State and Development: A Historical Study of Europe from 1 AD to 2000 AD*

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Abstract

State presence and longevity have long been associated with growth and development, and yet analyzing their relationship remains challenging as both the length of state rule and geographical boundaries change over time. After addressing conceptual and practical concerns on its construction, we present a measure of the mean duration of state rule that is aimed at resolving some of these issues. We then present our findings on the relationship between our measure and local development, drawing from observations in Europe spanning from 1 AD to 2000 AD. We find that during this period, the mean duration of state rule and the local income level have a nonlinear, inverse U-shaped relationship, controlling for historical, geographic and socio-economic factors. Regions that have historically experienced short or long duration of state rule on average lag behind in their local wealth today, while those that have experienced medium-duration state rule on average fare better.

Keywords: Development, Economic Output, Sovereign Turnovers

JEL Codes: O10, O47, O52

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1 Introduction

Does state presence determine local development? If so, how do state changes influence outcomes? While state longevity is conducive to political stability and thus to growth, longevity can also cause rent-seeking interests to accrue over time and thus lead to economic stagnation (Olson 1982). In this paper, we attempt to adjudicate between these two opposing perspectives by constructing suitable measures of state presence over space and time. We discuss various issues involved in this endeavor and present our results that focus on Europe from 1 AD to 2000 AD. Over this time period, we calculate the mean duration of state rule for identically sized grid-cells that cover the continent. While the relationship between the state variables and economic development can be studied in detail for any given region or a period, a large-N case study over extended time can help us to understand the general pattern of such changes. We pursue our inquiry using data from Europe, since it is the region on which there is foremost a large body of existing literature. The rise of the West in particular has been attributed to many different factors, and we test these competing explanations to examine whether our measure of state duration remains closely related to income levels after controlling for them. To our knowledge, this is the first such attempt at a systematic empirical analysis on the relationship between state duration, turnovers and development. [1]

Estimating sovereign state presence and changes over time faces several challenges. First, because these states' borders have not remained constant over the centuries, it is inappropriate to view them as they are today. Many sovereign states ceased to exist, while others were founded in their place, but with different borders, and the newly drawn borders inevitably encroached upon neighboring states. In order to minimize this issue and expand the number

[1] The topic of state changes and economic development in more contemporary time periods however has been studied extensively. See for example Alesina et al. (1996)'s work on political instability and Durham (1999) on regime types and economic growth using more recent panel data.

of observations in Europe, we construct identically sized grid-cells for our analysis.

This is done by first creating a rectangle covering Europe and surrounding bodies of water, and dividing it into small rectangles. Next, we identify the number of centuries of state presence (out of 20 centuries in total), as well as the number of unique sovereign states that ruled over each grid-cell from 1 AD up to 2000 AD in one-century-intervals (from 1 to a maximum of 21). Based on the total number of different sovereign states that ruled over the area, we then derive the mean duration of state rule, conditional on the centuries of state presence. For our outcome variable we also calculate the natural logarithm of present-day GDP per capita for each grid-cell (a more detailed description of this approach is discussed in sections two and three). Our state variable is intended to capture both the variation in different states' rule and the length of state presence. The unit of our observation makes it possible to observe the changes in state rule and presence at the local level, and to move beyond the context of ruler turnovers under fixed regimes and geographical borders.

With the construction of these variables, we find a non-linear relationship between the mean duration of state rule and the current local income level over the two millennia in Europe. Regions at both ends of the spectrum show lower incomes relative to the ones in the middle range during this time period. That is, we find an inverse U-shaped relationship between the mean duration of state rule and their income levels today. The number of centuries of state presence tells us the extent to which the region was under the rule of a state. The mean duration of state rule is weighted by the number of unique states present in the grid-cell, such that other factors held equal, a higher number of states decreases the measure. We find that regions with either short or extremely long mean duration of state rule, conditional on state presence, fall behind those that had experienced rule by states with relatively modest duration.

In order to address potential problems arising from omitted factors influencing both the mean duration of state rule and the economy, we introduce the following set of controls.

First, we include geographic variables such as elevation and agricultural suitability, as well as the distance to water and agricultural adoption date. These variables collectively measure the level of natural resources that certain regions were endowed with, and the timing of agricultural transition in particular explains the timing of state formation prior to 1 AD (Borcan, Olsson, and Putterman 2015). Here we posit that natural resources have always changed states over time through predation and innovations, while continuing to determine the income level today. Second, we include the region's distance to the nearest cities over the time, in order to control for cities that played central roles in historical development as well as the economy today. We include grid coordinates (the longitude and latitude, and their product), as one may argue that the core of Europe likely experienced more turnovers than the peripheries. We also include modern country fixed effects (based on the year 2000), to control for any unobservables that vary across current state borders.[2]

In our robustness section, we first test whether the significance of the mean state duration coefficient estimate remains robust to the inclusion of the state presence variable, which has been discussed as a main driver for long term growth (Bockstette, Chanda, and Putterman 2002; Borcan, Olsson, and Putterman 2015). We also control for the presence of empires in our main results, and include various regional dummies and existence of capital cities across different specifications. We find that the non-linear relationship remains strong, independent of how long a region has been under state rule. Next, we control for different types of local institutions, as well as conditions under which turnovers took place. There were different types of local institutions that likely influenced the extent of the sovereign states's rule over them, and determined the long-term outcomes of the region in each grid-cell. Furthermore,

[2]Yet another potential concern is reverse-causality, in which less economic development leads to civil unrest and revolts overthrowing state regimes, thereby increasing the number of turnovers. We are less concerned by this issue, given that our turnover variable is a cumulative count of state changes over the past 2000 years from 1 AD to 2000 AD, while our outcome variable is the local income level in 2010. The level of historical development is also accounted for by both the distance to cities and geographic factors included in our analysis.

changes in rule may have occurred violently with destruction of capital, which likely had differential consequences compared to less traumatic transitions. Using Bosker, Buringh, and Zanden (2013) and Dincecco and Onorato (2017)'s data, we look at whether there existed an active parliament in a city for each grid cell, as well as whether there was any physical plunder, siege or battle. Including these additional controls does not alter our main findings.

In order to check whether our results are robust to measurement errors, we next present additional findings under different measures of mean duration of state rule and GDP per capita. These include calculating the mean state duration using the number of state turnovers (rather than the number of unique states), and period discount rate. We also present models adjusting for potential spatial autocorrelation and find that our result remains robust.

Finally, given that our analysis is potentially sensitive to the length and the choice of time period, we present findings from running the analysis across different cutoff periods in the following discussion section. Looking beyond the most recent five centuries of nation-building and conceptualization of modern Weberian statehood, we find that the inverse U-shaped curve emerges and remains consistent throughout longer time periods going back to 1 AD.

The rest of this paper proceeds as follows. Section two discusses the importance of state presence and changes in development as discussed in the literature. Section three presents the data sources, construction of our main variable, the mean duration of state rule, and other control variables. Section four lists the estimation equation, and Section five discusses the main findings of the paper where we present evidence of the negative and nonlinear relationship. In Section six, we present various alternative explanations and measures and show the robustness of our results. Section seven discusses the results from different time spans, and section eight concludes with a discussion on related topics for future research.

2 Sovereign State Presence and Changes

Much of the growth literature has largely focused on the proximate effects of development like physical and human capital, and technological advancement (Solow 1956; Lucas 1988; Grossman and Helpman 1991; Romer 1990), while other works have examined the effects of geography, institutions, culture and luck on economic development (Sachs, Mellinger, and Gallup 2001; Sachs 2001; Acemoglu, Johnson, and Robinson. 2001; Weber 2008; Easterly et al. 1993; Becker et al. 2016). Existing studies have also regarded nations' size and number as outcomes of tradeoffs between the benefit of size and costs of heterogeneity (Stasavage 2010; Alesina and Spolaore 1997). The literature on the effects of state presence and changes as determinants of development, aside from these other factors, draws from the seminal work of Bockstette et al. (2003), which show a significant and positive relationship between state history and the current income level. Extensions of the original data used in Bockstette, Chanda, and Putterman (2002) appear in other studies including Ang (2013) and Ahlerup and Olsson (2012). More recently, Borcan, Olsson, and Putterman (2015)'s work on state antiquity and productivity extend the antiquity data from Bockstette, Chanda, and Putterman (2002) to 3500 BC when the first recorded statehood appears in history. Stasavage (2014) also presents a set of opposing arguments on the effect of state longevity similar to ours to motivate his research on the economic stagnation and survival of city-states in Europe.[3]

In our paper, we emphasize the importance of both state presence and changes by making three related points. First, the presence of sovereign states is critical for development; Bockstette, Chanda, and Putterman (2002) used presence and duration of experience with macro polities as proxies for societal complexity and technological advancement, explaining the long term divergence in income levels. State presence can then be construed as reflecting the rule-making capability crucial for facilitating transactions, protecting private property

[3]While similar in the emerging empirical pattern, this paper focuses on both the effect of multiple turnovers and state presence, rather than the duration of autonomy, on economic development.

and reducing uncertainty.

Of specific interest here are institutions that a sovereign ruler can put in place that give incentives to different domestic groups to advance their interests.[4] For example, the Romans made significant investments in the creation of labor and financial markets, and allowed business to flourish through trade with other parts of the empire (Temin 2006). This allowed Roman merchants to thrive and improve the economy for the whole empire. The main goal of such institutions is to improve cooperation among different economic units by improving information flow, resolving collective action problems, lowering transaction costs, sanctioning members and improving state capacity in general (Besley and Persson 2009; Jones 1988; Fearon and Laitin 1996; Knack and Keefer 1995). These institutions hence offer the necessary certainty for these economic agents to engage in productive activities, and the stability of such institutions, provided by the sovereign state, is a necessary condition for economic development.

