of historian H. J. M. Claessen, we have no reason to consider "the realm of the Aztecs, the Mongol Empire,...or the late Roman empire qua political structure as qualitatively different from, say, France, Spain or England in the fifteenth century. They were all states, varying from early to mature (quoted in Skalník 1989 p. ix)."

Moreover, because this coding scheme treats the *de facto* distribution of power as central in determining which units get coded as states, I treat as distinct political units some states that more traditional historiography might consider unified. For example, when Boleslaw III of Poland divided his Kingdom between his sons creating the Masovian, Seniorate, and Sandomierz provinces along with Greater Poland, my coding scheme treats each as distinct units. Similarly feudal territories like Toulouse, Provence, or Brittany, which although seigniorial dependants of the French King get coded as independent until they are integrated into France proper. Likewise, Imperial city states, prince-bishoprics, free-cities, and imperial abbeys that effectively demonstrate independence as outlined above get coded as independent units. So, for example, when Fredrick Barabarossa attempted to assert imperial rule in Lombardy, the various units that composed the Lombard League and successfully resisted begin to be coded as independent.

With this minimalist notion of statehood I am able to account for institutional configurations that others treat as distinct from territorial or "national" states. Without rejecting the notion that political entities like the Holy Roman Empire or the Swabian and Hanseatic leagues were unique constellations of political institutions we can consider, based upon my scheme, many of their constituent units as states while still capturing the relevant differences drawn by the literature between these alternatives and territorial states. They, unlike territorial states, preserved fragmented political authority.

Consider the Holy Roman Empire. Whether or not it represents a true alternative to the state, using my coding scheme, I arrive at a conclusion similar to those who, like Spruyt (1994*a*;*b*), view the Empire as a fundamentally unique institutional form. That is, from either perspective it is apparent that the Holy Roman Empire was marked by substantial fragmentation of political authority. Indeed, by the end of the thirteenth century an increasing number of units within the

[2]See Krasner (1999) for a more complete discussion of internal control, external recognition, and Westphalian sovereignty as useful analytic tools

Empire acquired de facto independence from Imperial rule. The extent of this was such that even petty magnates who previously swore "fealty to only God and Emperor eschewed themselves equally of both powers" and maintained "full jurisdiction... rights of legislation, privileges of coining money, levying tolls and (collecting) taxes (Bryce 1920; ch. xiv)." They were, by my definition, independent states. Indeed, "along the Rhine even the Lord of a single tower was often almost an independent prince (ibid)."

The same is true for leagues of city states. Although leagues like the Hansa were far more than a loosely bound affiliations of towns centered around the regulation of trade, when considered in light of my coding scheme they do not represent an alternative to the state. Consider the difficulties leagues faced at creating compliance. Leagues facilitated cooperation among members largely through reputational mechanisms (Ewert and Selzer 2006, Greif, Milgrom and Weingast 1994). With respect to generating revenue, like modern international institutions, they faced great difficulty in directly taxing their members. Instead they relied upon the voluntary compliance of individual member cities to obtain revenue. Typical of these organizations, lacking a third party enforcement mechanism the Hansa could at most expel member cities who failed to comply with calls for revenue (Fink 2011).

The absence of third party enforcement is perhaps best evidenced in leagues' conduct of military affairs. The Hansa and other leagues were certainly capable of projecting military force, fielding armies able to combat large territorial states like Sweden, England, Denmark, and Holland. For example, at the height of its powers the Swabian league could support armies rivaling those of any major power, in 1385 raising an army of more than 12,000 infantrymen and 1,200 calvary (Laffan 1957). But the ability to field large armies belied their true capacity to project force. When, for example, the Hansa waged war against the Danish Crown in 1360 it could not compel all of its member states to participate in the conflict (Dollinger 1970; p. 70). Similarly, it was in part because the consent of the forty-odd commissioners (representatives of the individual cities) was necessary to execute tactical maneuvers that Swabian league was defeated at Doffingen in 1388; coordination on the battlefield was made so difficult that the allied lords the league opposed were able to emerge victorious despite their numerical inferiority (Zimmermann 2009).

In other words, although leagues were certainly institutional responses to changing patterns of war and trade, they were organizations comprised of units I call states and not a fundamentally distinct alternative. Still, perfectly in line with other interpretations, leagues were institutions that by providing quasi-public or club goods like collective security or enlarged markets for traded goods allowed fragmented political authority to persist, an outcome captured in my operationalization.

1.3 Constructing the Data

Following this coding scheme the data are constructed by manually geo-referencing several sets of historical maps. Two of the main sources from which the base GIS boundaries are constructed are the Centennia Historical Atlas (Reed 2008) and the Euratlas (Nussli 2010) Digital Atlas. The Nussli data are measured in 100 year panels whereas the Reed atlas utilizes a much more high frequency approach, recording observations in tenths of years. I use the boundaries as defined by both datasets aligning them at every hundred year mark based upon the coding scheme defined above. The Nussli data matches the Reed data nearly perfectly at these points. Where there are discrepancies it is usually because the Nussli dataset takes observations from a window surrounding each panel and not a snapshot exactly at the one-hundred year point. Because the Reed data is not geo-referenced I construct shape files that are compatible with GIS analysis by manually constructing the boundaries from re-projected images provided by the atlas and then referencing each observation using the European Albers Equal-Area projection system.

The Nussli data have been used in several recent publications and are considered highly accurate (Stasavage 2011*a*;*b*, Blaydes and Chaney 2012). Nevertheless, even after combining the data from these digital sources there are still a number of imperfections; units I code as independent states are absent from the reconstructed shape files. These tend to be small independent principalities, ecclesiastical units, and city-states that were not picked up by the historical geographers who created the digital reproductions from which my maps are constructed. In order to rectify these flaws and prevent the ensuing selection problems that would plague the subsequent statistical analysis, I turn to a number of historical and contemporary primary source maps to create high frequency boundary changes for these missing units.

This combination of secondary and primary cartographic sources allows me to project the boundaries for all political units that meet the coding criteria. Using known pieces of physical geography, known political boundaries, and the location of cities and towns to properly reference these maps, I create shape files that, with a high degree of accuracy, reflect the geographic scale of each unit. For each unit I track the history of their boundary changes - expansions and contractions - and adjust the shape-files accordingly. In order to provide a more detailed description of the procedure I walk through the creation of the shape file for part of Nassau between 1159 and 1328.

The town of Nassau dates to at least 915 and was founded by Robert the son of Dudo-Henry of the House of Laurenburg. The Laurenburgs built Nassau Castle in 1125 and established the County of Nassau in 1159 - effectively claiming rights of taxation, toll collection, and justice. As such, Nassau enters the dataset as an independent state as of 1160. The County (later Principality) of Nassau exists in the digital base maps from this point, giving an accurate measure of its boundaries and size. However, the digital source maps fail to record the dissolutions and mergers of various component units of Nassau, of which nearly all meet my coding as independent states. I manually make these corrections as described below.

For 96 years Nassau existed as a single independent state. Upon the sale of Weilburg to the Count of Nassau in 1255 the territory was split between the two sons of Henry II with Otto I receiving the territory north of the river Lahn and his older brother Walram II receiving the rest. Using this geographic boundary as the dividing line I create the Counties of Nassau-Dillenburg and Nassau-Weilburg, respectively. Dillenburg remained a single state until Otto's death in 1303 after which Nassau-Dillenburg was divided into three units, splitting off Siengen and Hadamar from the initial unit. The boundaries of these new states are constructed using the boundaries as they exist on several historical reproductions and one primary source map (Blaeu et al. 1990, Franz 1952, Hockmann 2005). Using the known latitudes and longitudes of the cities of Siengen and Hadamar I then can reference the projected images from the historical reproductions using points representing the locations of these cities. From here, using these points and the boundaries of pre-existing Nassau-Dillenburg we can create the boundaries and subsequent shape-files for each of these new units. These three states remained independent until Siengen conquered Dillenburg in 1328 and then Hadamar in 1394.

2 The Military Revolution and The European System of States

In this section I first outline three main empirical predictions made by bellicist theories. Then, I provide a series of statistical tests showing that the predictions of bellicist theories do not match the empirical record. Moreover I suggest that these seemingly unwarranted predictions arose from a literature that has almost exclusively relied upon the historical experiences of extremely large units to make inferences about general patterns of state formation.

2.1 Predictions of War Making Theories

The general thrust of war-making theories of state formation can be summarized by the dictum, made famous by Tilly, that "war made states" (Tilly 1985). Indeed, a great deal of wide ranging historical evidence supports the claim that changes in the patterns of war caused the centralization, bureaucratization, and rationalization of many activities thought to typify modern statehood. Much of this literature either directly or indirectly asserts that the pressures of endemic war brought on by or, in turn, causing changes in the production of violence led to the creation of large states.

Specifically, these changes are described as an early-modern "military revolution," a notion first promulgated by Roberts (1956) who viewed changes in infantry tactics devised in the mid sixteenth century by Maurice of Orange and Gustavus Adolphus as fundamentally altering the manner in which armies were trained, raised, and paid for. Others view alternative technological and tactical changes as having marked the sea change between premodern and modern ways of waging war. Parker (1976; 1996), and McNeill (1984) for example, see as crucial the late-fifteenth century development of siege artillery, a technological innovation that engendered an even more costly defensive response, the *trace italliene*.[3]

These accounts are not exhaustive. For example, Black (1991), places a greater significance on

[3]Bean (1973) similarly judges the development of powerful artillery as the crucial technological change and is explicitly economic in linking the adoption of the cannon to the rise of large territorial states. In his logic, the innovation of these technologies drove up the fixed costs of war, making local political rule untenable, leading to geographically large states

developments that took place between 1660 and 1710, namely, the invention of the flintlock musket. Rogers (1995), on the other hand dates an almost continuous series of military innovations to the beginning of the Hundred Years War. Regardless, whether or not the exact timing of the military revolution is clearly defined, a recurrent theme in the study of early-modern military history is that a fundamental change in the production of force took place sometime between the mid fifteenth and the end of the eighteenth centuries.

Social scientists use these historical accounts to build theories of the modern state's origins, arguing that a causal relationship exists between military innovation and the rise of geographically large, territorial states (Tilly 1975; 1985; 1990, Downing 1992, Ertman 1997). Common to them is the idea that changes in the costs of war selected those states that could pay them. In the canonical iteration of these theories, the states most fit for survival were those at the intersection of "capital" and "coercion" (Tilly 1990). These were large states with both sizable populations necessary to provide the manpower for large standing armies and access to the finance necessary to fund them.

2.2 The Number and Size of States Across Time

With a simple description of the data two trends emerge. First, I show that during the period associated with the military revolution the typical state declined in size. Second, over the same period, I find that the number of states remained roughly constant.

