Monastic Land Ties and Anglo-Saxon Lords

Doug Puett

QMSS

Columbia University

April 30, 2012
1 Abstract

In this paper, I am investigating the hypothesis put forth by Stephen Baxter that certain Anglo-Saxon earls actively created local network ties with monasteries as a hedge against the changing whims of the monarchy and fate. I construct a social network using land ties and run a regression to attempt to predict wealth using network centrality methods.
## Contents

1 Abstract i

2 Introduction 1
   2.1 Literature Review ............................................. 2
      2.1.1 State Formation ............................................. 2
      2.1.2 Minimalist Interpretation ................................. 5
      2.1.3 Power and Governance ...................................... 6
      2.1.4 Land Rights .................................................. 8
      2.1.5 Role of the Earls ........................................... 8
      2.1.6 Role of the Monasteries .................................... 9
      2.1.7 Contemporary Theories ..................................... 9
   2.2 Research Program ................................................ 11
   2.3 Hypothesis ...................................................... 11

3 Data and Methods 12
   3.1 Data Source—The Domesday Book ................................. 12
   3.2 Methods .......................................................... 15
      3.2.1 Social Network Analysis .................................... 15
      3.2.2 Research Plan ................................................ 17
   3.3 Data ............................................................. 19
      3.3.1 Key Variables ............................................... 19
      3.3.2 Centrality Scores ............................................ 20
      3.3.3 Domesday Data .............................................. 21
   3.4 Data Description ................................................ 24

4 Results and Analysis 26
   4.1 Analysis ......................................................... 26
4.2 Results ........................................................................................................... 26
  4.2.1 Is there a difference in centrality for different types of landowners? .... 26
  4.2.2 Does centrality predict wealth? ............................................................... 29
  4.2.3 How much did each earl donate to monasteries? ............................. 29
  4.2.4 Did earls donate differently to different monasteries? .................... 30
  4.2.5 Did non-earls favor different monasteries? ....................................... 32
  4.2.6 Did wealthier earls donate more to monasteries than less important earls? 33
  4.2.7 Regression weighted by monastic prominence. ............................... 34
4.3 Summary of Results ..................................................................................... 36

5 Conclusion ........................................................................................................ 39

6 Appendices ....................................................................................................... 41
  6.1 Appendix A—Missing Values ................................................................. 41
  6.2 Appendix B—Additional Tables ............................................................. 44
  6.3 Appendix C—Regression Assumptions ................................................... 46

7 Bibliography .................................................................................................... 50
List of Tables

1 Largest Landowners in Domesday Book, 1066 ........................................ 25
2 Descriptive Statistics ........................................................................... 24
3 Description of Closeness Centrality Statistics for Landowner Types ........ 27
4 Regression of log(Wealth) on Centrality, Number of Holdings ............... 29
5 Number of Monastic Ties by Earl ......................................................... 31
6 Popularity for Land Ties by Monastery .................................................. 32
7 1066 Value Predicted by 1086 Value .................................................... 41
8 Land Value predicted by Land Size ....................................................... 42
9 ANOVA for Centrality Statistics by Landowner Type ............................. 44
10 Difference Between Actor Donation by Type ....................................... 45
11 Robust Regression .............................................................................. 48
12 Weighted Monastic Ties without Earl Harold ...................................... 48

List of Figures

1 Social Network Graph ........................................................................... 18
2 Map of Domesday Entries ................................................................... 22
3 Wealth by Landowner Centrality .......................................................... 28
4 Percent Monastic Ties by Total Wealth for Earls ................................. 33
5 Weighted Monastic Ties by Total Wealth for Earls ............................... 35
6 Map of Earl Harold and St. Æthelthryth versus Wealth Density .............. 38
7 Map of Earl Harold and King Edward versus Wealth Density ............... 38
8 Heteroskedasticity .............................................................................. 46
9 Q-Q plot for normality ....................................................................... 47
10 Residual Leverage ............................................................................ 47
2 Introduction

The Anglo-Saxon political landscape is shrouded in mystery. The rulers of England from c. 500 to 1066 AD, they were, in general, incredibly literate and organized statesmen for the time, however few records remain from so distant a past. Even the assumption of political continuity with later periods is impossible to make because the Norman Invasion in 1066 ended Anglo-Saxon kingship and replaced it with a Norman governing hierarchy. Historians who study this remote area of the past must instead base their conjectures on snippets of information from whatever source they can: an extensive corpus of poetry, archaeological findings, a brief set of chronicles, or one of the few laws and charters that have survived to the present times. Even one of the single best historical data sources, the Domesday inquest of 1086 (which also recorded holdings at the eve of the conquest), is merely a terse catalog of holdings with little information beyond what can be found on the land and who holds the rights to it.