Second, these rules or institutions initially put in place by the sovereign state by themselves may not sustain economic growth in the long run when they become resistant to changes (North and Thomas 1973; Olson 1982). Lagerlof (2016) for example presents an institutional mechanism in which autocracies invest in extractive capacity and become more resistant to democracy, while Hariri (2012) presents similar arguments in the case of former colonies. The longer an institution persists in a society, the more a particular group of economic actors become beholden to that institution. Such special interest groups contribute to institutional stagnation that could, in turn, result in lowering economic growth over time (Coates, Heckelman, and Wilson 2010; Coates, Heckelman, and Wilson 2011; Horgos and Zimmermann 2009). So even if a particular institution is inefficient, the beneficiaries of such an institution will resist any change to make the rules more efficient (North 1971). The

[4]Despite these benefits, there have been numerous non-rule-of-law states historically. Hoff and Stiglitz (2008) explains the phenomenon as a result of coordination failure where a commitment to forgive thefts is not credible, thereby hindering transition.

institution then remains inefficient and yet persists over time, leading to stagnation. This situation has been identified as a commitment problem, where groups that will benefit from an institutional change cannot credibly commit to compensate the existing beneficiaries for their loss (Acemoglu and Robinson 2000). Related to this point, Borcan, Olsson, and Putterman (2015) show that old states indeed suffer from excessive centralized power, and lag behind productivity relative to those with shorter state history. That is, older states, despite established bureaucratic infrastructure, have propensity to be autocratic under instability and over-extract taxes at the expense of economic growth (Olson 1993). The authors however also point to the importance of state experience; young states suffer from weak fiscal capacity (Tilly 1992; Collier 2009), which in turn leads to lower economic prosperity (Besley and Persson 2013; Dincecco and Katz forthcoming). The two opposing effects lead to a negative U-shaped relationship between state history and development.

Third, while there are potential drawbacks from old institutions as laid out above, too many state turnovers may also have significant negative impact on growth and development. On the one hand, institutional modifications impact local economic development through increases in state capacity, wealth and redistribution, even when such changes are violent and destructive (Dincecco and Katz forthcoming; Stasavage and Scheve 2012; Tilly 1992). These changes may also mean the creation of institutions in regions with no prior state foundation, or new institutions replacing old and inefficient ones, varying by natural surroundings and exogenous shocks (Acemoglu, Johnson, and Robinson 2005). These findings are not based on multitudes of state turnovers, however. Rather, a period of instability is often followed by establishment of stronger institutions, and the transition is complete after few turnovers. After the initial benefit of state changes, the detrimental effect of instability from multiple turnovers may be compounded. Weak states, their demise and subsequent takeovers lead to instability.[5]. In the presence of frequent conflict, rulers have little incentive to invest in

[5]Blaydes and Chaney (2013) find for example that their mean ruler duration measure is negatively

state-building, and strong states fail to emerge (Cox, North, and Weingast 2015). Finally, it is also well established that political instability is harmful for development (Alesina and Perotti 1996; Barro 1996). These findings together suggest that while incipient turnovers may benefit subsequent development, frequent turnovers may have the opposite effect.

3 Data Sources & Description

In constructing our mean duration of state rule variable and other controls, we use two main data sources in this paper: (1) Euratlas, which provides historical maps of Europe, and (2) Eurostat, which provides GDP data for the entire continent.[6] The historical maps from Euratlas contain geographic boundaries of all political entities in Europe for every 100 years starting from the year 1 AD until 2000 AD. These maps provide us with information on the sovereign entity that ruled a given region of Europe at the turn of the century over the past 2000 years. While the time span that we look at are limited by the absence of similar maps in earlier periods, the existing maps are particularly useful since the maps allow us to track political changes for a particular region over time. By overlaying these maps, we can obtain a list of the different sovereign entities that governed a given area.[7] As an example, consider different parts of present-day Germany; many sovereign entities have ruled parts of these areas, and major ones include the Kingdom of Austrasia, Saxony, Bavaria, Kingdom of the East Franks, Kingdom of the Holy Roman Empire, Brandenburg, Bohemia, Prussia, Hanover, the German Empire and the Federal Republic of Germany. Such a listing of sovereign rulers allows us to count the number of centuries for which each region

correlated with the likelihood of a ruler being deposed; in our paper we look at the mean state duration instead, which can be similarly interpreted as as measure of state stability.

[6]The Euratlas data is available at `http://www.euratlas.com/index.html` and the Eurostat data is available at `http://ec.europa.eu/eurostat`, both accessed 30 September 2015.

[7]One may also argue that the states preceding 1 AD may not be as relevant, as their state capacity was arguably limited and their influence on the present outcome should be discounted in time; we discuss these matter more in detail below.

was occupied by a state, but also identify to unique sovereign states that occupied these areas.

Figure 1 presents the overlap of the political boundaries for the entire continent using all 21 Euratlas maps. Europe provides an apt case study for us, since there were extended periods of fragmentation of former empires but also consolidation of nation states.[8]

[Figure 1 about here.]

In order to identify what we mean by sovereign states, we first require a working definition. Since the study covers 1 AD to 2000 AD, our definition of 'sovereignty' should be one that is consistent over this time period. Admittedly this task is difficult, because the concept of sovereignty likely has changed, and there have been both institutional and jurisdictional fragmentation of states in European history (Epstein 2000; Brewer 1989; Drelichman and Voth 2014). The goal of our paper is not to define a new, encompassing terminology that satisfies all the different definitions of sovereignty over different regions and time periods. That said, it is possible to identify sovereign states in Europe as long as we are consistent in the manner through which we single out such entities. In this paper, we identify a sovereign state as an independent entity that possesses four features as outlined in Euratlas (`http://www.euratlas.net/`): (1) a territory delimited by borders, (2) a population, (3) an authority exercising the effective public power on population and territory, (4) supremacy, that is with capacity to control absolutely the territory and the population.[9]

Both big empires and small city-states (the Roman Empire and Venice, for example) are classified as sovereign states in Euratlas, since they satisfy all of the said criteria. On the other hand, Euratlas inevitably excludes some entities that could be described as independent polities but did not satisfy one or more of these criteria. For example, it describes

[8] According to Euratlas, between 1 and 2000 AD, the number of sovereign states in existence in Europe reaches its peak of 158 by 1300 AD, and then decreases with centuries of state consolidation afterwards.

[9] Further information on the definition of sovereign states is available at `http://www.euratlas.net/history/europe/explanation.html`, accessed 19 August 2015.

some of the excluded entities as autonomous peoples: generally nomadic, semi-nomadic or not well-known populations without evident central authority. This approach necessarily limits the number of entities in consideration, especially in the early periods. Nevertheless, we only focus on the sovereign states as defined above, because our main interest lies on the effect of changes in both defined territorial borders and central authorities that have become fundamental to the modern states today. There are clear advantages when identifying sovereign states in this manner. First, the definition can be consistently applied over the last twenty centuries. Second, this conception of a sovereign state is different and more general from the other similar terms such as 'regime' that are used primarily to distinguish between democracies and autocracies (Przeworski et al. 2000; Jong-A-Pin and Haan 2011). Our use of the term 'sovereign state' and 'sovereign entity' (used interchangeably in this paper) is preferred, because we cover a vast time span (1 AD-2000 AD) where typologies such as democracy and autocracy are less relevant especially in the early centuries. Lastly, it is consistent with our empirical data source, ensuring that our theoretical conception of a 'sovereign state' matches the empirical strategy in this paper.[10]

Given this definition of a sovereign state, a change in sovereignty of a particular region refers primarily to a change in the authority that governs the region and its population. Nussli (2011) defines the succession of states by turnovers as described in national textbooks which the author has gathered for each country in Europe. The French source, for example, treats modern-day France as being the same continuous entity from the Carolingian empire

[10]Other categories of states including what some may consider to be semi-independent are addressed on case-by-case basis. For example, Cologne officially became a free imperial city from 1475 until the French occupation of 1794 and is thus considered a sovereign state in 1500 AD, although the real legal status of the imperial cities was unclear before the 16th century. Venice was an administrative unit of the (Eastern) Roman Empire from its foundation until about 810 AD. Some historians consider Venice as a semi-independent state from about AD 715 which remained semi-independent until 1060-1090 AD over the war between Constantinople and Normans. Euratlas considers the city state to be fully sovereign in the 1100 to 1700 AD period. Finally, Milan was a city of the Lombard Kingdom and then of the Empire of the Romans (known later as the Holy Roman Empire) until the wars of the Lombard League. After the 13th century, Milan became a sovereign state but sometimes semi-independent until the Spanish conquest in the 15th century. Euratlas codes Milan as a sovereign state in 1300 and 1400 AD.

and Capetian kingdom, successors of the ancient Franks, with the exception of a period of domination by the Roman Empire, identified as a supra-state empire with a separate identity from France.[11] Typically dynastic changes or ruler turnovers are not considered as state turnovers in the data; we therefore focus predominantly on conquests that involve domination by foreign entities. According to this approach, mergers and turnovers following implosion of a state would also not be considered state turnovers, so long as the region retains a common entity as listed in Nussli (2011)'s references.[12]

Combining state presence and turnovers, we construct our measure of mean duration of state rule as follows:

$$MeanStateDuration_i = \frac{1}{\#States_i} \frac{\#Centuries\ of\ Rule_i}{20\ Centuries} \tag{1}$$

where subscript i refers to gridcell i, *#States* refers to the number of unique sovereign states that ruled over the gridcell from 1 AD to 2000 AD, and *#Centuries of Rule* refers to the number of centuries (out of a total of 20) for which the grid-cell witnessed state rule. The above formula gives a composite measure of mean duration of state rule, capturing both the number of states the ruled over the region over different time periods, as well as the number of centuries of state presence within the twenty-one century time frame in our data. One could interpret the measure as a proxy for state stability, similar to Blaydes and Chaney (2013))'s ruler duration.[13] The difference however is that our measure captures

[11] See Duby (2013). One may argue that given the nature of political fragmentation in European history, both within and across states, this specification of historical statehood undercuts the argument that internal fragmentation blocked historical France's economic development as a whole. We acknowledge the importance of internal fragmentation and look at city-level institutions (see the robustness section), but accept Nussli's classification of sovereign entities as systematic and consistently applied to all entities in the dataset.

[12] Although some of these dynastic changes are certainly considered pivotal in the region's subsequent development trajectory (see Blaydes and Chaney (2013) for example), our aim for this paper is to systematically identify changes in sovereign states that minimizes ambiguities arising from the definition of turnovers. The resulting conservative measure for state changes is a response to the otherwise conceptually unclear classification of many state (vs. dynastic) turnovers observed over centuries.

[13] The authors find that there is an inverse relationship between ruler duration and the probability of being overthrown.

the level of instability through state turnovers rather than ruler changes. The measure also incorporates the fraction of time for which region i witnessed presence of a sovereign state. The importance of state presence and its antiquity is discussed at length in both Bockstette, Chanda, and Putterman (2002) and Borcan, Olsson, and Putterman (2015)'s work, which also present findings that are in line with our empirical findings below. Our approach to understanding the impact of state history differs from these authors, in that we use a fixed geographic unit of observation (grid-cell) to count the number of unique sovereign states, and calculate the weighted average duration of state based on this number. Unlike the existing works, we focus on the outcome of state changes at the *local* level instead of the state level in the current period, as the geographical boundaries of these states have changed over time and created regions with different state histories and yet within the same current state.