2.2.1 The Declining Trend in State Size

The top panel of Figure 1 plots the trend in state size across time measured in square kilometers. If one were to only consider the mean, it appears that the bellicist hypothesis matches the general trend; between 1400 and 1790 the average size of states more than doubled from approximately 33,000 to 71,000 square kilometers. Although a proponent of the military revolution might view this as confirmation, in the presence of extreme values the mean is a poor indicator of central tendency. This point is made apparent not only by the large spread between the median of state size and its mean but by the relationship between the mean and the third quartile of the distribution. For nearly all of the period for which we have data, the size of the state at the seventy-fifth percentile *was less than the mean size.*

The reason for this is clear. There are several extremely large states distorting what we might otherwise view as typical. That is, the distribution of the untransformed data is heavily skewed, with far more large states relative to what one would expect if size of states took a more symmetric distribution. An oft used and simple corrective to this type of problem is to log-transform the data which allows for better descriptive inference about the trend in state size for the typical state.[4]. In appendix I show that the log-transformed data are statistically indistinguishable from a normal distribution.

Although a naive interpretation of the untransformed mean trend would indicate a revolution in state size coinciding with known changes in military technology, once we transform the data this upward trend disappears. Rather, *the typical state between 1100 and 1790 declined in size.* The lower panel of Figure 1 indicates that both the mean and median state size are declining over time and in near perfect tandem.[5] The decline in both measures is substantial; the mean and median logged state size decreasing between 1100 and 1790 from 9.03 to 6.32 and 9.62 to 5.67, respectively. Re-transforming these results gives declines of 7,818 and 14,816 square kilometres from initial values of 8,372 and 15,106. By these measures the "typical" state, though quite small in 1100, became even smaller over time, contradicting the theoretical prediction made by war making theories of state formation.

2.2.2 The Trend in the Number of States

A related claim made by proponents of bellecist theories is that number of states capable of sustaining themselves in interstate competition declined during periods associated with large-scale changes in the production of military violence. However, as with the trend in state size I find no evidence of a dramatic reduction in the number of states during the era associated with these changes. Figure 2 shows that instead of declining over time, the number of independent units *increased*, expanding

[4]Using a similar approach but examining only 1500 and 1998 Warren, Cederman and Schutte (N.d.) also find that in both years state sizes are distributed log-normally

[5]A Engle-Granger two step procedure indicates that the two series are cointegrated. Estimating the following relationship Mean_t - $\beta \cdot \text{Median}_t = \mu_t$ where β is estimated to be 1.04, a Dickey-Fuller test yields a test statistic of -3.69 allowing us with a high degree of confidence to reject the null hypothesis that μ_t is a non-stationary series.

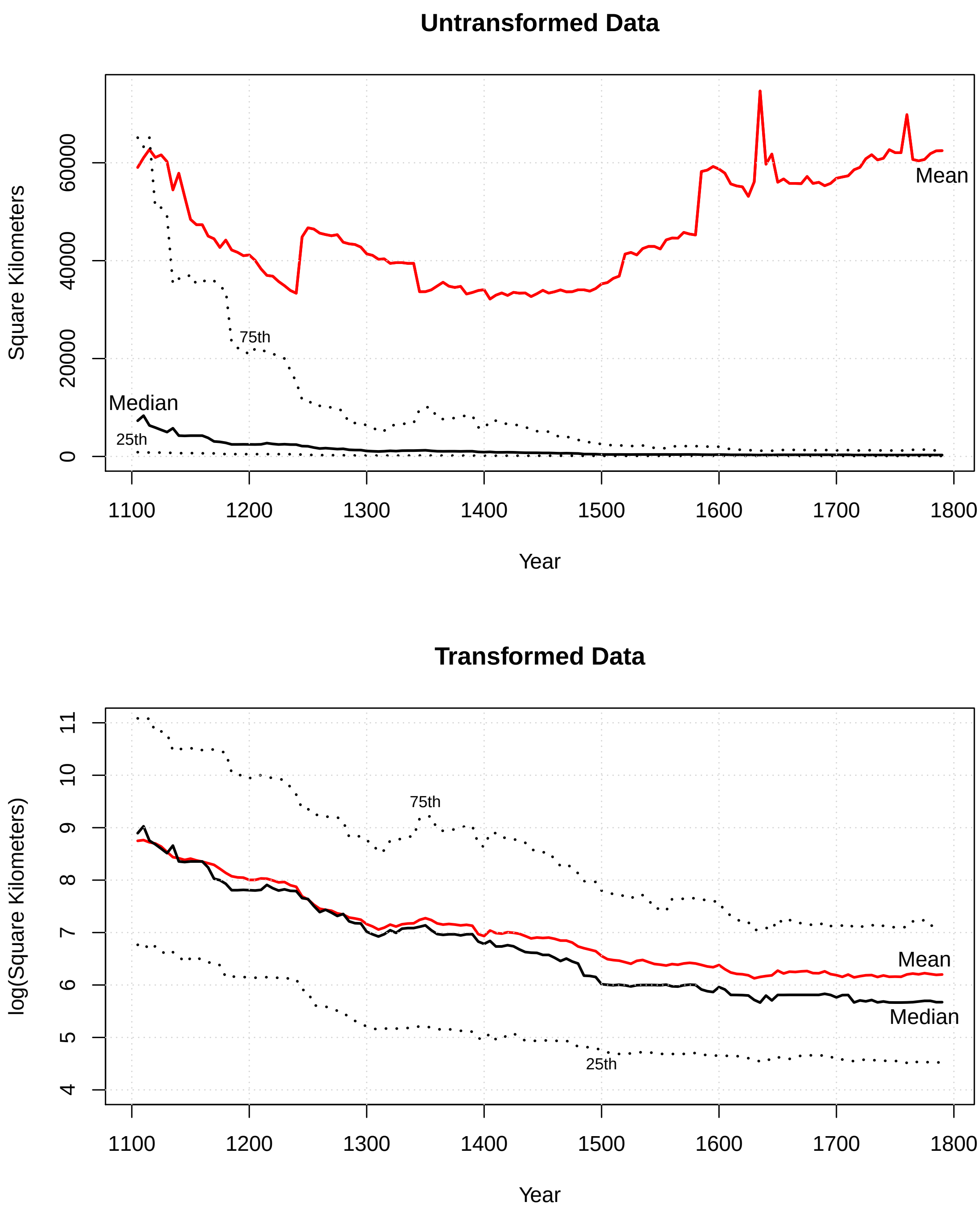

Figure 1: The Trend in State Size

Both panels present trends in state size across time. The top panel gives the untransformed data and the bottom panel presents the data log-transformed. The red line represents the mean value and the solid black line represents the median. The dashed lines represent the interquartile range. Note the remarkable symmetry around the median of the log-transformed data and the absence of such symmetry in the non-transformed data. Similarly note, tandem movement of the mean and median as one would expect from a normally distributed random variable.

rapidly between the twelfth and thirteenth centuries, peaking in the late fourteenth century, and declining slightly in the period after that.

Did this reduction from a late fourteenth century peak constitute a radical shift in the number of states within the European system? To better examine this question, I adopt the method proposed by Park (2010) to identify structural breaks in count processes like the number of states. This method classifies the set of time periods where the number of states can be described by a common data generating process. Moreover, it determines when changes in this process occur.[6] Implementing this procedure results in the choice of a single change-point dated at 1210. Figure 2 plots on the right hand axis the posterior probability of a change in regime, demonstrating the break at 1210. The mean of the first period is estimated to be 130.1 with a 95% credibility interval of $[124.3, 135.7]$ and the mean for the second period is estimated to be 227.8 with a 95% credibility interval of $[225.1, 230.7]$.

From this, two substantive conclusions can be drawn. First, the break identified in the early thirteenth century precedes by several centuries the events bellecist theories argue caused a fundamental change in the number of states. Second, the change proposed by this group does not materialize; the second regime identified by the model, that containing the entire period associated with the military revolution, has on average a greater number of states. In other words, during the period in which bellicist theories predict a decline in the number of states we see no dramatic change in the number of states.[7]

To summarize, although the bellicist literature describes a military revolution taking place at some point between 1450 and 1700, its predicted consequences fail to materialize when the data is examined systematically. During the period associated with large systemic changes in the production of violence two facts emerge: 1.) The typical state declined in size and 2.) The number of independent states saw no radical decline, though decreased slightly.

[6] A technical description of the method and estimation are included in the appendix.

[7] Stasavage (2012) looking at a subset of 168 city-states shows a similar pattern.

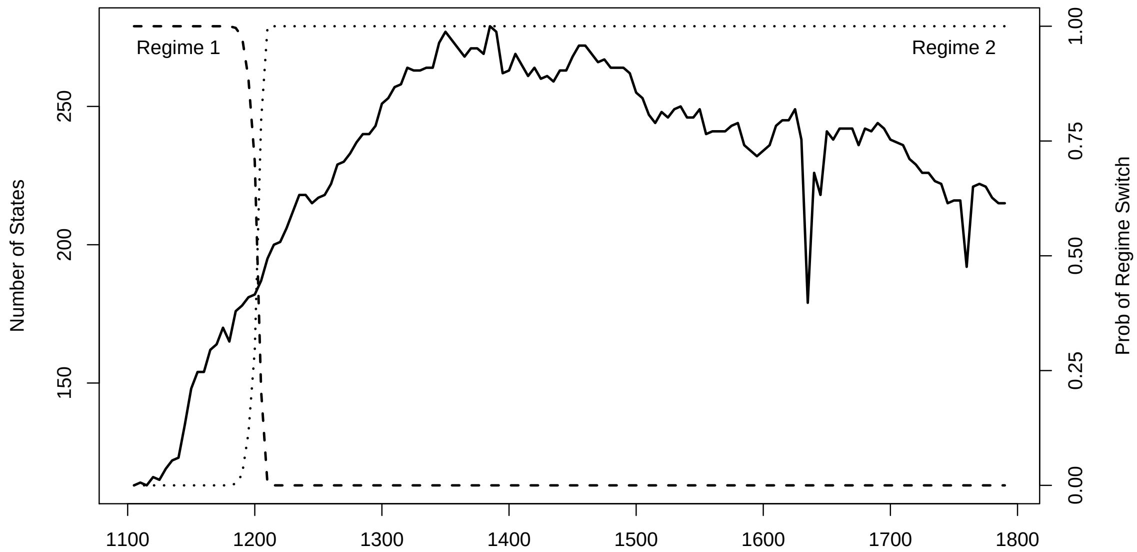

Figure 2: The Number of Independent European Statea

This figure plots the number of states across time. The sharp drop and recovery in this figure between 1620 and 1650 is the consequence of the Thirty-Years war. Similarly, the decline in 1760 is associated with the temporary decline in the number of units coded as independent because of the Seven Years war. The dashed lines represent the posterior probabilities of each interval falling within a given regime. Beginning with seven possible regimes, an optimal classification of two regimes, with a break at 1210 is chosen.