Because of the paucity of ready information for Medieval sources, there are heated disagreements on even questions as basic as: “how powerful were the king and his rule?” or, “was there an Anglo-Saxon state?” Some prominent historians such as Paul Hyams deny the political and bureaucratic strength of the Anglo-Saxon polity based on the deeply personal means of the negotiation of power and the resolution of conflict, and instead advance a relatively “minimalist” interpretation of the Anglo-Saxon state. Others, like James Campbell, argue for a strong and coherent Anglo-Saxon “maximalist” political development, based on the king’s profound legislative authority and ability to organize on a large scale. His main piece of evidence is the king’s apparent ability to levy tax and hold a series of inquests (now lost) to determine the taxability of the kingdom. Campbell claims that the Domesday inquest was built on a well-designed and ancient system of inquests used by many Anglo-Saxon kings before the conquest.

---

1Introduction to the Norman Conquest
2Only a few charters have survived or ever existed in the first place. Those that did survive were held mostly by churchs. Very few charters to secular lords survive. Williams (1981), p.171
3Williams (2002)
4Hyams (2003)
5Campbell (2003a)
In order to approach this state-building literature and add to the scope of the state-formation argument, we will see if there is any evidence of extra-political means of maintaining social position and authority within the Anglo-Saxon hierarchy, particularly by forming strong local and inter-personal ties at the local level. To do this, I will be using the Domesday inquest of 1086 (using 1066 reports) to investigate propinquity networks based on land holdings. I will use as a sample the large landowners to see if there is any measurable way that they were able to preserve and augment their wealth through local ties. In short, I am attempting to answer the question: were social networks important to Anglo-Saxon politics? If social networks were in fact an important component of the Anglo-Saxon political system, then there would be substantial extra-state sources of political power and legitimacy which rested on these social ties. This invalidates the claims of those who expound a “maximalist” state, but on the other hand, also supports the existence of standardized means through which political authority may be negotiated, which also is incompatible with the tenets of the “minimalist” interpretation of Anglo-Saxon political development.

2.1 Literature Review

2.1.1 State Formation

Despite the highly personal nature of authority and political relationships, there is also good evidence of at least a fledgling bureaucracy. This exists in both the existence of the Domesday Book itself and the chronicle records evidence that the early English kings were able to extract large sums from their populations, in particular to pay off the demands of Viking invaders. James Campbell even states “Domesday Book, the record of that great state,”

Campbell provides a maximalist interpretation of the Domesday evidence: “That the territory framework of English local government was already established in detail such as it was to remain for very many centuries. That the system of assessment for taxation was a compound of straightforwardness and complexity such that almost every piece of land was under assessment. That

---

6 Campbell (2003a)
7 Campbell (2003a), p. 1
assessments were related together in such a way that the hundred, the basic unit of local government, integrated fiscal, military and judicial functions.”

He continues: “In short it is Domesday, and Domesday alone, which proves that England was an elaborately organised state, using and creating the the resources of a developed economy; but prove this Domesday does.”

Campbell argues that the extensiveness and uniformity of the inquest, the ubiquity of the assessment values and system proves the strength and ubiquity of the governing apparatus.

There is good evidence that the system of inquest evident in the Domesday book predates the 1086 survey substantially, following a very ancient and well-defined system of assessment and organization. Some, such as W. J. Corbett even date the assessment system evident in the Domesday book to the 10th century. Tribute lists dating from the Seventh or Eighth century can also be construed as evidence that royal inquests were already in place at that time. This evidence of royally dictated land assessments comes many hundreds of years before the Domesday Inquest, claiming that the inquests are “cannot possibly be regarded as an essentially discontinuous series, accompanied as they are throughout the Anglo-Saxon period by charters making grants in hides.”

In addition to the written evidence surrounding inquests, Campbell also mentions the presence of Offa’s dyke, asking, “[h]ow could an earthwork over a hundred miles long and more than twenty feet high have been constructed without a detailed system of control and assessment which could deploy and supply very many thousands of diggers?” He also cites ancient forms of authority seemingly dating to the Roman conquest or before as evidence of the antiquity and perseverance of institutional forms in England.