Our approach follows existing works that have similarly used either century or half-century intervals to tract political situations (Stasavage 2014; Bockstette, Chanda, and Putterman 2002; Borcan, Olsson, and Putterman 2015). There is arguably no objective and measurable criterion to define the relative importance of specific years, or the delineation of correct time intervals for analysis. Euratlas captures state presence at fixed moments in history; ideally we would like to obtain a map of Europe for every year, since there could be cases where state changes have taken place within a given century. In presenting only the states at the beginning of each century, Euratlas maps potentially leave important information out, but do show the result of every time sequence within the 2000 years. We argue that while events in between centuries are not captured in the Euratlas data, it is also unlikely that state changes took place systematically by the imposed century-intervals, in anticipation of the beginning of a new century. That is, we find no reason to believe that our observations in the beginning of each century would lead to a bias with an outcome different from those observed over some other time intervals. On the other hand, there still remain potential issues with measuring the mean state duration, as we can only track state presence at the beginning of each century. As explained in the following sections, we attempt to address potential systematic measurement issues in certain regions by introducing a set of controls, including standard geographic covariates, as well as regional and development indicators.

The other data that we use in this paper are Gross Domestic Product (GDP) and the population in the year 2010 from the NUTS-3 classification, the most disaggregated administrative level in Eurostat.[14] The construction of the dataset involves the merging of the Euratlas and Eurostat data. In order for us to obtain comparable units, we again begin with a geographical grid that covered the entire European continent. This approach follows existing works in the literature that make use of grid-cells as units of analysis, and potentially run into methodological tradeoffs (Alesina, Easterly, and Matuszeski 2011). In our case we need to determine how to interpret several intersections of land within a grid-cell, in which each different slice of land has a different history of state changes. We also note, however, that such decisions are even more problematic for larger geographic units of analysis, and that grid-cells instead have the attractive feature of allowing for considering only some of the border changes at a time. Given the various state changes over different centuries, it is otherwise difficult to assess changes using, for example, the entire boundary.[15] Moreover, this approach allows for changes in a sovereign state's territorial size over time. For example, France has been a sovereign state for many centuries but its size has expanded and contracted over time (for e.g. expansion during the Napoleon period and contraction thereafter). By using the grid-cell approach, we are able to account for such territorial changes

[14]More information on the NUTS classification is available at `http://ec.europa.eu/eurostat/web/nuts/overview`.

[15]For example, one may suggest that it would be more natural to instead use the NUTS-3 regions as the unit of observation. While using regions instead of grid cells would address issues related to spatial correlation from increasing the number of adjacent observations with the same values, specific information pertaining to border changes are necessarily lost by increasing the size of the observation unit. We address the spatial correlation issue below with the inclusion of Conley (1999) standard errors, as well as other spatil lag and error models.

at the borders of the main sovereign state. A similar approach has been taken to look at historical conflicts and city locations in Europe (Dincecco and Onorato forthcoming), and more recent waves of conflict and global income levels (Tollefsen, Strand, and Buhaug 2012).

Our grid comprises of $10,000$ cells, each approximately 77km $\times$ 62km. This grid is first overlayed with each of the twenty-one Euratlas maps (see Figure 2). Out of the 10,000 cells, we restrict the analysis to about 2,400 grid-cells that have some land mass, and to sovereign entities that govern at least 0.1 km of the grid-cell area.[16] This ensures that grid-cells only containing water and sovereign rulers that only rule a very small section of the grid-cell are not included in the analysis. Next, we identify the sovereign entity that governed a particular grid-cell at the turn of each century. If a grid-cell is part land and part water (e.g. coastal grid-cells), we identify the sovereign entity that govern the land mass in that grid-cell. In addition, if there is more than one sovereign entity that rules a grid-cell in a given year, we use the sovereign entity that governs the maximum area of the grid-cell. Figure 2 presents the distribution of the number of sovereign state owners per grid-cell.

[Figure 2 about here.]

Next, we overlap the grid with NUTS-3 Eurostat maps and calculate the year 2010 GDP per capita for each grid-cell. As before, we restrict the analysis to grid-cells that have some land mass, and to NUTS-3 areas that occupy at least 0.1km of the grid-cell area. If a particular grid-cell is part of two or more NUTS-3 regions, we use the GDP per capita data based on the NUTS-3 region that occupy the maximum area of the grid-cell. These steps ensure that the process of calculating the regional income data is consistent with that of the sovereign rulers (we also calculate the 'average' and 'area-weighted' income data for each grid-cell for robustness). Figure 3 and 4 show the distribution of the mean state duration and year 2010 GDP per capita for each grid-cell, respectively.

[16] Grid-cells that did not have a sovereign ruler in the year 2000 were considered to not possess any land mass.

[Figure 3 about here.]

[Figure 4 about here.]

In sum, the unit of analysis we use in this paper is the grid-cell. This is a preferable option compared to that of present-day states because the state boundaries have changed over time and there are only a limited number of countries in Europe. The use of the grid-cell as the unit of analysis also ensures that the size of the different units are the same over time and makes it possible to conduct a micro large-N analysis. The main outcome variable is the logged GDP per capita in the year 2010 for each grid-cell (calculated in Purchasing Power Standards thousands of Euro per capita),[17] and the main predictor variable is the mean state duration associated with the grid-cell over the period from 1 AD to 2000 AD.

For each grid-cell we calculate the number of centuries during which there was a sovereign state in power, and the total number of unique sovereign entities that governed the same area. We then construct the mean duration of state rule as laid out in Equation 1 above. In addition to the state duration measure, we consider four different alternative explanations of economic development. First, the geographic environment of a region influences its economic development (Sachs 2001). For instance, agriculturally productive areas are associated with higher levels of production and income (Johnston and Mellor 1961). In particular, Diamond (1999) and Ashraf and Michalopoulos (2015) argue that the geographical location of Europe made it more suitable for agriculture and domestication of animals that eventually led to the Neolithic Revolution. Especially in periods prior to industrialization, the share of agriculture of the GDP was very high, making agricultural suitability an important determinant of economic development and a coveted resource for sovereign states. We obtained agricultural suitability data from Ramankutty et al. (2008) and calculated the suitability index for each

[17] Purchasing Power Standards (PPS) is the term used by Eurostat to calculate the GDP of different regions, taking price-level differences into account. For more information on PPS, see `http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Purchasing_power_standard_(PPS)`, accessed 31 July 2014.

grid-cell measured as the fraction of land suitable for agriculture. Agricultural suitability is also related to the elevation of a particular region, since high-altitude areas are more conducive to growing certain types of crops. We obtain the mean elevation data from ESRI 2008 GIS Maps.

Second, the European economic growth is also associated with the maritime trade, especially in the post-1500 period (Acemoglu, Johnson, and Robinson 2005). Trade between European countries and their colonies increased the power of traders and merchants who demanded better property rights. In turn, these institutions are associated with higher levels of economic growth in those regions. In addition to arable land, regions that had access to water passages would have more value to sovereign states and potentially witnessed more incidents of regime changes and turnovers. We control for this mechanism using the distance from the center of a grid-cell to the nearest body of water.

Third, if (as we claim in this paper) state changes are important determinants of current economic outcome, then the existence of states before 1 AD may also have lasting influence. While we necessarily limit our calculation of state changes back to 1 AD, one way to control for additional (pre)historical state presence is by including the state formation variable as identified by the timing of agricultural adoption (Borcan, Olsson, and Putterman 2015)[18]. That is, we use the number of years from the adoption date up to the year 2000 (Pinhasi, Fort, and Ammerman 2005), as a proxy for the pre-1 AD regime influence.

Fourth, the growth of cities is correlated with places moving from an agriculture-based economy to more industrialized forms of production. Cities bring together the manufacturing and service arms of different sectors, making the transport of goods, dissemination of information and procurement of labor more efficient (Stasavage 2014; Henderson 1988; Glaeser et al. 1992). Moreover, high population densities in cities are seen as essential to the

[18] In Borcan, Olsson, and Putterman (2015), the authors show that there is a strong and positive correlation between the timing of agricultural transition and the timing of first state formation; earlier establishment of states would imply more opportunities for changes and turnovers

increase in labor productivity and economic growth of that region (Ciccone and Hall 1996). These urban centers are also often targets for invasion due to their wealth and strategic locations, which may lead to more state changes. Hence we control for the distance to the nearest city within a grid-cell to account for impact of urbanization on GDP output.[19]

Finally, we include the latitude and longitude controls, as well as the year 2000 country indicators, further demanding tests that help control for location and current border shocks. Certain locations, even controlling for geographical endowments and historical development, may witness frequent turnovers simply due to its proximity to the core of Europe, while the peripheries experience less (Merriman 2003). In addition, we expect that local income levels are likely driven by the state-level unobservables that vary across the modern state boundaries.

[Table 1 about here.]

Table 1 presents the summary statistics of all the variables used in our analysis. There is considerable variation in the number of unique sovereign states that ruled a given grid-cell. Less than one percent of the grid-cells, all of which lie in the peripheral stretches of land by the sea or remote islands, are coded as having been ruled by just one sovereign state, and only one grid-cell was governed by the maximum number of 12 different sovereign states (in Sardinia, Italy). On average, a grid-cell was ruled by five unique sovereign entities over the 21 centuries. As described above, mean state duration is the fraction of time for which a region was ruled by a sovereign state. This variable ranges between 0-0.75 with a mean of 0.19, and from Equation 1 this translates to the mean ratio of centuries of rule over the number of unique states being 3.8. Grid cells with mean levels of state rule are located in present-day United Kingdom, Ireland and Germany. As shown in the maps earlier, there are

[19]For the city count, we use all the cities listed in Bairoch, Batou, and Chevre (2008) and geocode the location of each city. The available population figures in Bairoch, Batou, and Chevre (2008) capture European cities which at some time between 800 and 1850 AD, had 5000 or more inhabitants.

also expected variations in the GDP per capita across the continent. On average, the GDP per capita of a grid-cell was about 19,000 PPS euros per thousand people with a fairly high standard deviation of 10600. The distribution is similar when we use other variations of the logged GDP per capita measure.[20]

4 Mean State Duration on Development

How does the mean state duration explain the current local income level? On the one hand, Borcan, Olsson, and Putterman (2015) show that both countries with short and long state antiquities suffer from low productivity relative to those in the middle range. The former inhibits productivity because of its inability to increase fiscal capacity, while the latter does so as the centralized power becomes extractive and entrenched in power struggles. But the relationship between the mean duration of state and development may also be non-linear and inverse-U shaped, as the general findings discussed in the literature suggest that turnovers may impact subsequent state performance. As in Equation 1, the mean duration of state is calculated not only by the length of state presence in a region, but also the number of state turnovers. Holding other things equal, more turnovers decrease the mean duration of each unique sovereign state, a critical distinction that separates a stable state presence from an unstable one. This means that both regions where states had short average durations and those where they had long durations suffer from lower development. The former has either a short state history, frequent turnovers, or both, while the latter has a long state history, low turnovers, or both.