2.3 The Relationship Between Size and Survival

Thus far I have shown that in the period associated with the military revolution the number and size of states fail to change as hypothesized in war-making theories. The mechanisms proposed in these theories operate by altering the type of state capable of surviving in an anarchic international arena. That is, it is argued that the costs associated with mass armies consisting of professionally trained riflemen, the purchase of increasingly powerful cannons, and the development of defensive ramparts made small states unviable. This section provides two findings. First, over the entire time period of study small states were *more* likely to survive, the opposite of that hypothesized in bellicist theories. Second, I find that the relationship between geographic scale and the survival of states did not change across time. That is, the relationship between size and failure was the same before, after, and during the period associated with the military revolution.

Since the set of theories I am attempting to evaluate concern the capacity of states to survive I utilize duration analysis which requires a coding of state failure. I treat failure as any instance in which an existing state ceases to appear as an independent political unit according to my coding scheme. Thus, if a state is conquered it is treated as failing. If two states merge I treat the new state as either a new unit (and the pre-existing states as being censored) or if it is clear that one subsumed the other I treat the subsumed state as having failed. In the few cases where this is ambiguous I alternate codings and re-estimate the model with each possible alternative. The treatment of these ambiguous cases does not substantively change the results.

The relationship between the hazard rate (the instantaneous rate of failure) and the geographic size of states is estimated via a mixed effects Cox proportional hazards model of the basic form

$$\lambda_i(t) = \lambda_0(t) \times \exp(\delta_p \cdot \ln(\text{Size}_{it}) + \epsilon_i + \eta_v)$$

Time is described in three ways. First, t, indexes the time in years since a state came into existence. Second, v indexes chronological time, e.g. 1445 or 1750 and third, p captures a multi-year period in chronological time, e.g. 1450 to 1500.

The baseline hazard rate is captured by $\lambda_0(t)$. The relationship between size and the hazard rate is captured by the set of parameters $\delta_p = \mu + \gamma_p$ where it is assumes that γ_p - the period varying effect - is distributed $\mathcal{N} \sim (0, \sigma_\gamma^2)$ and where μ, captures the time invariant, mean, relationship between state size and failure. The magnitude of each γ_p signifies the deviation for each period p from the time invariant mean effect μ. I present results allowing the effect of state size to vary by 100 and 50 year intervals, respectively. Since the data includes repeated observations, that is, because some states fail and then reappear only to fail again, I follow convention and include a unit specific random "frailty" effect, ϵ_i. Similarly following convention, because failure times might be clustered by chronological time, I include a time random effect, η_v.

First I estimate the model without the time varying component and find that, in contrast to the conclusions of bellicist theories, there is a robust *negative* relationship between the probability of survival and the size of states. That is, I find that geographically large states are more likely to fail than their smaller counterparts. I then estimate the same model, allowing the effect of size to vary across period. The magnitude of these effects are roughly uniform across models. Figure 3 plots these coefficient estimates. In the left panel I plot μ, the parameter capturing the time invariant relationship between size and the hazard rate, which is positive and statistically significant in all specifications. To gauge the magnitude of this effect, I have plotted in Figure 4 survival curves from the most conservative model, manipulating state size from the first to the third quartile. A substantial difference is apparent. For example, having survived up to 100 years the probability of surviving in the next period is roughly one third less for the state at the seventy-fifth percentile of state size than the state at the twenty-fifth.

In order to examine the hypothesis that the relationship between size and failure changed during the period associated with the military revolution I compare the time varying effect of size γ_p across periods. Since each γ_p captures the period specific deviation from μ, if γ_p differs in a statistically significant way from zero we can say that for period p the relationship between geographic scale and survival differed from the average effect. Plotted in the right-hand panel of Figure 3 we see that this is not true for any time period; none of the time varying effects differ in a statistically significant way from zero and, moreover, I find no statistically significant difference *between any pair of time periods*.[8]

Matching the results from the previous section, I find no evidence in favor of the notion that the military revolution affected the size of states. The survival probability of small states was *greater* than that of large states. Moreover, the data find no evidence of a change in the relationship between geographic scale and failure during the expected period. Indeed, I find that the positive relationship between size and the failure rate of states did not change in a statistically significant way across time.

2.4 Case Selection and War Making Theories

The (mis)use of the untransformed, skewed data, to draw conclusions about broad patterns of state formation is mirrored in the case selection of historical scholarship relating war to patterns of state formation. That is, it is the history of these large states that proponents of war-making theories of the state build upon. For example, Roberts, a historian of Sweden, draws upon the Swedish experience in the Thirty-Years war to make conclusions about the effects of new infantry tactics

[8] Table 5 in the appendix presents the differences and measures of uncertainty for each pair of period varying parameters.

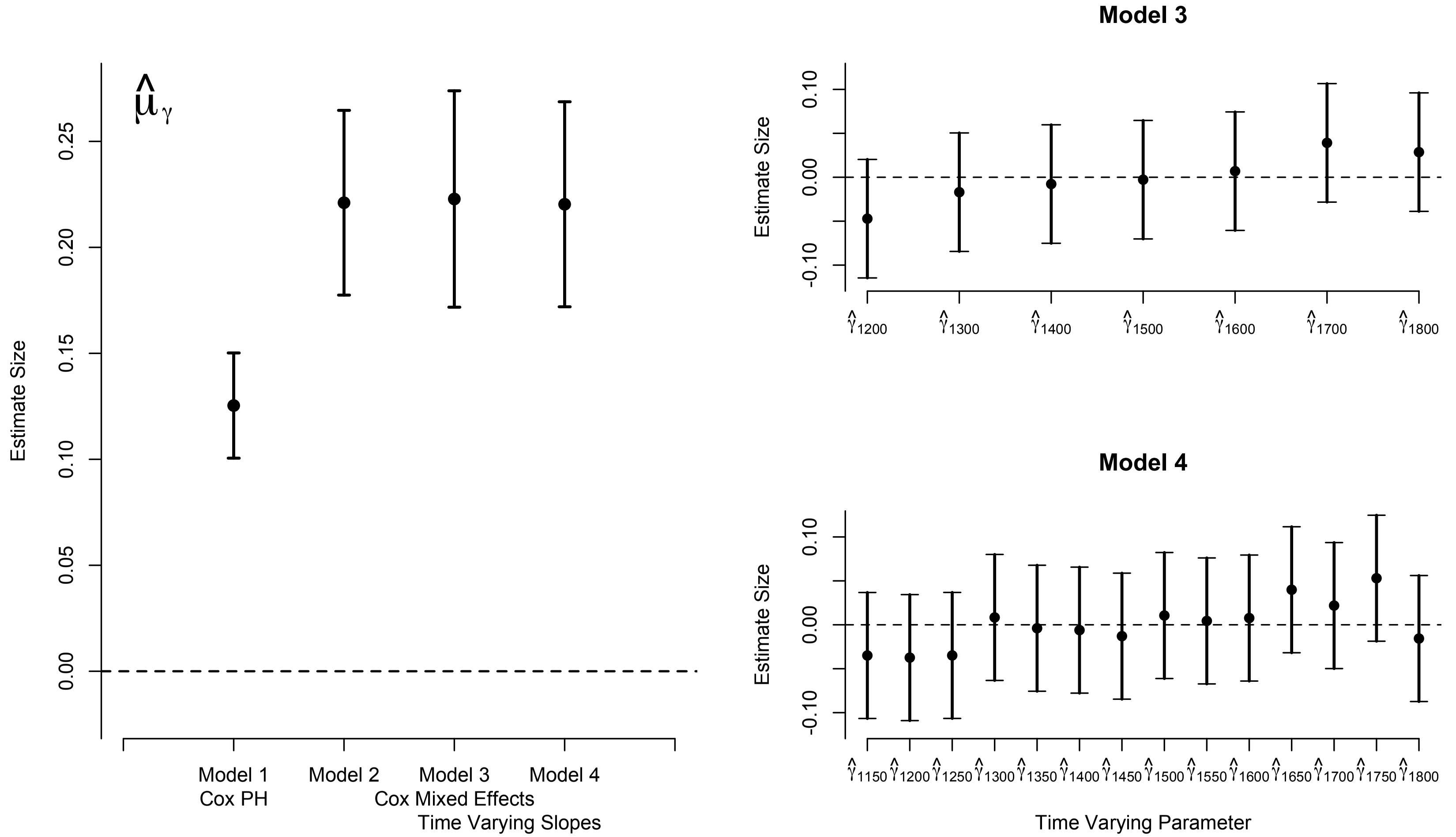

Figure 3: The left panel plots the parameter estimates of the time invariant relationship between size and the hazard. Models 1. and 2. do not include time varying estimates of this effect. Model 2. is a standard Cox-proportional hazards model and does not include any random effects. Models 3. and 4. include period varying effects of size. Model 3. allows the effect of size to vary by 100 year periods and Model 4. allows the effect of size to very by 50 year periods. These period varying effects, none of which are statistically distinguishable from zero, are plotted in the right panel

.

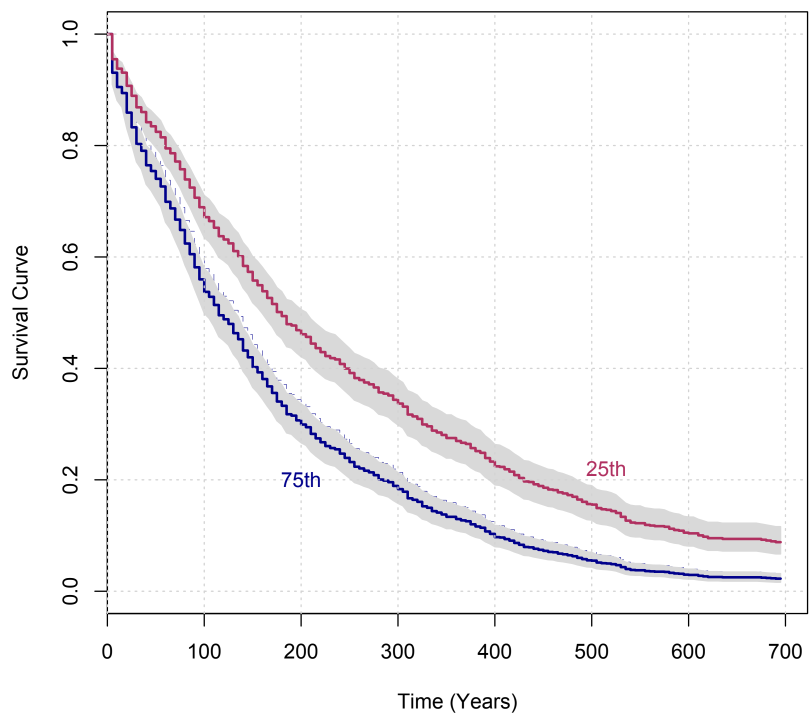

Figure 4: The estimated survival curves from Model 2 from a manipulation of logged size across its inter-quartile range. The top line represents the survival curve for a state at the 25th percentile of logged state size. The bottom line represents the same value for a state at the 75th percentile. The dashed lines represent 95% confidence intervals for the survival curve.

across Europe. Parker, a scholar of Early Modern Spain draws similar conclusions based upon his favored case. Indeed, the extreme cases, Russia, the Ottoman Empire, Sweden, Spain, France, and England are those scholarship has largely drawn upon to make inferences about general patterns of war and state formation.