Given the presence of large assessments, the minting of the coinage with which to pay the levies, as well as the long history of land organization and other massive works dating back centuries, Campbell describes a strong national state in pre-Conquest England. In addition to this

---

8 Campbell (2003a), p. 1
9 Campbell (2003a), p. 2
10 Campbell (2003a), pp. 2-3
11 Corbett (1900), pp. 223-30
13 Campbell (2003a), p.5-6
14 Campbell (2003a), p. 6
15 Campbell (2003a), p. 7
strong administrative state, he claims: “It was an entity with an effective central authority, uniformly organised institutions, a national language, a national church, defined frontiers (admittedly with considerable fluidity in the north), and, above all, a strong sense of national identity.”

Important to the evidence of a strong bureaucratic state is the flow of money through it, allowing it to function and allowing it maintain autonomy: “Any defensible interpretation of the English state at that time has to take account of the circulation of a great deal of coin, and of much ‘commercialisation’, not least of military service.” Only a relatively strong state could control not only the minting of coinage, but also the ability to control the flow of this coin through the population, and ultimately back into its own hands. The most important part of this flow of money was the ability of the king to support a substantial military and to pay off Viking invaders. Campbell describes some of the vast amounts of money and resources that the English governing apparatus was able to extract from its population, as in financial data evident from the *Anglo-Saxon Chronicles*, which claims that in the year 1040, the army-tax was paid at almost 22,000 pounds, and later another 11,048 pounds were paid for thirty-two ships. Other very high figures are given for years 981-1018, in which an average of 6,000 pounds a year were levied with a high of 82,000 pounds in 1018.

Campbell discusses the philosophical implications of the governing apparatus’s ability to levy money: “The state probably was... a highly stressed one in which there was a relationship between the power to enforce tax and the use of tax to maintain standing forces. It must have been in important ways highly centralised; one in which the connections between the central authority and the localities mattered very much and one in which the number of men, below the level of sheriff, who were in some sense agents of government was very large.” Campbell argues for the significance of the village reeve as the central tie between the king to the villages of his kingdom. The Anglo-Saxon reeve, from which the Modern English word *sheriff* is derived, had an ambiguous administrative role. Campbell argues that the reeve was the principle collector of the king’s taxes,

---

17Campbell (2003c), p. 201
18Campbell (2003c), p. 202
19Campbell (2003c), p. 207
as opposed to the land-owners themselves. For this reason, Campbell hypothesizes the strength of formal office holders at the expense of the personal authority of the landowners.\footnote{Campbell (2003c), p. 210}

2.1.2 Minimalist Interpretation

In contrast to the institutional arguments given above, there was in addition an unmistakable personal characteristic to any political interaction. Certainly, there is no doubt that social relationships were absolutely essential to living in early England. Based on anthropological evidence, Paul Hyams uses anthropological evidence as well as records from the *Anglo-Saxon Chronicles* and Old English laws to promote an idea that interpersonal feuds were a key source of conflict resolution and was effective even to the point of providing necessary security for the state of the English monarchy.\footnote{Campbell (2003a), p. 8-9}

Anglo-Saxon kin were called on to act in feuds, and were often the only viable source of social protection in the feud-based culture.\footnote{Hyams (2003), p. 14} Evidence for the importance of kinship in feuds abounds, and can be seen in almost any contemporary literary source: in the chronicles, poems such as *Beowulf*,\footnote{Hyams (2003) p. 74 lists a dozen passages as particularly strong evidence of the Anglo-Saxon feud culture. The most authoritative edition is Fulk (2008), but Liuzza (2000) provides an adequate Modern English translation} and even religious texts and hagiographies were written in a feud like mentality.\footnote{The poem *Guthlac* in Krapp and Dobbie (1931) is a depiction of the spiritual trials of St. Guthlac written in surprisingly martial tones.}

Hyams argues that the presence of the system of the feud in fact worked to preserve peace in the kingdom. This line of thinking denies that the king had to take an active role in preserving peace in his country, but also insists that the king, through a system he controls indirectly, could still keep his kingdom in a state of peace.\footnote{Hyams (2003), p. 14-15} Hyams insists that although the king had an active hand in politics, but in contrast to the maximalists, he “find[s] little contemporary evidence of the sharp division between royal government (that is, the state) and society, which the maximalist view would seem to require. Instead [he sees] assertive royal aspirations compelled to co-exist
with something much less than an actual royal monopoly of the means of violence.”

Yet still, Hyams insists that “[r]oyal authority is clearly central to Anglo-Saxon England. The king’s role in all noble affairs over a wide area of the country is paramount in the sources. Politically active contemporaries could never afford to neglect the king in their calculations. The impressive line of vernacular royal leges proves that Anglo-Saxon personal vengeance operated in a context that ostentatiously included public, royal courts willing to exert pressure against private acts they deemed illegitimate.”