To see whether the mean duration of state rule affects the local income level today as

[20]The constructions of these alternative GDP per capita measures are discussed below in the Robustness section.

predicted, we use the following estimation equation for our analyses:

$$
\begin{aligned}
Income_i = &\beta_0 + \beta_1 * [\text{Mean State Duration}]_i + \beta_2 * [\text{Mean State Duration}]_i^2 + \\
&\mathbf{X}_i \beta_3 + \gamma_j + \epsilon_{ij}
\end{aligned}
$$

where $Income_i$ is the logged GDP per capita in the year 2010 in grid-cell i, Mean State Duration$_i$ is the mean duration of state rule, and Mean State Duration^2 is its square. This specifically allows us to examine a non-linear relationship between the mean duration of state and GDP per capita. The matrix $\mathbf{X}_i$ contains the list of control variables for grid-cell i including the geographic and urbanization controls. As discussed earlier, geographic controls include the agricultural adoption date, agricultural suitability, distance to water, elevation, and a polynomial of latitude and longitude for each grid-cell. We use the distance to the nearest city as our measure for urbanization. Lastly, we also include country fixed effects in the year 2000 (γ_j) to account for any unobservables that vary across current state borders. The coefficients of interest are β_1 and β_2, both related to the mean state duration variable.

5 Main Findings

We present our main findings in Table 2. Model one is the base model where the logged GDP per capita in the year 2010 is regressed on the mean duration of state rule between 1 AD and 2000 AD and its square term . The mean duration of state rule has a positive coefficient estimate whereas the square term has a negative coefficient estimate, and both estimates are statistically significant at the one percent level. This suggests that there is a non-linear relationship between mean duration of state rule and present-day GDP per capita. The signs on the two coefficient estimates suggest an inverse-U relationship: mean duration of state rule is associated with higher present-day income levels but this relationship tapers off and ultimately becomes negative as state rule continues for longer centuries.

[Table 2 about here.]

Models 2-6 progressively introduce different control variables. In all models the positive and statistically significant coefficient estimate of the mean duration of state rule and the negative and statistically significant coefficient estimate of its square term are present at the one percent level. Given that our results may potentially be driven by where the grid-cells are located, we include latitude, longitude and the product of the two in Model 7. All seven models include country fixed effects in the year 2000 to account for possible unobservables in present-day state boundaries that could affect the GDP per capita of a region in the year 2010. The sign and statistical significance of the mean state duration variable and its square term remain consistent across all models, providing us with robust evidence on the inverse-U shaped relationship.

[Figure 5 about here.]

[Figure 6 about here.]

Figure 5 presents the inverse-U relationship between mean state duration and present-day GDP per capita based on the full model in Table 2. The figure shows that 2010 GDP per capita increases with the mean state duration but does so only up to point. As the mean state duration goes beyond 0.3, its association with logged GDP begins to decrease. To substantively make sense of these findings, we present the marginal association of mean state duration on the change in the 2010 logged GDP per capita levels in Figure 6, holding all other controls at their mean levels. It shows that the marginal effect of states has a positive association on income initially but that this effect is decreasing and ultimately turns negative.

6 Robustness

In this section, we provide further support for our results through additional robustness tests. First, we account for state presence, specific empires ruling Europe for long periods of time and have been cited as possible determinants of long-term economic growth on the continent, and certain regions of Europe experiencing different levels of state capacity or specific historical events like communism. Next, we address the issue that some European cities developed parliaments and some others were plundered during the last 2000 years thus influencing the GDP of these regions.

Alternative measures of our outcome variable are also examined and show that our results are not dependent on a specific construction of GDP per capita. Lastly, we account for possible spatial correlation between different grid cells, and present robustness with both spatial lag and spatial error models.

6.1 State Presence, Specific Empires & Specific Regions

The effect of mean state duration on GDP could depend on certain regions having a different historical experiences than others. First, the very presence of a state could affect the economic outcomes of a region. Even though we take state presence into account in the way we construct the mean state duration variable, we include a non-linear functional form of the variable in our estimations. In so doing, we show that our results on mean state duration are robust to the direct influence of state presence on GDP.

Second, some areas of Europe that witnessed domination by certain empires may have benefitted in terms of economic growth because of institutions that survived since that time.[21] In addition to the Roman Empire's rule, which is often included in the literature as

[21] Empires may have also enabled increased trade and led to economic integration for constituent nations, leading to higher economic growth; see Mitchener and Weidenmier (2008). Not all empires facilitated integration and trade, however; see Nexon and Wright (2007).

a determinant of a region's long term economic growth (Duncan-Jones 1982; Temin 2006), there are other successful and historically significant empires that we can explore in the analysis. These include the Mongolian and Ottoman Empire, and for each of these empires we calculate the duration (in centuries) of its rule on the grid-cell. We include as controls the number of centuries that a grid cell was under the Roman, Ottoman and Mongolian rule during the past 2000 years to account for the effect of these specific empires.

Third, different regions of Europe have had different levels of state capacity, and economic development in some parts of the continent today may be the result of specific geographies or historical events. While the modern country dummies in our regressions control for most of these regional effects [22] Some do not align with current borders, and other run over multiple states. One region that may have a different economic path is West Germany, especially the Rhineland, which consisted of several hundred small states from the Kingdom of the Romans and the Small States of the Holy Roman Empire after the Great Interregnum (1254 to 1273). In our data, the Kingdom of the Holy Roman Empire as a single entity encompasses approximately 400 small lordships and principalities within the territory, whose boundaries were in some cases unknown. Because these data are absent and this area was amongst the wealthiest throughout history, the results from treating it as one entity may be biased against a positive effect.[23]

Another region of potential importance is the European "city belt" (also known as "city-state Europe"), stretching from northern Italy, through the Alps and southern Germany, to

[22] For example, communist legacies in Eastern Europe may be partially responsible for economic outcomes today (Pop-Eleches 2007). Similarly, the geography and institutional structure in the Low Countries may have a different economic trajectory from the rest of the continent (Bavel 2010; Mokyr 1977).

[23] While the Euratlas maps have been deemed accurate and accepted as valuable source in the recent literature (Blaydes and Chaney 2013; Stasavage 2010; Blaydes and Paik 2016; Abramson 2017), there are bound to be discrepancies in terms of which states should be included and which are not. In some cases, small principalities, ecclesiastical units and city states may be classified as sovereign states but missing from these maps.(Abramson 2017). The Euratlas sample identifies a maximum of 158 sovereign states in a given century over the time span, which some argue under-count the actual number (for example, (Tilly 1975) claims that in 1500 there were 500 independent political units in Europe). Most of the under-counting appears to have resulted from the Rhineland as described here.

the Low Countries; these cities along the Rhine river in the center of Europe constituted a commercial continuum out to the North and Baltic Seas. They were strong enough to deter any centralizing effort in establishing a territorial state in their locations, and as a result, modern territorial states developed in areas that were peripheral to this core.(Rokkan 1975; Abramson 2017) In order to alleviate doubts that the city belt might be driving our main results, we control for the grid cells in this region. Finally, we also control for contemporary capital region-grid cells to assess whether in addition to regional effects, our results are simply driven by important cities driving the regional development today.

[Table 3 about here.]

Table 3 presents the results of the three potential concerns discussed above. Model 1 includes the state presence variable and its square term aimed at isolating the direct effect that the presence of a state may have on the economic output of a region. Our main mean state duration variable and its square term continue to have a positive and negative sign respectively, and both variables also continue to remain statistically significant. Similarly, Model 2 presents results after controlling for the number of centuries under Roman, Ottoman and Mongolian rule. As before, we find that the mean state duration and its square term continues to have positive and negative signs respectively, and both coefficients remain statistically significant. This remains true in Model 3 as well when we include controls for different European regions as well as contemporary capital region-grid cells. To take into account historical European capitals, we also include the number of centuries with a capital as a control in Model 4 along with other regional controls.[24] Taken together, these results increase our confidence that the mean state duration has a inverse U-shaped relationship with GDP.

[24]Historical capital locations from 1 to 2000 AD are obtained from Pierskalla, Schultz, and Wibbels (forthcoming).

6.2 Parliament & Plunder

Despite remaining robust to the geographic and political controls above, it remains to be seen whether our findings hold when accounting for local variations in the type of institutions that governed each grid-cell. In political economy models, autocratic institutions can either undermine or countervail vested interests from taking root, while representative institutions may have correlated with longer regimes because they were better able to establish checks on unpopular and therefor brittle governments (Cox, North, and Weingast 2015; Blaydes and Chaney 2013; Besley and Persson 2009). Given the long-standing political fragmentation as a fundamental part of European history, there has also been much emphasis on looking at institutions at the city level (Stasavage 2014). Furthermore, there is evidence that violence which may accompany transitions can have long-term negative effects on economic, health, and educational outcomes (Abadie and Gardeazabal 2003; Akresh and Walque 2008; Chamarbagwala and Morán 2011), sometimes sustaining over more than one generation (Harish 2015).

[Table 4 about here.]

For an additional analysis controlling for both representative institutions and violence experienced, we utilize the city-level data from 800 AD to 1800 AD in Bosker, Buringh, and Zanden (2013). The dataset contains information on whether a given city had an active parliament, and whether it experienced any physical plundering in the previous century.[25] For each grid-cell, we find out whether there is a city, and count the number of centuries for which the city had an active parliament from 800 to 1800 AD, as well as the number of centuries for which the city was plundered.[26]. As an alternative measure of violent incidents,

[25] According to Bosker, Buringh, and Zanden (2013), the first parliaments convened in twelfth and thirteenth-century Spain, Italy, and France, spreading over the rest of Europe in the following centuries. Plunder is defined as "the near complete demolition, looting, carnage or burning down of a city or the killing or deportation of the major part of its inhabitants."

[26] In the case that there are multiple cities within a grid-cell, we aggregated both parliament and plunder information at the grid level for a given century (based on whether any of the cities had an active parliament

we also utilize Dincecco and Onorato (2017)'s data, which geo-locate sieges and battles in Europe between 1000 and 1799 AD. Table 4 presents results in which each variable is added first separately and then jointly to the base estimation equation. We find that our main results stay robust to the inclusion of these additional controls.