Figure 5 presents the cases that five prominent historians have used to argue in favor of a military revolution, highlighting both their rank and size relative to the entire distribution of state sizes. Though not exhaustive, the list is reflective of the general empirical approach this vast historical literature has taken. The lower panel of Figure 5 describes the entire distribution of state sizes, plotting the rank of each state against its size in logged square kilometers at three points in time: 1400, 1650, and 1790; right before the military revolution, following the Thirty-Years war, and at the close of this study. We see that when selecting cases historical scholarship emphasizing the role of war has drawn from, almost exclusively, the extreme end of the distribution of state sizes.

Unlike the historical case studies that emphasize the role of war in determining processes of state formation, the empirical approach of proponents of economic theories does not exclusively rely upon the experiences of large outlying states. For example, Spruyt (1994*a*;*b*) in highlighting the experiences of the city-states comprising the Hanseatic League, finds in favor of economic causes. In taking a more quantitative approach Stasavage (2011*a*;*b*) stresses the advantage small states had in constructing financial instruments necessary to fund defense and therefore survival. Taking advantage of the full distribution of observed outcomes, in the next section I provide evidence in favor of economic theories.

3 Commerce and the Origins of the Modern State

The causal link between the revival of commerce and patterns of European state formation has been drawn by a number of scholars. Despite this, few systematic empirical tests of this relationship have been undertaken. This section briefly outlines the relevant literature tying the re-emergence of commerce and urban life to political fragmentation.

In an early incarnation, Stein Rokkan (Eisenstadt and Rokkan 1973, Rokkan 1975; 1980, Rokkan and Urwin 1982) argued that the existence of a "city belt"[9] running through central Europe was the crucial determinant explaining why the modern territorial state developed in places peripheral to this productive core. The existence of a large number of prosperous urban centers prevented the rulers of any one from consolidating rule over the others. In peripheral England and France, for example, the absence of many urban centers allowed monarchs, by force or diplomacy, to establish rule over expansive territories.

Spruyt (1994*b*) views the creation of new social groups as both an outcome of the revival of commerce and a catalyst for premodern innovation in the organization of the state. In those places where trade resumed new towns and cities formed as hubs of economic life, allowing a class of

[9]Rokkan at various times refers to the region I identify as the European core as the "trade belt," "middle belt," "city-studded centre," "city-state Europe," "heartland," and "dorsal spine"

The Rank and Size of Prominent Cases

Author	England	France	Holland	Prussia	Spain	Sweden
Bean	✓	✓				
Brewer	✓					
McNeil		✓	✓	✓	✓	
Parker		✓	✓		✓	
Roberts			✓			✓

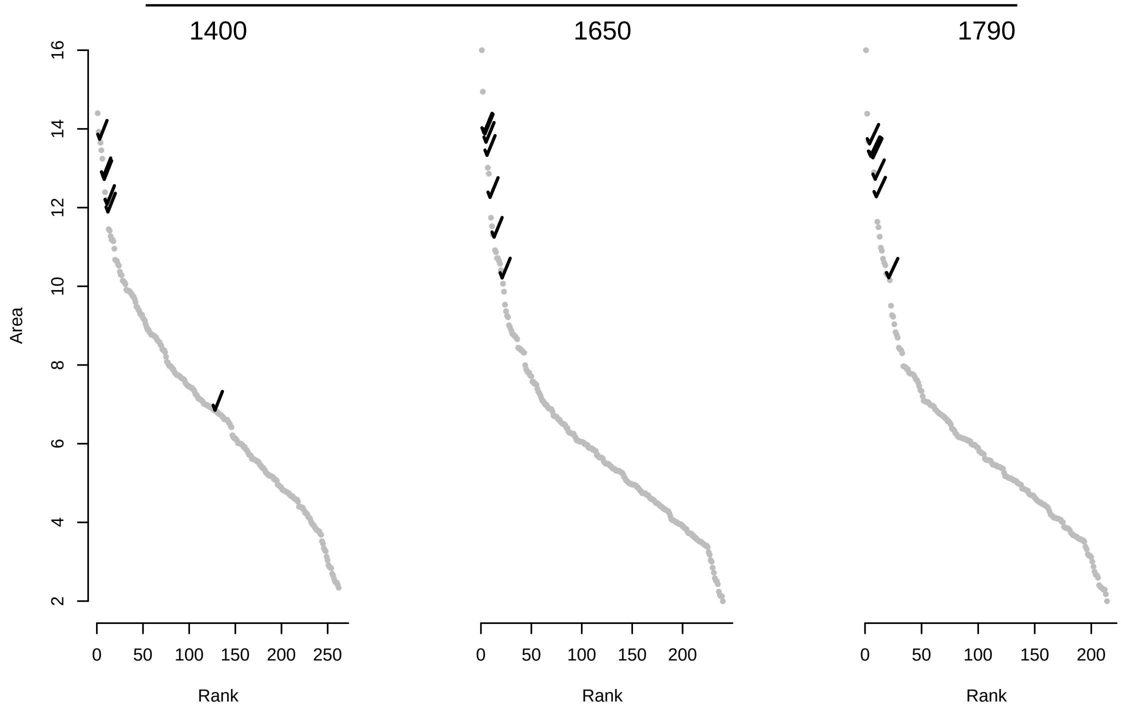

Figure 5: This table presents the main cases used by several prominent historians whose work describes the military revolution. The rank size of all states in 1400, 1650, and 1790 - before, during, and after, the period associated with the military revolution - are then plotted against the log of state size (measured in square kilometers). Those cases selected by the historians described in the top panel are highlighted.

burghers to establish effective independence. By virtue of these groups' economic power, monarchs, particularly the Holy Roman Emperor, were impeded in their attempts to create geographically large states and were forced into political bargains accepting the de facto independence of these states. Moreover, because of their wealth and ability to establish institutions like the *Hansa* capable of providing collective security these states could wield sufficient military force to not merely claim independence but to sustain it over time.

What is common amongst these economic theories is that changes in patterns of economic activity, principally those associated with changes in commerce and urban life altered the balance of political power, causing political fragmentation in the urban core of Europe. This section examines trends in the number and size of states at the regional level, providing evidence that only in the most productive places in Europe, a central regional band extending, roughly, in an arc from the Low Countries, through the Rhineland and into Northern Italy, could small political communities persist. That is, in the places where the "commercial revolution" of the first half of the previous millennium took hold political fragmentation ensued. However, in less productive regions, in the absence of dense urban and commerical growth, large territorial states formed.

As initial evidence Figure 6 plots both the trend in logged state size and number of states across time, first dividing the map into two broad regions: the urban European core, the area described above, and the remainder of the map, what I will call the periphery. In both regions the number of states is increasing before the early thirteenth century. After this period the upward trend in the number of states continues in Central Europe whereas in the periphery it plateaus and then begins to decline in the early fifteenth century. Similarly the average size is initially declining in both groups. However, in the periphery, beginning in the early sixteenth century, the average size starts to increase whereas it continues to decline in the center.[10]

These patterns coincide with the reemergence of trade and a general revival of commercial and urban life during the first third of the millennium. Like the regional pattern in the number and size of states these economic trends were not uniform across space but were geographically concentrated

[10]We can divide the continent into a number of more refined regions, however, the same pattern holds; fragmentation and decline in size concentrated within the productive core and consolidation and increased size following the fifeteenth century in all regions in the periphery

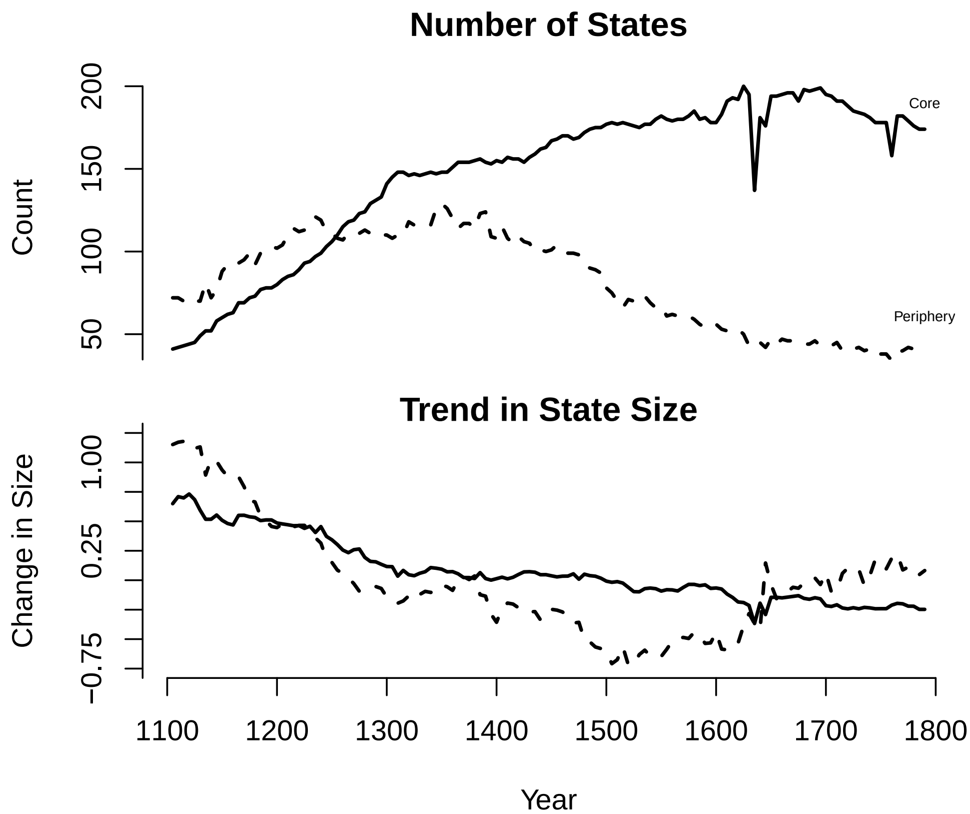

Figure 6: The average size and number of states separating out the urban European from the rest of the continent. In both plots the black line represents the core of Europe and the dashed line represents the periphery. The top panel plots against time the number of states in these two regions. The lower panel plots for each region the difference between the mean of log-transformed data in a given year and the mean for the entire (regional) series.

in a manner nearly identical to the patterns of state formation described above. The emergence of towns and cities - a product of the geographically concentrated revival of commerce and economic development - created groups in these places with the resources necessary to maintain or claim independence, thereby preventing the consolidation of territorial states.