Another convincing source of knowledge about Anglo-Saxon personal relationships is the roughly contemporary Iceland sagas as explored by William Ian Miller. Miller does not mince words he describes the importance of feuds to this culture:

The bloodfeud informs every aspect of Icelandic political and legal life. It variously appears as a structure within which political activity takes place, as a means by which that activity is pursued, as the ultimate sanction behind arbitrated settlements and legal judgements, and more.”

While it is unlikely that the English placed quite as much importance on their feuds, there is plenty of evidence in the Anglo-Saxon Chronicles and other sources that the English mentality at least approximated the Icelandic.29

2.1.3 Power and Governance

The “minimalist” position is not without its detractors. Patrick Wormald disagrees with Paul Hyams, that the lack of surviving written evidence of feuds in the Anglo-Saxon period might “indicate that Edmund’s strictures on feud took effect; even that the Old English ‘state’ had begun to claim Weber’s ‘monopoly of legitimate violence’. If so, it was a monopoly that kings had no hesitation in exploiting vigorously.”30 So, there is a conflict between those who thought the king had great personal authority in adjudicating violence and disagreements, whereas others thought

26 Hyams (2003), p. 73
27 Hyams (2003), p. 73
28 Miller (1990), p. 179
29 Hyams (2003), p. 21
30 Wormald (1999a), p. 341
that it was in fact social pressures that overwhelmingly contributed to the peace and stability of the kingdom.

In addition to evidence of institutional development before the Norman Conquest, Wormald finds substantial evidence of England as well as a relatively advanced legal culture. He begins a very complete study of as the English law codes and the implication of the legal culture for the study of English society. Most notably, these laws describe an active and influential king who wielded much power over his subjects. Of course, there is a difference between the laws where the king says what powers he has and what conflicts he could adjudicate, and what the reality for the king’s power were. Wormald describes the early English practice of writing laws as something that Kings did because they thought they were supposed to, based on what they knew about the Romans. Despite the propaganda implications of the laws, Wormald uncovers much evidence that points to the king having an active role creating and maintaining peace in his kingdom.31

Patrick Wormald directly approaches the “statehood” question. While he acknowledges that nowhere did an early medieval government achieve the level of consensus that citizens of modern-day states take for granted, he does acknowledge that the fact that English kings were willing to “punish even their greatest subjects for what they identified as crime, and in the name of the whole community they ruled...whether or not those kings sought to ‘concentrate their material resources’ or had a ‘theory of sovereignty’ with which to buttress their claims.”32 Wormald is willing to ascribe to English kings a good amount of authority over even their most powerful subjects.

There is a conflict in the literature between those who seemed to have thought that the king had nearly unlimited power and those that thought that all power had to be constantly negotiated. To better understand how power was articulated, historians have turned to better understand exactly how the king managed to articulate power in the localities. Their strategies are to better investigate the precise articulation of land rights and how through this means were English kings able to negotiate power and control their subordinates while not necessarily having the full institutional

31 Wormald (1999c)
32 Wormald (1999a), p. 352
apparatus of modern states and while still behaving in way that relies strongly on personal ties.

2.1.4 Land Rights

Given the centrality of personal relationships in Anglo-Saxon governing and judication, there is little evidence that whatever bureaucracy that did exist was a very strong and rational body, instead of being based heavily on personal authority. Not a rational bureaucracy, it seems instead that the primary source of political power in Anglo-Saxon England was land, but it is unclear to researchers how exactly land rights were articulated and used as a mechanism of political power. Stephen Baxter and John Blair expand on this, postulating that the king had great powers to grant and rescind offers of land to the barony as a way to maintain authority over his lords.

Even James Campbell briefly acknowledges that land reciprocity could be governed by the same sort of economic ties that are traditionally associated with a gift-exchange mentality: “Might it not be that in all or many cases what appears to be a sale is really an indication of acceptance of the Germanic principle that any gift should be accompanied by a reciprocal counter-gift, though possibly no more than a formal one?”

2.1.5 Role of the Earls

The Anglo-Saxon earls had considerable power in the localities and were considerable holders of wealth—controlling far more land than those who were not a part of the ruling hierarchy. On the other hand, their positions were quite precarious, as “Anglo-Saxon earldoms could be, and often were, restructured quite radically at the command of the king and his counsellors.” These wealth but precarious barons also formed a counter to the king and his power. While the king wielded much more power than the earls, the earls together were also incredibly powerful, although their

33Campbell (2003a), p. 30
34Reynolds (1994) is a significant work in the re-evaluation of the nature and role of land tenureship in the construction of social power authorities.
35Baxter and Blair (2006), p. 25
36Campbell (2003b), p. 230, although Campbell seems to be more swayed by theories that grant a good deal of property rights, including alienability to individuals.
37See Table 1, below
38Baxter (2007), p. 6, from Freeman, NC, ii. 571-85 (Note G)
authority stemmed from the king, who never allowed the earls to gain too much of an upper hand.\textsuperscript{39} The power of the earls, “did not rest simply on the possession of land, but upon the network of patronage and influence which such possessions enabled him to exercise.”\textsuperscript{40} While the Anglo-Saxon lords were very wealthy, they had to negotiate their power with both the king and with local power sources, in order to maintain their wealth and privilege.