6.3 Alternative Measures

An alternative measure for state changes, instead of the number of unique sovereign states, can be the number of turnovers that states experienced. Turnovers may refer either to a new entity that has not ruled the region previously, or an old entity that has ruled the area before and returns to power. The variable thus allows for a higher count of changes than the number of unique states, because an old sovereign state coming back to reclaim its land would be counted in the former but not in the latter. To see the difference between turnovers and the number of unique sovereign states, consider a hypothetical region ruled by the following kingdoms in chronological order: Romans, French, Ottoman, French, Ottoman, and the Republic of Germany - in this case, there are four unique sovereign state owners but five sovereign state turnovers. Models 1 and 2 in Table 5 presents our the full model taking all controls into account. In Model 1, we use the number of turnovers rather than number of unique sovereign states to calculate the mean state duration, and in Model 2, we weigh the turnovers according to the time period; that is, we allow higher weights for turnovers that occurred closer to year 2000 and discount those that occurred further back in time. This addresses a main limitation with our data, in which we are unable to differentiate the level of state capacity and strength across time periods. By collapsing state presence and the number of unique states into a scalar measure, we are likely placing more weight to the states in the past as opposed to the more recent periods.[27] In both models, our main result

or was plundered), and then count the number of centuries with this feature.

[27] Here we use the historical discount factor x to be 0.05, where each turnover is discounted by $(1+x)^t$ and t is the number of centuries prior to 2000 AD.

implications remain essentially the same.

[Table 5 about here.]

Next, since we calculate economic development using a new geographic unit of analysis, our results may be dependent on how we measure the outcome variable. In order to check whether the findings are robust, we also consider alternative measures of different variables to provide robustness of our results. First, we examine alternative measures of our outcome variable, the logged GDP per capita in the year 2010. For our main findings, we used the value associated with the region that covered the maximum area of the grid-cell when there were two or more NUTS-3 regions overlapping with a grid-cell. Here we present results where the outcome variable is calculated using (1) the simple average, and (2) the area-weighted average of the different NUTS-3 regions. Table 5 presents the full model as in our main findings, and the mean state duration continues to have an inverse U-shaped statistically significant relationship in all models.

6.4 Spatial Autocorrelation

Our main results assume that different grid-cells are independent and identically distributed. However, because some grid-cells are in close geographic proximity to others, it is possible that they influence the variables of interest in a neighboring grid-cell. This is especially the case in our empirical approach, given that a representative political entity often occupies multiple grid-cells, and all the same attributes of the entity are assigned to these grid-cells that are adjacent to each other. We have found that areas of historically high turnovers overlap with areas of lower income levels today, but if we want to estimate the effect of state changes on the development outcome today without controlling for spatial autocorrelation, we may obtain biased estimates. In order to check whether the negative relationship between the two variables holds under potential spatial autocorrelation, we present the coefficient estimates with standard errors adjusted for spatial autocorrelation in table 6. Controls are introduced progressively like in Table 2, and we find that similar to our baseline results, the inverse-U relationship between the mean state duration and present-day GDP per capita continues to hold.

[Table 6 about here.]

7 Discussion

We have shown that there is an inverse-U relationship between mean state duration and present-day growth levels in Europe over the time period 1 AD-2000 AD, and that these results are robust to alternative measures, spatial autocorrelation, and accounting for specific regions and empires as well as types of local institutions and violence. These findings are consistent with the existing literature that show how politically stable state presence is important for economic growth, as well as with works arguing that extended state presence may also be detrimental for development. It is however difficult to conceptualize how regions that have on average stable rule for up to a certain period see positive long-run development, but stagnate for longer such rules, as this may depend on the time span as well as the period in history which one looks at. Another potential issue is with the conceptualization of statehood, which likely changed over time. While the definition of a state described above may be considered closer to a modern Weberian state, one may argue that states in earlier periods should be simply defined instead as statehood as a form of political organization above the tribal level (Borcan, Olsson, and Putterman 2015). North (1990) argues that formal institutions became necessary relatively late in the process of development; while state rule can reduce transaction costs and protect property rights, these mechanisms may have been stronger in the later stages of the time period. Finally, our use of national textbooks to determine state existence and continuity may not address the likelihood that governments in the age of nation building re-conceptualized the past of the political unit and its population to cultivate feelings of nationhood. One feasible way to address these concerns is to explore whether the inverse-U relationship is evident if we choose different time period cutoffs. For this purpose, we construct our mean state duration variable for different time periods by using the same structure as Equation 1, but restricting the number of states and number of centuries of state presence based on the duration under consideration. As an example, in order to compute the state duration for the time period 1 AD - 500 AD, we first identify the number of unique sovereign states that governed each grid cell and the number of centuries of state presence for this time period. Then we divide the number by five centuries, giving us the mean state duration for the time period 1 AD - 500 AD. Such a construction ensures that the mean state duration variable is always between 0 and 1, making it comparable across different time periods.[28]

[Figure 7 about here.]

Figure 7 presents the relationship between mean state duration and present-day logged GDP per capita for different time periods. When we confine the time span to only the most recent centuries between 1500 and 2000 AD, 1600 and 2000 AD and so on, we do not observe a consistent pattern emerge. The concept of sovereignty had begun to change from 1400 AD and onwards (Benton 2009), and Europe witnessed the type of modern state formation that was unseen in the previous centuries. The mean duration outcomes in the more recent time periods thus appear to be dependent on the number of centuries included in the time span, and more importantly marked by significant periods of state consolidations across the continent. Due to the rise of modern nation states that likely differ from the precedents, and the short time span considered, we do not have a clear direction on how the variation in

[28]We also note that the conversion of mean state duration to the number of centuries depends on the time span considered. For example, for the time period 1 AD - 2000 AD, a mean state duration of 0.3 would correspond to 6 centuries, while for the time period 1 AD - 500 AD, a mean state duration of 0.3 would correspond to 1.5 centuries.

mean state duration may affect the outcome by the 21st century. These inconsistencies are, however, smoothed out when the analysis is done over longer time periods. When we include time periods preceding 1500 AD, we observe a consistent pattern emerge. For every time span between 1400 to 2000 AD, 1300 to 2000 AD and so on, we find that the relationship is consistently inverse U-shaped as from our main finding from the 21 century time-span.

8 Conclusion

In this paper we introduce a measure of mean duration of state rule, and show a strong and positive relationship between the variable and the current local income level. Using data from a vast time period (1 AD-2000 AD) in Europe, we find that a region under either short or long mean duration of state rule also witnesses a lower economic standing today relative to others. In line with existing empirical and theoretical works in the literature, our empirical findings suggest that state presence is important for economic development, and the length of its duration signals stronger fiscal capacity and subsequent development. They also suggest that a region may benefit from opportunities for state turnovers when the surviving states, after long duration, become overly extractive and hinder progress.

As our findings stand robust to various controls and alternative measures, we believe that there are several potential avenues for future research. First, this paper focuses on Europe because of the availability of relevant data on sovereign state changes and GDP at the micro-level. Hence a fruitful exercise would be to extend this analysis to other parts of the world, especially in places formerly under European colonial rule. The current evidence for these regions has mainly focused on the effect of European colonization on economic growth (Banerjee and Iyer 2005; Acemoglu, Johnson, and Robinson. 2001), and we do not yet know if this is a result of an accumulation of sovereign state presence and their changes over time, or if the European colonization was the main determinant of development in these regions.[29] Another apt region to test our hypothesis would be China, where despite the sizable land mass there were significantly fewer sovereign state changes (at least in the case of China proper) over the same time period.

A second research avenue would be in exploring the impact of state changes on the emergence of democracy. Each sovereign entity in the modern period could be coded as a monarchy, autocracy or democracy based on the extension of suffrage and the existence of a monarchy. Much of the existing literature has focused on the dichotomy between autocracies/democracies and its relation to economic growth (Przeworski et al. 2000). With the availability of sovereign state data over the past 2000 years, one may examine the root of divergence of modern states, explore the extent to which monarchies differ from autocracies and democracies in delivering growth, or whether a certain level of economic output in required before a transition from monarchy to democracy or autocracy.

Finally, one can also explore the given data by investigating the extent to which the duration of each sovereign state is a function of geographic factors. For example, the existing set of maps affords the possibility of contributing to the current literature on the relationship between the polity size, the level of decentralization and the duration of polity (Stasavage 2010; Alesina and Spolaore 1997). Big states benefit from economies of scale when providing non-rival public goods as well as the size of markets, and may rely on more efficient forms of taxation; smaller countries, on the other hand, benefit from lower communication and transport costs. The size of states in each period can therefore be seen as an endogenous outcome of both political and economic outcomes, such that the geographic scale of a state may provide a signal for its survival in the next period.

[29] A recent paper by Maloney and Valencia (2015) suggests that pre-colonial prosperity explains the current level of economic activity; similarly pre-colonial institutional variables, including turnovers, may have a persistent effect independent of colonization.

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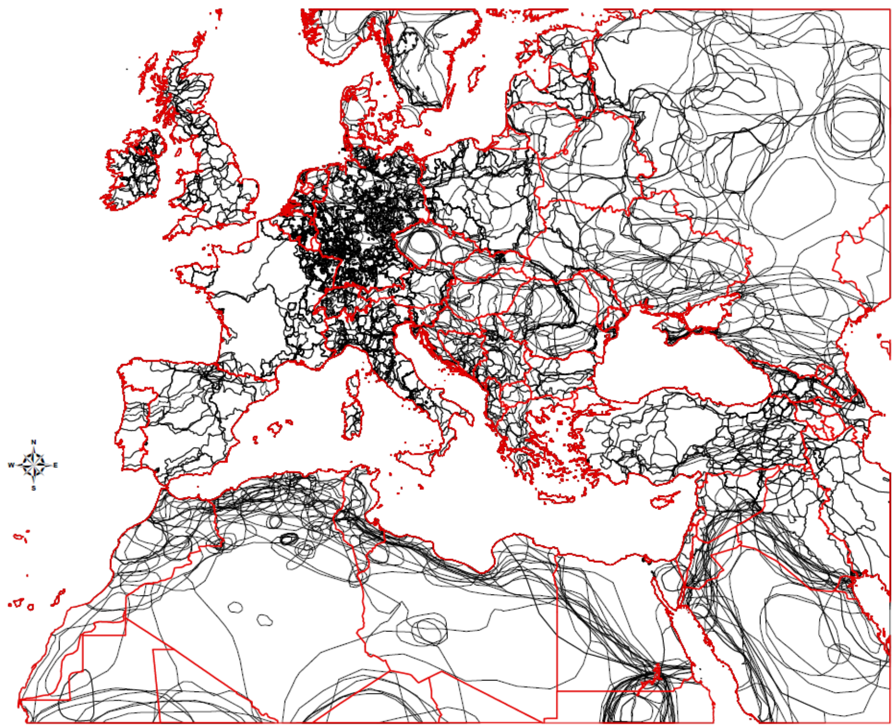

Figure 1: Overlap of Sovereign Rulers (1 AD - 2000 AD)

Note: The above figure presents the overlapped boundaries of all sovereign rulers in Europe based on Euratlas for the period 0AD-2000AD. The boundary in red color refers to present-day (year 2000) state boundaries.