3.1 Urban Growth and State Formation

This section directly estimates the causal relationship between development and state formation. As the unit of analysis I employ arbitrarily defined pieces of geography, 10,000 km^2 grid squares, and estimate the effect of changes in urban population on the number of states forming within the bounds of a given unit.[11] The data on urban population comes from the widely used data set of Bairoch, Batou and Pierre (1988) which describes the population sizes of the about 2,200 towns which ever had 5,000 or more inhabitants at some time between 800 and 1800.[12]

I estimate the following model:

$$\text{Number of States}_{it} = \alpha + \beta \cdot \log(\text{Urban Population}_{it}) + \epsilon_{it} \tag{1}$$

Where the parameter of interest β captures the effect of urban population on the number of states on a given grid-square. I estimate this relationship via pooled OLS and, since the number of entrants is by definition a non-negative integer, negative binomial regression. The results are summarized in Table 1. I estimate three models, the marginal effects of which are extremely close in size. For each model I successively add in year effects and, latitude and longitude as controls. The estimated effects of a one-hundred percent change in urban population range from 16% to 20%, a substantial effect when the differences between the maximum urban population in any given year range from forty-seven to sixty-six times the mean.

These results provide some initial evidence that the most urban quadrants were those that had the most states form on them. As a consequence, the average size of these states in these places was by definition smaller. Nevertheless, these results need not signify a causal relationship. That is, the assumptions necessary for the above regression analysis to consistently estimate β from Equation 1 are unlikely to be satisfied. The size of the urban population and the number of states that exist on a given piece of territory are likely driven by a number of common but unobservable confounders. Moreover, simultaneity bias

In order to show that the relationship between changes in patterns of urban development and state formation is causal, I take an instrumental variables approach, exploiting random climatic

[11] I have estimated all of the subsequent analysis using an alternative dependent variable, a Herfindahl like index of fragmentation, defined for each grid-square j as $H_j = \sum_i^N (\frac{\text{Area}_i}{\text{Area}_j})^2$. Where Area_i is the total area held by state i in grid-square j and Area_j is the total area in grid-square j. This measure is highly correlated with the number of entrants ($\rho = -.72$) and all of the results remain qualitatively the same if this measure is used.

[12] For a discussion on the use of urban growth as a good proxy for preindustrial economic activity see Acemoglu, Johnson and Robinson (2002), Chanda and Putterman (2007)

	Model 1		Model 2		Model 3	
	OLS	Neg Bin	OLS	Neg Bin	OLS	Neg Bin
log(Urban Population$_{it}$)	.16	.16	.17	.20	.16	.17
	[.14,.18]	[.09,.24]	[.15,.19]	[.05,.32]	[.14,.18]	[.05,.29]
Controls						
Year Effects			Yes		Yes	
Lat/Long					Yes	
R^2	.10		.11		.11	
ϕ		6.55		6.94		
N	9357		9357		9357	

Table 1: The marginal effect of a one-hundred percent change in urban population on the number of entrant states on a given grid-square. Ninety-five percent confidence intervals in brackets estimated from robust standard errors clustered by grid-square. The confidence interval for the negative binomial regressions are estimated via quasi-Bayesian simulation.

variation in the ability of arbitrary pieces of geography to support large urban populations. Using a set of paleoclimatological sources I construct an estimate of the propensity of land to feed large populations by growing cereals like wheat. I show that the ease with which some places could produce calorically dense and easily storable foods like wheat is a strong cause of urban population and, I argue has no direct effect on state formation processes. It follows that this measure is an ideal instrument, satisfying the necessary exclusion restriction needed to estimate causal effects.

3.2 Urban Growth and Agricultural Productivity

Cities as centers of economic specialization can only exist once populations are able to devote effort to activities other than subsistence. Places that could produce certain foods most easily were also those more likely to develop as urban centers. In pre-modern Europe these locations were those that could grow a specific set of crops that were superior to other alternatives in terms of their ability to support sizable populations over an extended period.

The sentiment that premodern urban life required an agricultural surplus to sustain itself is echoed throughout the literature on the commercial revolution and pre-modern city-growth. De Vries (1984) and Bairoch and Braider (1991) provide but two prominent examples of the view that increases in agricultural productivity were a necessary precondition for the growth of cities.

Nicholas (1997) is rather succinct in describing this logic.

> *Cities could not develop until the rural economic could feed a large number of people who, instead of growing their own food, compensated the farmer by reconsigning his products and later by manufacturing items that the more prosperous peasants desired. The 'takeoff' of the European economy in the central Middle Ages is closely linked to changes in the rural economy that created an agricultural surplus that could feed large cities* [p. 104]

To identify the causal effect of urban development on state formation in an instrumental variables framework I exploit random climactic variation in the ability of a given location to produce key agricultural outputs necessary to support large populations. The natural predisposition for some places to feed large groups has been directly related to the development of urban life and the revival of commerce by a number of economic historians. Pirenne (1969), for example, argues that the location of towns in premodern Europe was a function of natural geography, that "In a more advanced era, when better methods would permit man to conquer nature and to force his presence upon her despite handicaps of climate or soil, it would doubtless have been possible to build towns anywhere the spirit of enterprise and the quest of gain might suggest a site." This was, however, not the case. Rather, "...the first commercial groups were formed in neighborhoods which nature had disposed to become...the focal points of economic circulation."

I focus on the ability of some places to produce cereals like wheat and barley for two reasons. First, the European diet of the premodern era was centered around the consumption of complex carbohydrates derived from cereals. Economic historian Robert Lopez notes that "in the form of bread, porridge, or mush, cereals were almost everywhere the basis of human alimentation...(Lopez 1976)." Not only were cereals central to diets across European geography but across classes as well and were integral to the consumption of the aristocracy and peasantry alike although certainly in unequal proportions (Duby, Clarke and Becker 1974).

Second, the ability to grow cereals has been directly linked to the support of large populations. Cereals like wheat, unlike other plants, are most capable of feeding large populations with minimal effort; cereal crops, unlike fruits, pulses, or nuts, are extremely fast growing, high in calories from carbohydrates, and have extremely high yields per hectacre (Diamond 1997). Moreover, unlike other crops cereals can be stored for long periods of time enabling communities to smooth consumption over extended periods. To summarize, the ability to feed large populations was key to the development of cities. Since in pre-modern Europe the principle component of diets were cereals like wheat, foods that are particularly good at supporting large populations, climatic variation across time and space in the ability to grow these crops serves as a good encouragement for urban growth.

The instrument is constructed in two steps:

1. I take spatially referenced temperature data from two paleo-climatological sources, both measured at half-degree by half-degree latitude/longitude intervals. The first measure from Mann et al. (2009) records temperature anomalies for the past 1500 years. A temperature anomoly captures the deviation at each point from the 1961-2000 mean temperature. I then construct a measure of absolute temperature by adding back the 1961-2000 baseline mean temperature as calculated from Jones et al. (1999)'s twentieth century data. This yields a half degree by half degree grid of temperatures for every year over the past 1500 years. Hundred year averages of these yearly measures are then taken.

2. Next, using tension weighted splines I take these estimates, measured at fixed intervals, and construct a smoothed measure of temperature for the entire continent. From this continuous measure the average for each grid-square is taken yielding an estimate of temperature across our fixed but arbitrary pieces of geography. All of these operations are taken using the interpolation and zonal averaging tools found in ArcGIS 10.

To show that the logic of the instrument holds, I use twentieth century data on temperature and two measures of the ability to grow wheat to demonstrate the robust relationship between the two. I employ two data sets from the FAO. The first, the "Agro-climatically attainable yield for rain fed wheat," is from the Global Agro-ecological Assessment for Agriculture in the 21st century. It captures the ability of land to produce wheat absent of modern irrigation techniques. I estimate the optimal climate to grow wheat (at around 10.5 degrees Celsius). A clear a parabolic relationship

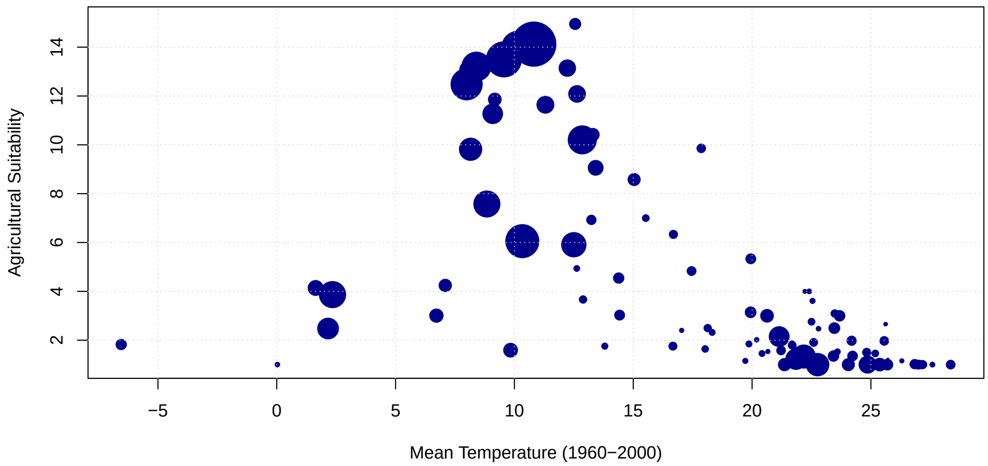

Figure 7: The FAO wheat suitability index is plotted on the y-axis against average annual temperature on the x-axis. The FAO measure is the "Agro-climatically attainable yield for rain fed wheat" is from the Global Agro-ecological Assessment for Agriculture in the 21st century. It captures the ability of land to produce wheat absent of modern irrigation techniques. A clear parabolic relationship with a peak at approximately 10.5 degrees Celsius is observed. The radius of each circle is proportional to the average wheat yield between 1960 and 2000

between temperature and this FAO measure is observed simply by plotting it against average annual temperature between 1960 and 2000.

Regressing the FAO measure of wheat suitability on the absolute deviation from 10.5 degrees we see that, indeed there is a negative relationship between the two. The results from this regression are summarized in first column of Table 2. The effect of a one degree deviation from the optimal temperature is substantial, decreasing the FAO measure by .61 units. This is a particularly large effect since the FAO measure is on a fourteen point scale. Moreover, an large amount of the variation in the FAO wheat suitability measure is explained by deviation from this optimal growing temperature, the R^2 statistic is calculated to be .55. In addition, regressing average annual wheat yields between 1960 and 1990 on deviation from the optimal growing temperature again shows a similarly robust relationship. A one degree deviation from the optimal temperature has a large effect on average annual wheat yields – approximately 1600 hectograms per hectare.

Variable	FAO Wheat Suitability	Avg Wheat Yield
Intercept	9.89	36901
	(.49)	(2659)
Growth Temperature	-.61	-1612.7
	(.05)	(254)
R Squared	.55	.30
N	119	94

Table 2: The relationship between temperature and the suitability to produce wheat. The first column regresses the FAO wheat suitability index against the absolute average distance from 10.5 degrees Celsius between 1960 and 2000. The second column regresses the average wheat yield on this measure.