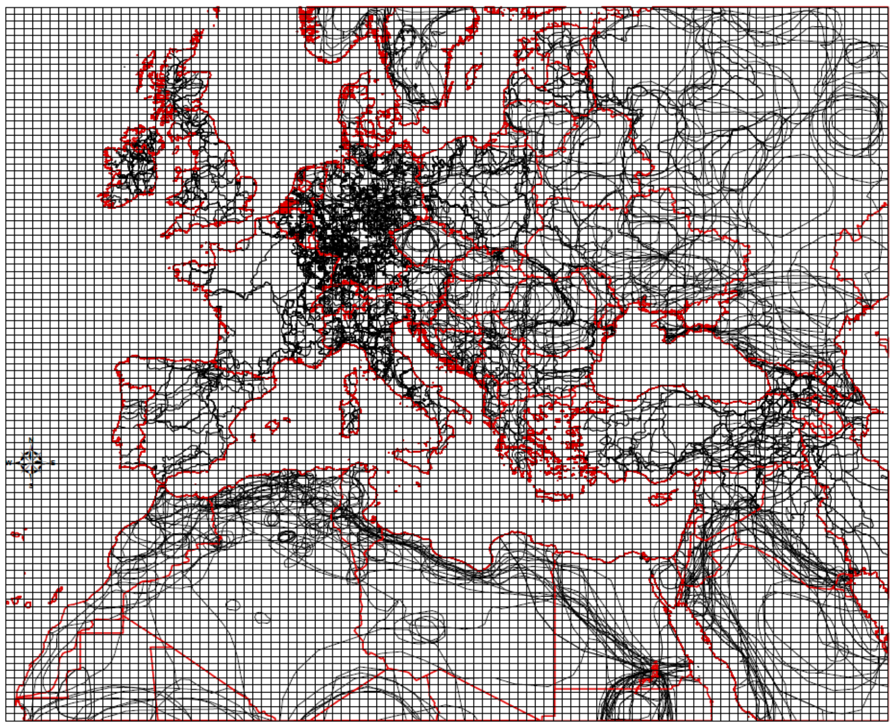

Figure 2: Overlap of Sovereign Entities (1 AD - 2000 AD)

Note: The above figure presents the overlapped boundaries of all sovereign rulers in Europe based on Euratlas for the period 0AD-2000AD along with the grid that comprises of 10,000 grid-cells. The boundary in red color refers to present-day (year 2000) state boundaries.

Mean State Duration

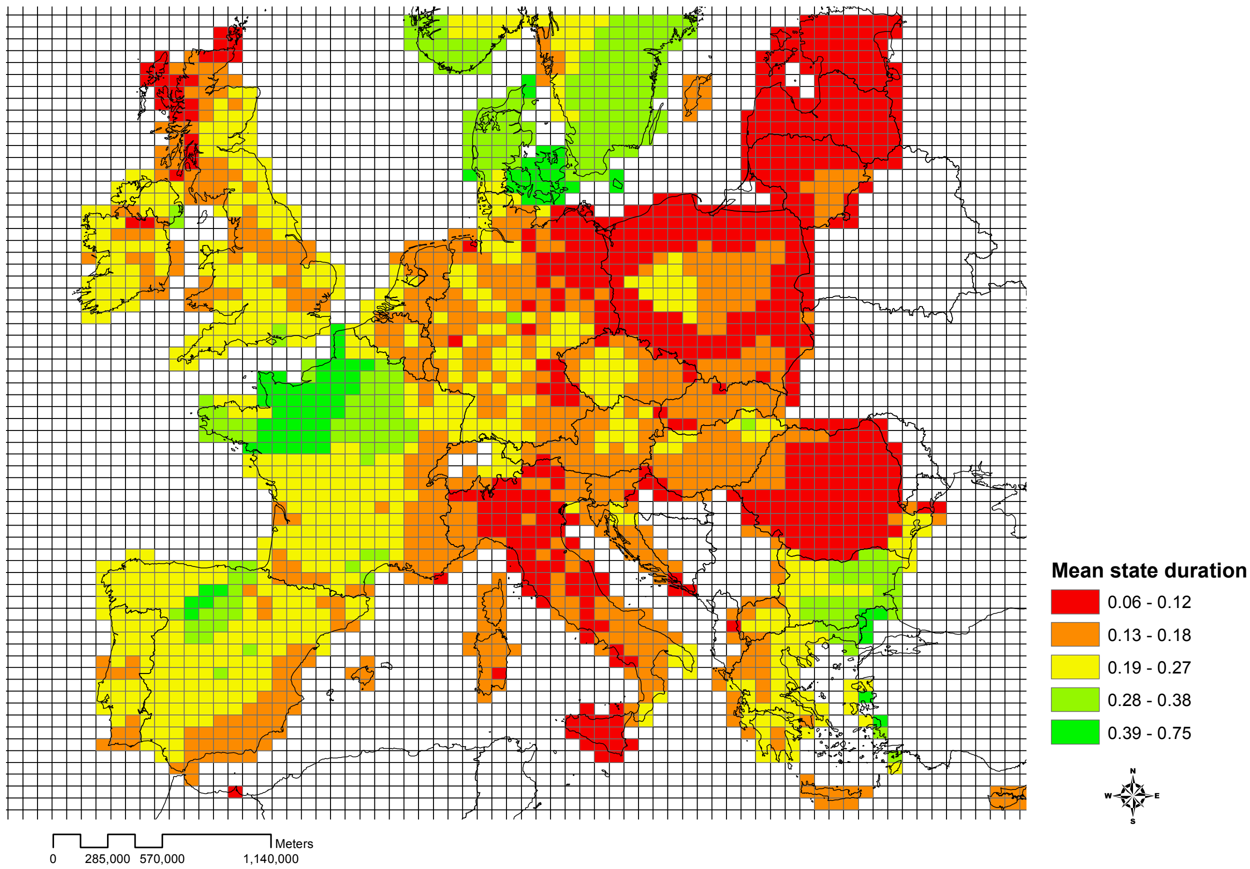

Figure 3: Mean State Duration

Note: The above figure presents the mean state duration based on Euratlas from the year 1 to 2000 AD along with the grid that comprises of 10,000 grid-cells. The data is restricted to only those grid-cells have some land mass. The boundary shown refers to present-day (year 2000) state boundaries.

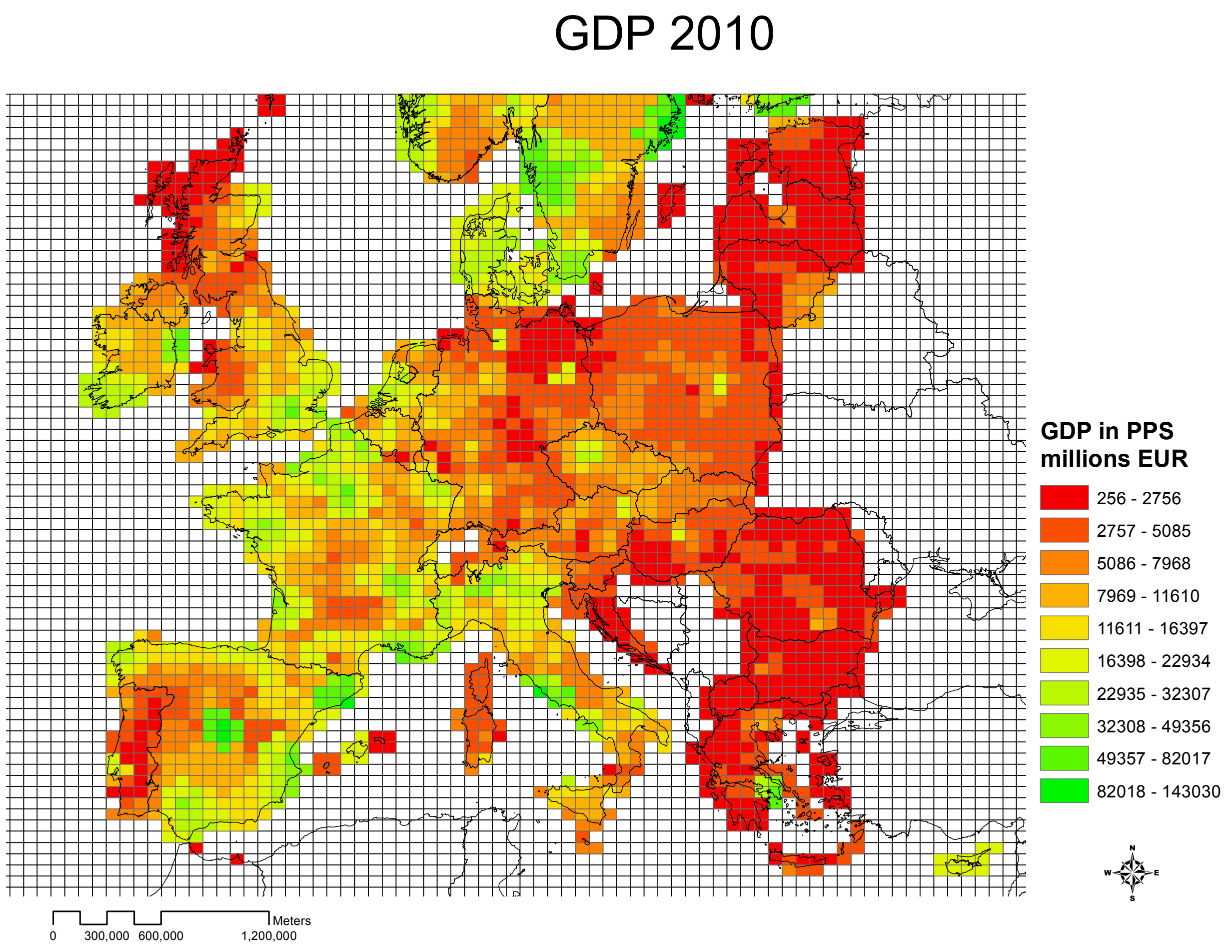

Figure 4: GDP per Capita Distribution

Note: The above figure presents the distribution of GDP per capita based on Euratlas in the year 2000 along with the grid that comprises of 10,000 grid-cells. The data is restricted to only those grid-cells have some land mass. The boundary shown refers to present-day (year 2000) state boundaries.

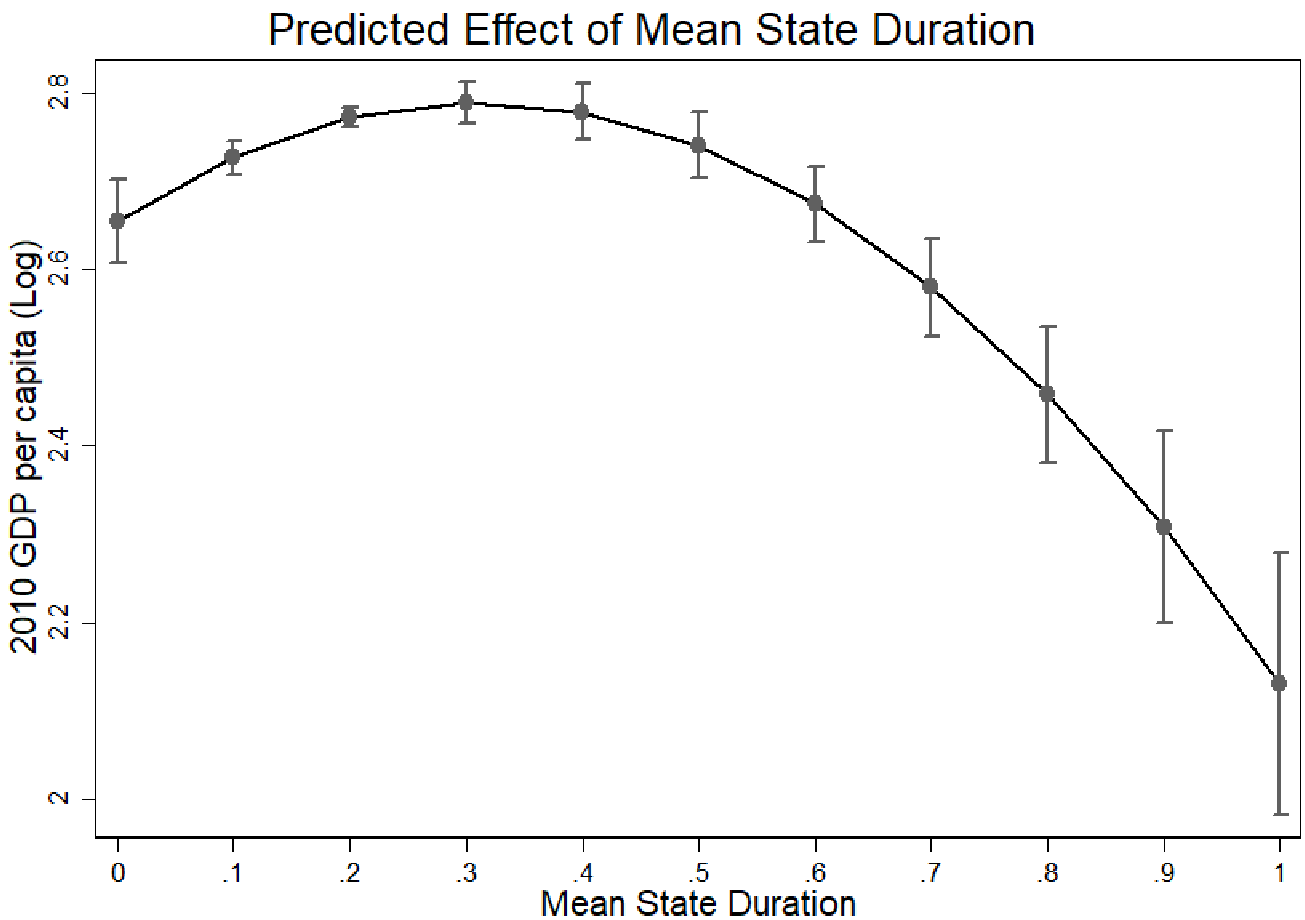

Figure 5: Quadratic Relationship between Mean State Duration and logged GDP per capita.

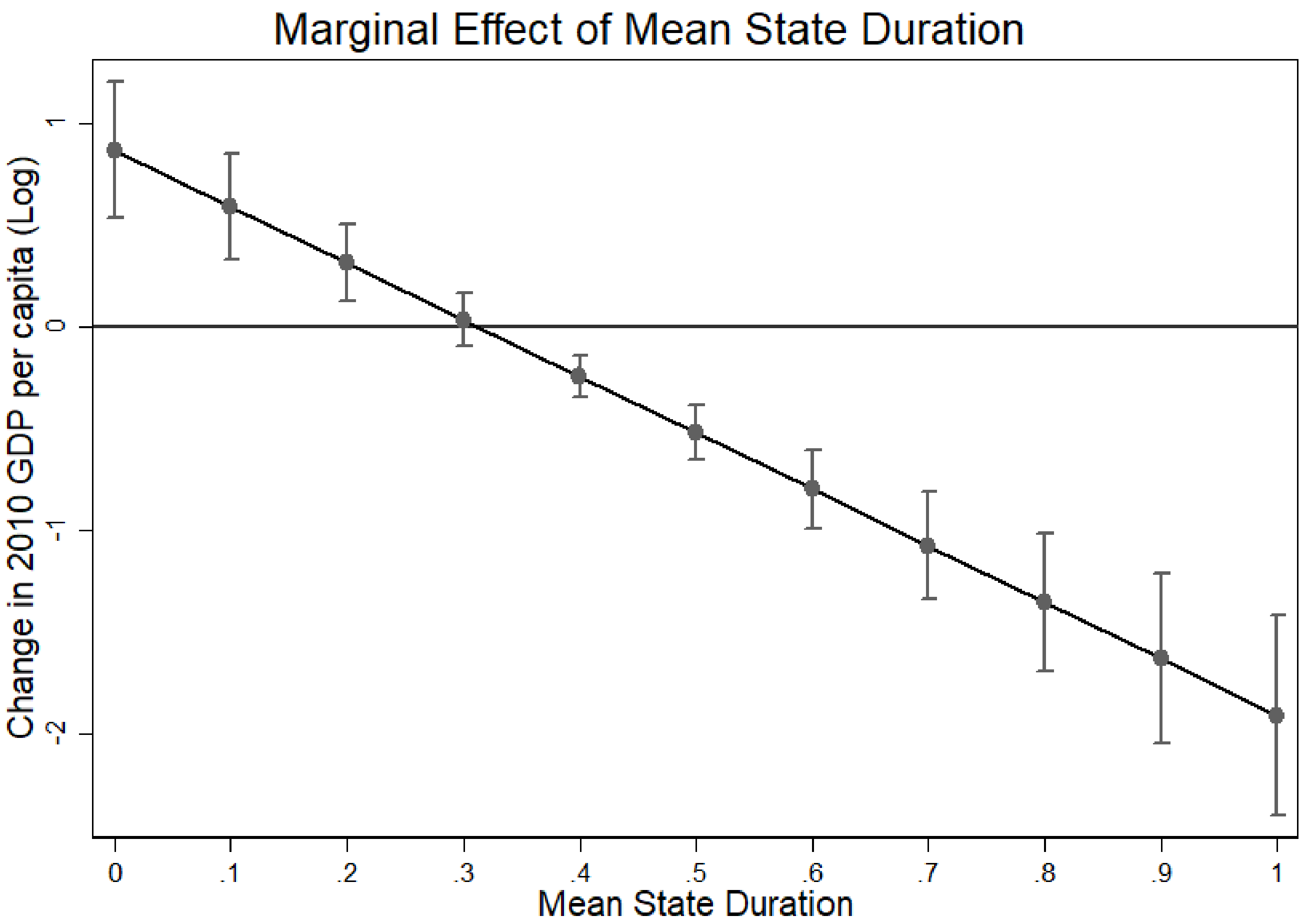

Figure 6: Linear Marginal Effect of Mean State Duration on logged GDP per capita.

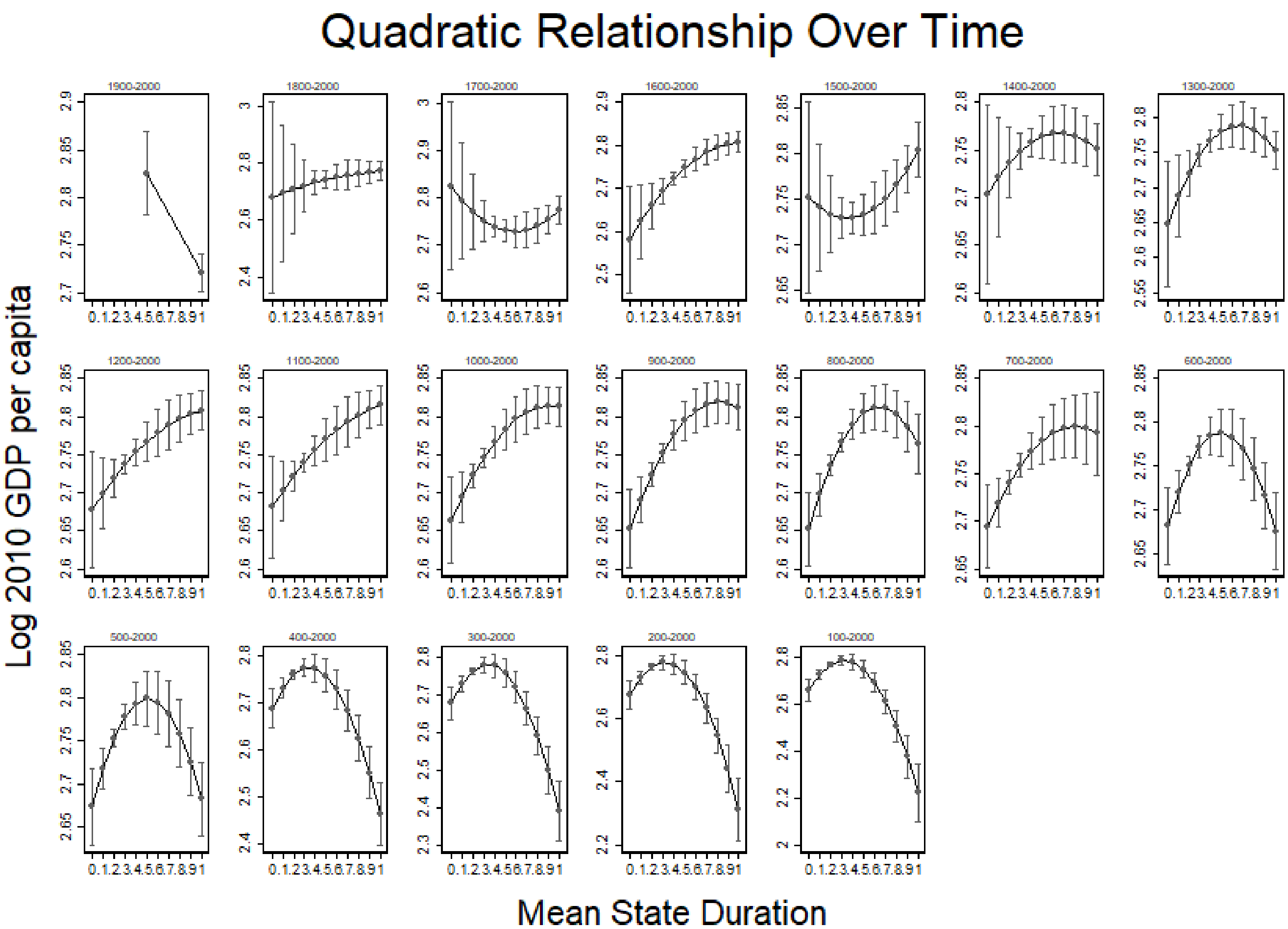

Figure 7: Quadratic Relationship between Mean State Duration and GDP per capita for different time periods (XXXX-2000).