3.3 The Validity of the Instrument

In order to consistently estimate β, the parameter describing the relationship between urban population and the number of states forming on a given piece of territory, in an instrumental variables framework several assumptions must be satisfied. The first assumption, random assignment, is likely satisfied since until the 19th century there has been little to no human effect on climate, the changes to which have been determined by naturally occurring phenomena in ways unrelated to our independent variable of interest, urban population. The second assumption that the instrument is strong is also satisfied. In each of the first-stage regressions all tests against weak instrumentation meet conventional levels of statistical significance.

The last assumption, the exclusion restriction, is also likely satisfied. For this to be violated the instrument, deviation from the optimal growing temperature for cereals like wheat, would have to affect the number of states entering on given quadrant in some way other than through my measure of economic development, urban population. It seems unlikely that changes in this measure of climate will effect the choice to form a new state or for states to fail other than through their effect on economic incentives as proxied by urban development.

To see this we can broadly divide the constraints facing statemakers into two components. The first are the costs of statehood. Substantively these can be taken to mean the size of militaries and bureaucracies necessary to maintain statehood. Shocks to the propensity for a given piece of geography to support urban populations should have no direct effect on this particular incentive to form or dissolve as an independent state. The instrument perturbs the major component of the second constraint, the economic surplus available for latent or existing states to claim, here measured by urban population. The question then becomes do changes in this measure of temperature affect economic incentives not captured by changes in urban population?

Here, we must recognize two facts about the preindustrial economy. First is transportation costs were extremely high such that long distance trade was concentrated in luxury goods (Findlay and O'Rourke 2007). As such, markets for agricultural products were for much of this period local.[13] Second, the market for surplus agricultural product was concentrated in towns and cities. That is, those who specialized in non-agricultural sectors - located in towns - exchanged their goods for the surplus agricultural product produced in the hinterland. Because of the limited ability to trade these goods across extreme distances, changes in the productivity of agriculture affect these local markets either by shifting labor from the countryside to towns or by allowing a greater number individuals to specialize in non-agricultural activity, both of which result in a greater number of people living in towns and cities. Since my measure of urban population includes towns as small as 1,000 individuals, we should pick up these dynamics.

Moreover, since the changes in optimal growing temperature over a hundred year panel are extremely slow, the long term tend in which would be very difficult to perceive at any given point in time in an era before meteorological data was systematically collected. Because of this these changes would only effect the economic incentive to form states through their long term effects - the ability to sustain large populations.

[13]Whyte (1979), for example, argues that in early-modern Scotland there existed a limit of 22 kilometers inland from the coast or major rivers beyond which the cost of overland transport prohibited large-scale trade in grains. Others similarly view the creation of national and international markets for agricultural products like grain as being relatively late phenomena. Gras (1915), for example, famously argued that before the seventeenth century England consisted of at least fifteen distinct agricultural markets. Econometric evidence finds support for this claim. For England Bowden (1990) shows a process of declining wheat price differentials between the late fifteenth century and mid eighteenth century. Using a similar methodology, Weir (N.d.) finds that by the mid eighteenth century France consisted of several distinct markets for grain. With perhaps the best sub-national data, Gibson and Smout (2008) similarly show that a national market for oatmeal emerged in Scotland slowly between 1660 and 1780, with much of the convergence in prices across space occurring after 1750. The evidence concerning international trade in agricultural products is even more stark. In a number of recent econometric studies little or no apparent market integration in the form of diminished price differentials can be found throughout the early modern age. See, evidence from all of Europe see Unger (1999), Allen (2001),Özmucur, Pamuk and Center (2007) ,and Bateman (2011) the latter of which exploits the most comprehensive dataset on wheat prices in terms of geographic and temporal coverage. Inter-regional evidence, for example that provided by Allen and Unger (1990) and Unger (1999) arrives at a similar conclusion of geographically disjoint markets for grains.

Nevertheless, in case the growing climate for wheat has some direct effect on urban population I attempt to control for alternative channels through which the optimal growing temperature might effect state formation. I control for the ways in which climate, other than though the deviation from this optimal temperature for cereals, might effect the number of states on a given square. I do this in two ways. The first is by controlling for both latitude and longitude. Since climate is strongly correlated with geographic location, controlling for the position in space should similarly control for the effects of climate other than through the optimal growing temperature.

By including grid square fixed effects we get similar results. Here identification comes from within unit variation, deviation from the mean of the unit's distance from the optimal growth temperature for cereals. In this sense we are again controlling for long term climatic conditions and identification is only coming from the random changes from this long-term value. A Hausman test fails to reject the null hypothesis that the 2SLS fixed effects parameter estimates are different from the pooled 2SLS estimates, indicating that controlling for latitude and longitude accounts for all time invariant aspects of climate. Similarly, I estimate the same instrumental variables model in first differences, where identification is coming exclusively from century-on-century changes in the propensity to support urban populations. The results are similar though less precisely estimated. Moreover, although the results are nearly identical, in the first-differenced 2SLS estimates the instrument fails to meet "rule of thumb" levels of strength (Stock and Yogo 2005).[14]

3.4 Instrumental Variables Results

The instrumental variables estimates of β, interpreted as the effect of a 100 % change in urban population on the number of states forming on an arbitrary piece of land, are shown in Table 3. The effect sizes are rather large, a one hundred percent increase in total urban population on a given grid-square is expected to increase the number of states locating within that same unit by

[14]One might worry about violations of exclusion that operate through the spatial correlation of the dependent variable. That is, the instrument may be correlated across space and consequently its effects on the number of states in one quadrant might directly effect those in another other. To account for this possibility I have estimated all of the 2SLS models in an FGLS framework to account for arbitrary serial correlation across observations. The results remain nearly identical. Additionally, I conduct a Lagrange multiplier test for error dependence in the possible presence of a missing spatially lagged dependent variable. In the specifications that rely upon within-unit variation I find no evidence of a missing spatial lag. However, in the pooled estimates I cannot reject the possibility.

Instrumental Variables Estimates

	(1.)		(2.)		(3.)		(4.)	(5.)	(6.)
Model:	2SLS	IV Neg Binomial	2SLS	IV Neg Binomial	2SLS	IV Neg Binomial	2SLS	2SLS	2SLS-FD
log(Urbanization$_{it}$)	.37	.15	.36	.16	.67	.24	.79	.58	.88
	[.31,.41]	[.14,.17]	[.31,.42]	[.14,.17]	[.39,.97]	[.14,.35]	[.40,1.19]	[.15,1.01]	[-.05,1.82]
Controls									
Year Effects			Yes	Yes	Yes	Yes			
Lat/Long					Yes	Yes			
Fixed Effects							Yes	Yes	
Entrants$_{t-1}$								Yes	
First Stage Regressions									
$\lvert \text{Temp}_{it} - 10.5 \rvert$	-.26		-.27		-.09		.40	.23	-.14
	[-.29,-.24]		[-.29,-.24]		[-.14,-.06]		[.24,.58]	[.08,.38]	[-.29 , .00]
F statistic for Excluded Instruments	338		352		22		22	9.7	3.8
R^2	.70		.71		.77		.002	.003	.003
N	1684		1684		1684		1684	1684	1684
T	7		7		7		7	6	6

Table 3: 2SLS and IV Poisson parameter estimates of the effect of urban population on the number of states existing on a given $10{,}000^2$ km piece of geography. Controls for latitude and longitude, year effects, and fixed effects, are continued in both the first and second stage regressions. 95% confidence intervals estimated from robust standard errors clustered by grid-square are in brackets.

between just under four and just over eight tenths of a new state depending upon specification. Again, this is a rather large effect size as the inequality between geographic units is quite large. Taking the smallest 2SLS estimated effect size, .37, it would only take slightly more than a two and a half fold increase in the total urban population to increase the number of states on a given unit by one.

The estimates in which identification is coming off of changes in optimal growing temperature after accounting for other possible climatic channels, those controlling for latitude and longitude as well as for unit specific heterogeneity (Models 3 through 6) are slightly larger, ranging from .67 to .88. Of these, the fixed effects (Models 4 & 5) and first-differencing (Model 6) estimates have a ready interpretation. Because they are identified off of within unit changes, they tell us how the number of states on a given geographic unit changes over time with changes in urban population. As an additional specification Model 5 includes the lag of the number of states. Again instrumenting for the urban population, the effect is roughly similar. Controlling for the number of states in a territory during the last century, a one-hundred percent change in the urban population still causes .58 of a new state to form on the same piece of geography in the next century.

Interpreted this way these results provide an explanation for why the central European core became simultaneously more urbanized and politically fragmented. Distance from this central corridor is highly predictive of the size of the urban population living within the bounds of a given geographic unit. For example, in 1800 at a distance of 2000 kilometers away from the central core a given unit is expected to have an urban population of approximately seven thousand. In the same year, a unit directly on the line connecting Northern Italy and Holland, the urban population is expected to be more than ten times this amount.[15] Making use of the lowest estimated effect of urban population on the number of states existing within a given unit, the grid square directly on this central band is expected to have two and a half more states on it than the quadrant 2,000 kilometres away. Using the largest estimated effect this difference doubles, with five more states expected to be found in the centrally located quadrant. To visually demonstrate the geographic distribution of political fragmentation as a function of urban population, Figure 8 plots the predicted

[15]These estimates are derived from a regression of urban population on the fourth order polynomial of distance from the line connecting Amsterdam and Milan.

values derived from the same model across space.

4 The Interactive Effect of War and Economic Change

The temporal and geographic patterns thus far demonstrated can be read in a slightly more nuanced manner suggestive of an interactive relationship between economic and military factors determining the size of states. Although the central urban band became increasingly fragmented, the geographically concentrated trend towards small and more numerous states was greatest in the period before 1500 - the era before the military revolution, indicating an interactive relationship between the costs of statehood and the size of the economic surplus available for states to expropriate.

One can think of this interaction in the following way. Latent political groups, those who might plausibly seek to form their own state, are constrained not only by the economic resources at their disposal but also by the costs of setting up and maintaining independent states. When both the costs of statehood are low and the resources available to meet them are high, the pace of political fragmentation should be at its greatest; a larger number of possible states will be able obtain a positive payoff from claiming and maintaining independence. When a large economic surplus exists, if the costs of statehood are sufficiently high we should expect comparatively fewer states to form than when the costs are low. In other words, we should expect the effect of changes economic incentives to vary with respect to the costs of producing violence.

The historical record provides ample evidence of this interactive effect of war making and changes is economic development. The period of rapid urban growth associated with the commercial revolution was also a period of marked decline in the relative costs of waging war. The gradual replacement of armies comprised of heavily armored feudal shock-calvary with those made up of infantry supported by relatively few horsemen effectively drew down the costs of producing military force for the urban groups who at this very point in time were gaining the economic capacity to support these new forms of military organization.

The combined introduction of the high saddle, stirrup, and horseshoe in the Carolingian period allowed knightly armies to dominate the production of violence through much of the Middle Ages. These heavily armored calvary could at a fast gallup decimate infantry formations and served as the

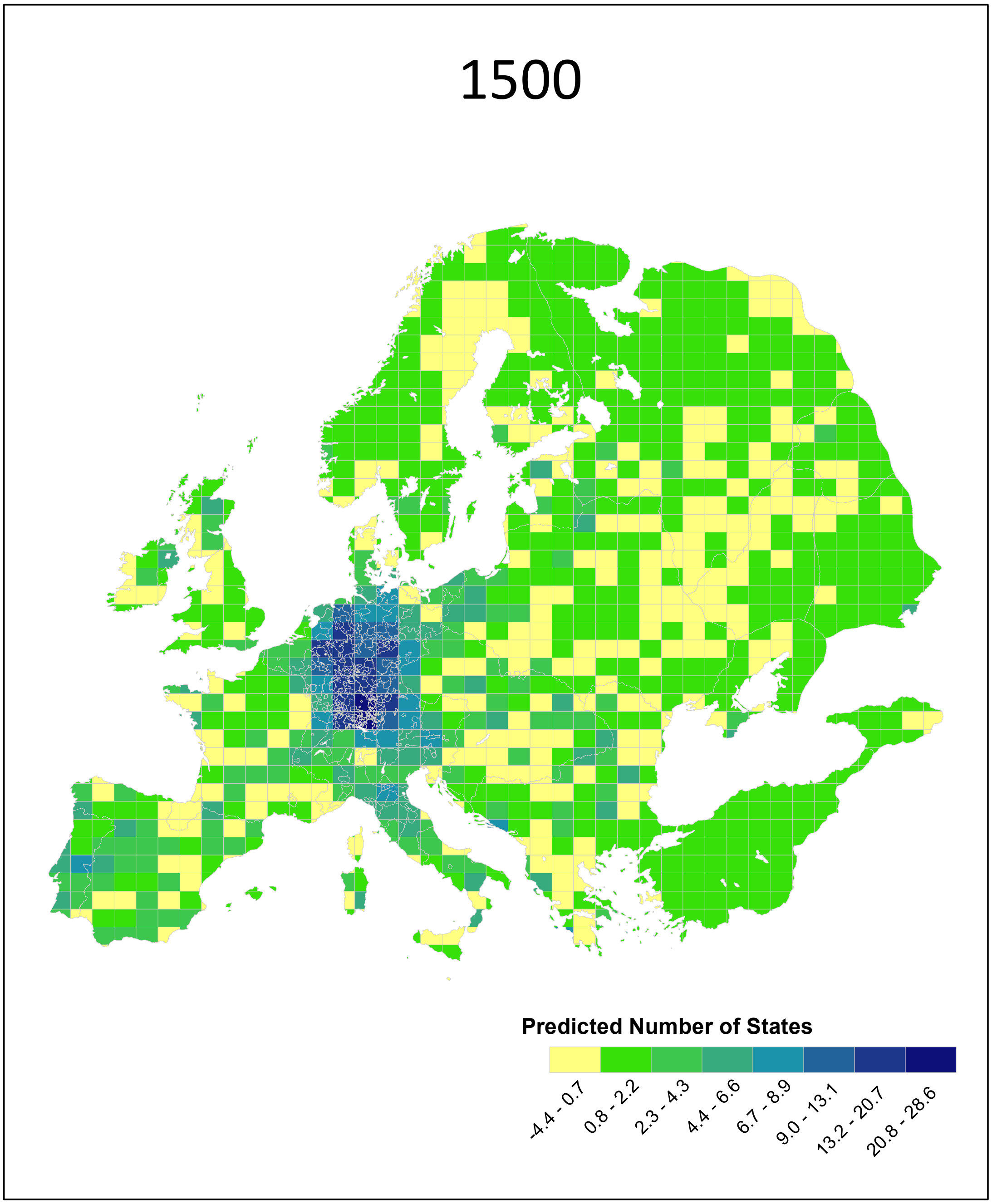

Figure 8: **The Fragmentation of Central Europe:** The expected number of states in the year 1500 as derived from the 2SLS estimate of Model 4 in Table 3. plotted across space. Darker colors denote a greater number of predicted states for a given piece of geography, lighter colors represent fewer predicted states.

vast preponderance of mediaeval militaries (Oman 1885, Verbruggen 1997). However, armies of this sort were extremely costly to maintain. Parker (1988, p. 69-70), for example, estimates the cost of a war-horse capable of carrying a knight in full armor to be between six and twenty-six months of his wages and, moreover, notes that a knight would need between three and five mounts per year. Rogers (1993), in turn, estimates the cost of a fully equipped knight to be ten year's wages for a common foot archer. The costs of knighthood and the lack of a commercialized economy led to the development of large feudal states wherein a hierarchy of vassalage, the exchange of manorial revenue directly for military service, weakly bound polities together (Bloch 2002).

Beginning in the late twelfth and early thirteenth centuries the near invincibility of armored calvary on the battlefield was curtailed by a series of tactical and technological innovations. The development of massed pike infantry that could withstand the charge of mounted calvary and technological innovations like the cross-bow favored infantry over expensive mounted soldiers (Contamine and Jones 1984, Rogers 1993). Indeed, a clear trend between 1100 an 1300 toward infantry based armies is apparent. Though in the eleventh century the vast majority of men at arms were knights supported by relatively few infantry, by the mid thirteenth century this ratio had flipped. For example, the Lombard army raised in 1231 to counter Fredrick II's imperializing efforts was comprised of 3,000 horsemen, 10,000 infantry with pike, and 1,500 crossbowmen (Contamine and Jones 1984; p. 72). As early as 1302, when at Courtai the communal pikemen of Flanders decisively defeated a French army consisting of mostly heavy calvary, a clear ability of infantry based armies to defeat feudal calvary was apparent (Verbruggen 1997; p. 166-173).

These changes lowered the relative costs of producing force directly; a crossbowman, for example, was approximately one-fortieth as expensive as a knight (Rogers 1993). The trend towards infantry lowered the costs of producing force in additional indirect ways; whereas knights required training beginning at a very young age removing an entire class of individuals from productive activity all together, a commune could with only semi-regular drilling could maintain an effective force of pikemen. Both of these effects advantaged urban groups. First, densely urban places were those where sufficiently large groups of men could organize and train - even if only sporadically- as infantry (Contamine and Jones 1984, Verbruggen 1997; p. 84, 62). Second, because urban groups were wealthier they held direct material advantages over their rural counterparts, allowing them a superior capacity to purchase the means of coercion. Indeed, rural states like Poland and Russia were extremely resistant to modernizing their militaries and remained oriented towards heavy calvary until the seventeenth century, in part because they lacked the commercial resources to adapt to the changing technologies of war (Parker 1996; p. 37).

To briefly summarize, in the period before the introduction of gunpowder, there was a decline in the costs of producing violence concurrent with an increase in the economic capacity of urban places to purchase the means of coercion. The empirical implication of this is a larger effect of urban population in the period before the military revolution. To examine this interactive hypothesis I consider the changing effect of urban population across time, showing that in periods associated with high costs of statehood the effect of urban population on state formation was less than in periods when the costs were low.

To begin, I divide the data into two periods. The first, up to and including 1500, captures the period of low costs of statehood, before the military revolution, and the second, after 1500, contains the period associated with the military revolution and high costs of statehood. The results from this exercise are presented in panel A. of Table 4. We see that, as expected, across specifications the magnitude of the effect in the period associated with high costs of statehood is less than that in the period associated with low costs. Moreover, based upon a generalized Hausman test, we see that the parameter estimates on the log of urban population from each pair of models are statistically different from each-other.

To further show how the effect of urban population changes across time I estimate the following model:

$$\text{Number of States}_{it} = \alpha + \beta \cdot \log(\text{Urban Population}_{it}) + \sum_{t=1200}^{T=1700} \gamma_t \cdot T_t \times \log(\text{Urban Population}_{it}) + \eta_t + \epsilon_{it} \tag{2}$$

Where T_i is a century indicator, η_t the century effect, and ϵ_{it} a disturbance term. The total effect of logged urban population in a given century is given by $\beta + \gamma_t$. These estimated total effects along with their ninety-five percent confidence intervals are presented in the lower panel of

A.) Instrumental Variables Results

	(1.)		(2.)		(3.)	
	Pre 1500	Post 1500	Pre 1500	Post 1500	Pre 1500	Post 1500
log(Urban Population)$_{it}$	.65	.16	1.21	.35	.57	-.05
	[.56,.73]	[.12,.20]	[.51,1.90]	[.19,.50]	[.14,1.00]	[-.10,.003]
Generalized Hausman Test:	(417.14)		(2.358)		(5.83)	
F statistic for Excluded Instruments	226	436	10.4	30.5	10.0	45.7
Controls						
Lat/Long			Yes	Yes		
Year Effects			Yes	Yes		
Fixed Effects					Yes	Yes
N = 1684, T = 4/3						

B.) Total Effect of Urban Population by Year

log(Urban)$_{1200}$	log(Urban)$_{1300}$	log(Urban)$_{1400}$	log(Urban)$_{1500}$	log(Urban)$_{1600}$	log(Urban)$_{1700}$	log(Urban)$_{1800}$
1.10	.62	.72	.43	.22	.16	.11
[.88, 1.33]	[.54,.70]	[.61, .83]	[.36,.49]	[.17, .28]	[.12,.21]	[.8,.15]
N=1684, T=7	Angrist-Pischke multivariate F test of excluded instruments: 507. 5					

Table 4: Panel A. shows the effect of urban population on the number of states forming on a 10,000 square kilometer grid, dividing the data by time period. The first period includes all years before and including fifteen-hundred. The second includes all years after fifteen-hundred. Panel B. shows the estimated total effect of urban population as it varies by year. The estimates are derived from the estimation of Equation 2. Ninety-five percent confidence intervals calculated from heteroskedasticity robust standard errors clustered by grid-square in brackets.

Table 4. Again, we see that there is a general decline across time in the effect of urban population on the number of states forming, indicating that in periods of high costs of statehood, e.g. those associated with large standing armies and expensive state apparatuses, the effect of urban growth is attenuated. However, one should be cautious in interpreting these results as there are a number of possible alternative explanations for a declining effect of urban population across time. Still, these results suggest an interactive effect between urban growth and the military costs associated with the formation of new states.

5 Conclusion

Did war make states? This paper provides evidence that if it did, it did so conditionally. Rather, I have shown that the revival of urban life in the early half of the last millennium caused the emergence and allowed for the persistence of small political communities. In the absence of urban revival large, territorial, states emerged.