	mean	sd	min	max	count
GDP per Capita (Max Area)	19.12	10.66	1.61	81.73	2223
GDP per Capita (Avg)	19.93	10.69	1.61	61.09	2223
GDP per Capita (Weighted)	19.55	10.61	1.61	74.06	2223
Mean State Duration	0.19	0.10	0.06	0.75	2223
Mean State Duration (Sq)	0.05	0.07	0.00	0.56	2223
Mean State Duration (Using Turnovers)	0.18	0.17	0.04	1.00	2223
Mean State Duration Sq (Using Turnovers)	0.06	0.16	0.00	1.00	2223
Mean State Duration (Using Disc Turnovers)	0.29	0.34	0.05	2.08	2223
Mean State Duration Sq (Using Disc Turnovers)	0.20	0.68	0.00	4.32	2223
State Presence	16.95	4.33	5.00	21.00	2223
State Presence Sq	306.14	136.64	25.00	441.00	2223
Agri Adoption	6.78	0.70	5.42	9.81	2223
Agricultural Suitability	0.59	0.28	0.00	1.00	2223
Distance to Water	86.20	93.25	0.00	462.46	2223
Elevation	302.36	345.17	-1.85	2304.88	2223
Distance to City	30542.25	64709.28	0.00	963983.19	2223
Roman Empire	3.14	3.45	0.00	14.00	2223
Ottoman Empire	0.48	1.38	0.00	7.00	2223
Mongolian Empire	0.00	0.05	0.00	1.00	2223
Latitude	48.75	6.16	34.78	59.26	2223
Longitude	10.34	10.79	-9.89	34.14	2223
Lat*Lon	509.84	531.68	-537.90	1656.49	2223
Eastern Europe	0.21	0.41	0.00	1.00	2223
Low Region	0.02	0.14	0.00	1.00	2223
West Germany	0.06	0.23	0.00	1.00	2223
European City Belt	0.11	0.31	0.00	1.00	2223
Europen Capital Cities	0.01	0.12	0.00	1.00	2223
Number of Centuries with Capital	0.43	1.37	0.00	14.00	2223
Parliament	0.75	1.78	0.00	7.00	2223
Plunder	0.09	0.41	0.00	5.00	2223
Number of Sieges	0.13	0.52	0.00	6.00	2223
Number of Battles	0.21	0.65	0.00	9.00	2223

Table 1: Summary Statistics. The GDP per Capita variables are measured in PPS Euros/1000 ppl.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean State Duration	0.944***	1.006***	1.054***	1.155***	1.157***	1.119***	0.868***
	(0.157)	(0.159)	(0.160)	(0.160)	(0.163)	(0.166)	(0.171)
Mean State Duration Sq	-1.327***	-1.420***	-1.473***	-1.605***	-1.631***	-1.579***	-1.390***
	(0.193)	(0.195)	(0.196)	(0.198)	(0.197)	(0.200)	(0.205)
Agricultural Suitability		✓	✓	✓	✓	✓	✓
Elevation			✓	✓	✓	✓	✓
Distance to Water				✓	✓	✓	✓
Agri Adoption					✓	✓	✓
Distance to City						✓	✓
Latitude							✓
Longitude							✓
Lat*Lon							✓
Country FE in Yr2000	✓	✓	✓	✓	✓	✓	✓
Observations	2376	2314	2313	2313	2223	2223	2223

Table 2: Mean State Duration on logged 2010 GDPPC. The outcome variable in all the above models is the logged GDP Per Capita in year 2010 (in PPS thousands EUR per thousand people). All models include country fixed effects in year 2000, and robust standard errors are shown in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

	(1)	(2)	(3)	(4)
Mean State Duration	0.436**	0.811***	0.699***	0.703***
	(0.175)	(0.178)	(0.170)	(0.170)
Mean State Duration Sq	-0.926***	-1.338***	-1.170***	-1.168***
	(0.206)	(0.214)	(0.202)	(0.203)
State Presence	✓			
State Presence Sq	✓			
Roman Empire		✓		
Ottoman Empire		✓		
Mongolian Empire		✓		
Eastern Europe			✓	✓
Low Region			✓	✓
West Germany			✓	✓
European City Belt			✓	✓
European Capital Cities			✓	
Number of Centuries with Capital				✓
Agricultural Suitability	✓	✓	✓	✓
Elevation	✓	✓	✓	✓
Distance to Water	✓	✓	✓	✓
Agri Adoption	✓	✓	✓	✓
Distance to City	✓	✓	✓	✓
Latitude	✓	✓	✓	✓
Longitude	✓	✓	✓	✓
Lat*Lon	✓	✓	✓	✓
Country FE in Yr2000	✓	✓	✓	✓
Observations	2223	2223	2223	2223

Table 3: Mean State Duration on logged 2010 GDPPC (controlling for state presence, specific empires and specific regions). The outcome variable in all the above models is the logged GDP Per Capita in year 2010 (in PPS thousands EUR per thousand people). All models include country fixed effects in year 2000, and robust standard errors are shown in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

	(1)	(2)	(3)	(4)	(5)	(6)
Mean State Duration	0.848***	0.869***	0.849***	0.848***	0.868***	0.853***
	(0.171)	(0.171)	(0.171)	(0.171)	(0.171)	(0.170)
Mean State Duration (Sq)	-1.376***	-1.389***	-1.371***	-1.379***	-1.393***	-1.384***
	(0.205)	(0.205)	(0.205)	(0.205)	(0.204)	(0.204)
Parliament	✓		✓			
Plunder		✓	✓			
Number of Sieges				✓		✓
Number of Battles					✓	✓
Agricultural Suitability	✓	✓	✓	✓	✓	✓
Elevation	✓	✓	✓	✓	✓	✓
Distance to Water	✓	✓	✓	✓	✓	✓
Agri Adoption	✓	✓	✓	✓	✓	✓
Distance to City	✓	✓	✓	✓	✓	✓
Latitude	✓	✓	✓	✓	✓	✓
Longitude	✓	✓	✓	✓	✓	✓
Lat*Lon	✓	✓	✓	✓	✓	✓
Country FE in Yr2000	✓	✓	✓	✓	✓	✓
Observations	2223	2223	2223	2223	2223	2223

Table 4: Mean State Duration on logged 2010 GDPPC (controlling for parliament presence and city plunder). The outcome variable in all the above models is the logged GDP Per Capita in year 2010 (in PPS thousands EUR per thousand people). All models include country fixed effects in year 2000, and robust standard errors are shown in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

	(1) GDPPC Max Area	(2) GDPPC Max Area	(3) GDPPC Average	(4) GDPPC Weighted
Mean State Duration (Using Turnovers)	0.441***			
	(0.138)			
Mean State Duration Sq (Using Turnovers)	-0.469***			
	(0.127)			
Mean State Duration (Using Disc Turnovers)		0.215***		
		(0.064)		
Mean State Duration Sq (Using Disc Turnovers)		-0.110***		
		(0.026)		
Mean State Duration			0.957***	0.948***
			(0.173)	(0.167)
Mean State Duration (Sq)			-1.464***	-1.450***
			(0.208)	(0.201)
Agricultural Suitability	✓	✓	✓	✓
Elevation	✓	✓	✓	✓
Distance to Water	✓	✓	✓	✓
Agri Adoption	✓	✓	✓	✓
Distance to City	✓	✓	✓	✓
Latitude	✓	✓	✓	✓
Longitude	✓	✓	✓	✓
Lat*Lon	✓	✓	✓	✓
Country FE in Yr2000	✓	✓	✓	✓
Observations	2223	2223	2223	2223

Table 5: Using Alternative Measures of Mean State Duration and 2010 GDPPC. The outcome variable in Models 1 and 2 is the logged GDP Per Capita in year 2010 (in PPS thousands EUR per thousand people) calculated using the maximum area within a grid-cell. The outcome variable in Models 3 and 4 are similar in that it is the logged GDP calculated using the average and weighted area within a grid-cell. All models include country fixed effects in year 2000, and robust standard errors are shown in parenthesis.* $p<0.10$, ** $p<0.05$, *** $p<0.01$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mean State Duration	0.944***	1.006***	1.054***	1.155***	1.157***	1.119***	0.868***
	(0.269)	(0.267)	(0.264)	(0.265)	(0.272)	(0.276)	(0.280)
Mean State Duration (Sq)	-1.327***	-1.420***	-1.473***	-1.605***	-1.631***	-1.579***	-1.390***
	(0.318)	(0.318)	(0.314)	(0.317)	(0.313)	(0.318)	(0.328)
Agricultural Suitability		✓	✓	✓	✓	✓	✓
Elevation			✓	✓	✓	✓	✓
Distance to Water				✓	✓	✓	✓
Agri Adoption					✓	✓	✓
Distance to City						✓	✓
Latitude							✓
Longitude							✓
Lat*Lon							✓
Observations	2376	2314	2313	2313	2223	2223	2223

Table 6: Mean State Duration on logged 2010 GDPPC (using Conley standard errors). The outcome variable in all the above models is the logged GDP Per Capita in year 2010 (in PPS thousands EUR per thousand people). All models include country fixed effects in year 2000, and Conley standard errors are shown in parenthesis.* p<0.10, ** p<0.05, *** p<0.01.