In emphasizing the importance of economic change in the development of the territorial state my findings run counter to much of the existing literature which in contrast places substantial theoretical weight on changes in patterns of war and war-making. The specific effects attributed to the military revolution, a series of historical shocks to the production of violence believed to have selected large states against their smaller counterparts, do not appear when the entire distribution of cases is considered. Still, the European system of states we observe today is characterized, almost exclusively, by large territorial states. Was this too an outcome determined by purely economic or military causes? In the quarter century separating the French Revolution and the Congress of Vienna, Europe's political geography underwent a dramatic and rapid alteration that is without historical parallel. Between 1790 and 1816 hundreds of independent units were consolidated into but a handful of comparatively large states. The reasons for this are both numerous and statistically difficult to distinguish from each other.

The most basic enumeration of the causes of this rapid consolidation of states, beginning with the most immediate catalysts, includes both the pressing concern of the victorious parties to maintain a balance of power against future French ambitions as well as the preceding administrative reforms of the Napoleonic conquest. Less proximate causes would have to include the drivers of French ambition in the first place, any list of which would highlight the development of operative nationalisms, a feature of politics that has had profound effects on the construction of new states. Moreover, we still must consider the macro-historical forces highlighted throughout this piece; patterns of war-making and patterns of economic development.

Complicating matters of inference, at the exact point in time that the number of European states declined from over two hundred to under fifty the world underwent simultaneous and sharp breaks in the production of both economic output and large scale violence - the industrial revolution and the creation of the conscript mass army. Not only were the effects of these macro-factors observationally concurrent but they are clearly interrelated. The ability to feed, clothe, and transport armies in the millions could only be achieved in the industrial era. Moreover, the consequences of these changes are manifest in the immediate catalysts of consolidation. For example, both have been directly linked to the creation of national identities.

Disentangling this complicated web of interacting causal processes is a substantial undertaking left for future scholarship. Still, we can still learn much from the history of preindustrial Europe. In addition to serving as a template for understanding current processes of state formation in places that have yet to escape their Malthusian shackles, the preindustrial European political-economy can provide a point of juxtaposition for differences in patterns of political development in those places whose histories are dissimilar to Europe's. Beyond this, by understanding how varying economic trajectories have influenced past patterns of political fragmentation we can gain a better intuition for Europe's future in the wake of divergent growth. Secessionist movements in Catalonia and Scotland, in addition to the ultimate success of the supranational European Union, are certainly a function of latent political groups' independent economic capacity.

Appendix

The Log-Normality of State Size

To gauge the appropriateness of this distributional assumption I plot the true sample quantiles of the log-transformed data against quantiles from a hypothetical normally distributed random variable with the same mean and variance as the observed data. If state size were normally distributed we would expect the sample quantiles to be on the line $y = x$. Figure 9 gives these Quantile-Quantile (QQ) plots of both the untransformed state size in the upper panel and the log-transformed QQ plot in the lower panel. As expected when we take the log-transformed state size the QQ plots rest almost perfectly on the 45 degree line, a good indication that the data is, indeed, lognormal.

One might consider another transformation of the data designed to preserve rank, properly weight outlying cases, and create an approximately normal distribution, the Box-Cox power-transformation (Box and Cox 1964). This transformation is as follows:

$$y_i^{(\lambda)} = \begin{cases} \frac{y_i^{\lambda}-1}{\lambda} & \text{if } \lambda \neq 0 \\ \log(y_i) & \text{if } \lambda = 0. \end{cases} \tag{3}$$

Using the data pooled across all time periods I estimate λ to be -0.099, very close to a value of zero. This provides some suggestive evidence that a log normal transformation is appropriate. None of the substantive empirical conclusions drawn from this chapter are altered if I utilize a Box-Cox instead of the logarithmic transformation.

Change Point Method

To assess how the processes driving the number of states changed over time I adopt the method proposed by Park (2010) to identify structural breaks in count processes like the number of states, treating the number of states as coming from a number of possibly distinct Poisson processes and then identifying the point in time where the data generating process transitions from one state to another. Following Frühwirth-Schnatter and Wagner (2006) Park transforms a Poisson process into a linear regression model with a log Exponential (1) error distribution by exploiting the assumption that the time between successive events is independent and follows an exponential distribution. Taking the logarithm of interarrival times, they link the length of time between the $j-1$th event and the jth event within time interval t, τ_{tj} as follows:

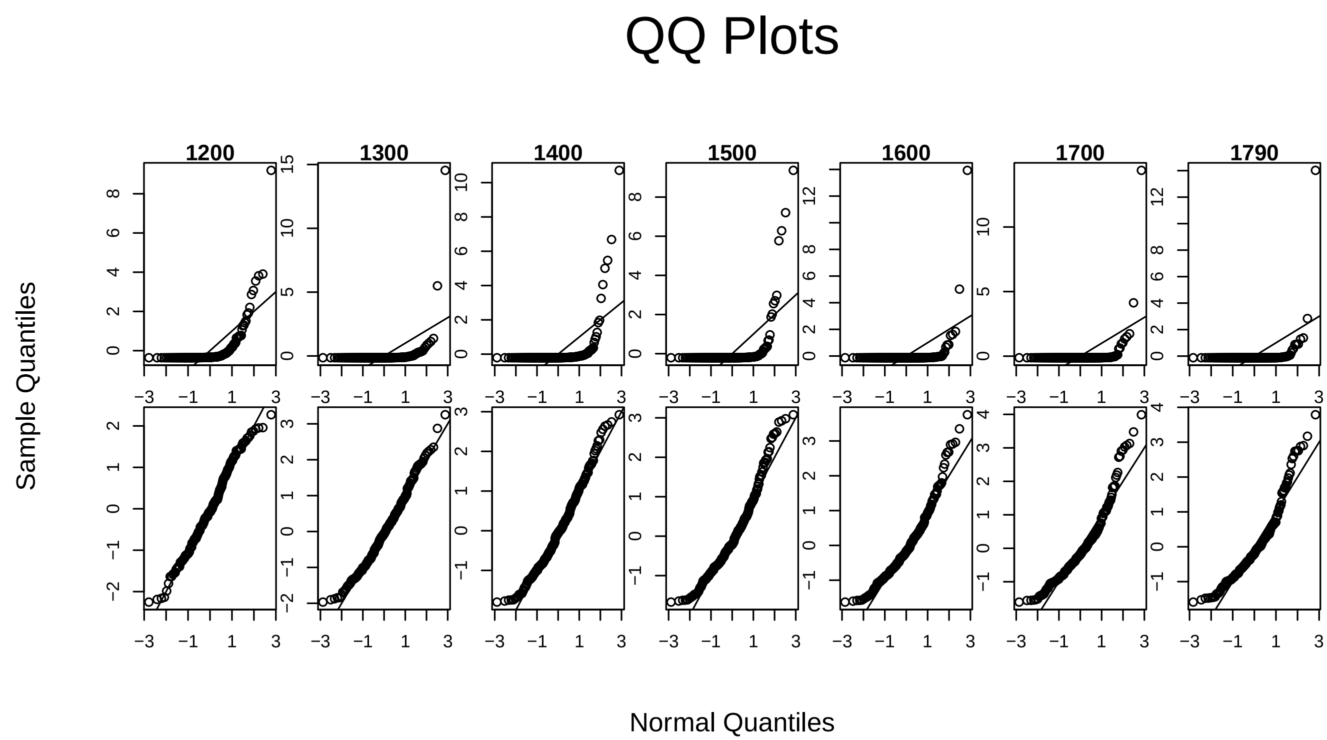

Figure 9: The top row plots for the untransformed data theoretical normal quantiles on the x axis against the sample quantiles on the y. The bottom row plots the same but for the log transformed data. Note that the transformed data sits nearly perfectly on the line $x = y$ whereas the untransformed data does not.

$$p(y_t|\lambda_t) = e^{-\lambda_t}\lambda_t^{y_t}$$
$$\tau_{tj} \sim \mathcal{E}xp(\lambda_t) = \frac{\mathcal{E}xp(1)}{\lambda_t}$$
$$\log \tau_{tj} = \mu_m + \varepsilon_{tj}, \varepsilon_{tj} \sim \log(\mathcal{E}xp(1))$$

Where $\mathcal{E}xp()$ is the Exponential distribution and μ_m the regression parameter characterizing the hidden state m at time t. Using the approximation of the log Exponential(1) distribution proposed by Kim, Shephard and Chib (1998) and Chib (1998) 's method to identify changepoints Park's procedure can recover point estimates and credibility intervals for μ_m in each state as well as the transition matrix

$$\begin{pmatrix} p_{11} & p_{12} & 0 & ... & 0 \\ 0 & p_{22} & p_{23} & ... & 0 \\ & & & .... & \\ 0 & 0 & 0 & p_{m-1,m-1} & p_{m-1,m} \\ 0 & 0 & ... & 0 & 1 \end{pmatrix}$$

Where the probability of switching to regime j from state i is defined as $p_{ij} = P(m_{t+1} = j|m_t = i)$ and regime transitions are constrained to only temporally forward switches.

I begin with an arbitrary large number of possible changepoints - seven in this instance - and use the Bayes factor selection criteria outlined by Chib (1995) and Park (2010; 2012) to choose the correct number of breaks. For each of the seven models I adopt uninformative Beta priors on the location of each changepoint reflecting an equal duration of each regime given the number of states in the model. So, since we have 139 observations for the one changepoint case I adopt $\mathcal{B}eta \sim (6.95, 0.1)$, for the two changepoint case $\mathcal{B}eta \sim (4.33, 0.1)$, and so forth. For the Poisson parameter I choose gamma priors: $\lambda_t \sim \mathcal{G}amma(1, 1)$ and in the appendix provide a number of sensitivity tests to show all of the results are insensitive to the choice of priors. In each model MCMC chains are run 100,000 times after discarding the first 100,000 runs.

The Time Invariant Effect of State Size on Failure

	γ_{1100}	γ_{1200}	γ_{1300}	γ_{1400}	γ_{1500}	γ_{1600}	γ_{1700}
γ_{1100}	0.00	.	.	.	.	.	.
	(0.00)	.	.	.	.	.	.
γ_{1200}	0.04	0.00	.	.	.	.	.
	(1.05)	(0.00)	.	.	.	.	.
γ_{1300}	0.05	0.01	0.00	.	.	.	.
	(1.27)	(0.22)	(0.00)	.	.	.	.
γ_{1400}	0.05	0.01	0.00	0.00	.	.	.
	(1.29)	(0.24)	(0.02)	(0.00)	.	.	.
γ_{1500}	0.06	0.02	0.01	0.01	0.00	.	.
	(1.46)	(0.41)	(0.19)	(0.17)	(0.00)	.	.
γ_{1600}	0.07	0.03	0.02	0.02	0.01	0.00	.
	(1.78)	(0.74)	(0.52)	(0.50)	(0.33)	(0.00)	.
γ_{1700}	0.05	0.01	0.00	0.00	-0.01	-0.02	0.00
	(1.26)	(0.22)	(0.00)	(-0.02)	(-0.19)	(-0.52)	(0.00)

Table 5: The difference between each of the time varying parameters. Z statistic in parentheses. A Bonferrini correction for multiple comparisons confirms that none of the differences achieve standard levels of statistical significance.

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