### 2.1.6 Role of the Monasteries

In all of the turbulence of Anglo-Saxon politics, monasteries were not subject to the same rules as temporal lords:

Religious houses were relatively stable centres of power in a world where secular lordship was often volatile and ephemeral; many of them were richly endowed and therefore constituted powerful lordships in their own right; and their spiritual and social functions made them natural focal points for local identity and allegiance.\textsuperscript{41}

This made them attractive as a secure source of wealth and power, but spiritual as well as temporal. Baxter, in his analyses, focuses in particular on the patronage of Leofricsons. This analysis is particularly effective because of the deep religious piety of the Leofricsons in addition to any secular aims they may have had. Their piety was so deep that there exists a narrative \textit{Vision of Earl Leofric}, a “vivid account of the earl’s divine visions, experienced in reward for his deep piety,”\textsuperscript{42} which survives from the late eleventh-century.

### 2.1.7 Contemporary Theories

To fill the gap of knowledge in how power is articulated, scholars have begun to concentrate on the negotiation of power in localities. To quote Michael Innes:

In the localities we meet forms of political leadership which were inherently personal, resting on one-to-one obligation and the recognition of transcendent moral qualities. Power, deeply unequal in its distribution within a profoundly hierarchical society, rested in reciprocity. It depends on informal channels of moral obligation and social

\textsuperscript{39}Baxter (2007), p. 9
\textsuperscript{40}Williams (1981), p 177
\textsuperscript{41}Baxter (2007), p. 14
\textsuperscript{42}Baxter (2007), p. 1
pressure, not constitutional positions. In such a world, power could only be negotiated and shared.\textsuperscript{43}

A possible solution to the tension between the “minimalist” and “maximalist” camps may be resolved by locating and analyzing loci of power centered in the localities.

One historian in particular embarks on this type of local-level investigation for the Anglo-Saxons. Stephen Baxter, in his \textit{Earls of Mercia}, hypothesizes that land holding was a way for the King to retain power over his lords, granting and taking back control over land as a system of rewards and punishments. However, lords could also do certain things in an attempt to hold power, especially by forming local ties to hedge against the precarious nature of national politics. To quote from Baxter and Blair:

\begin{quote}
The power of earls was considerable but precarious, for they could easily lose control of all or part of their earldoms and the comital manors which came with them. To compensate for this, earls sought to augment their power by constructing networks of allies and clients in the shires where they held office, forming connections with richly endowed and powerful monasteries, and encouraging men from all ranks of society to commend themselves into their lordships. Such strategies enabled earls to plug into local circuits of power, but they also had the effect of intensifying the rivalry between earls, especially in the debatable territory of the Midlands where earls were placed in direct competition for land, allies, and clients.\textsuperscript{44}
\end{quote}

The central hypothesis of Baxter’s \textit{The Earls of Mercia} is that the Leofwinsons did just this to retain power from 970-1066, using especially their patronage of monasteries to create a wealth of stable power in the localities. This allowed them one of the longest and most powerful reigns of earldom in the late Anglo-Saxon period, only falling from power after the Norman Conquest. Although Baxter claims that while the Leofwinsons are somewhat special, especially in their longevity, he also claims that their example should be studied in particular to better inform our knowledge late Anglo-Saxon political society at large.\textsuperscript{45}

\begin{footnotes}
\footnotetext[43]{Innes (2000), p 9-10}
\footnotetext[44]{Baxter and Blair (2006), p. 45}
\footnotetext[45]{Baxter (2007), p. 9}
\end{footnotes}
2.2 Research Program

My plan is to follow in the vein described by Stephen Baxter in his work and look at what the English nobles did to retain power in the turbulence of Dark Age power struggles. One of his central hypotheses—that the House of Leofwin retained power by developing local ties to hedge against the changing fortunes of the whims of the monarch, mostly by devotional donations to monasteries—is in fact testable on a wider scale, by using a network analysis based on propinquity ties. If an earl or other powerful landlord holds land in a village that also has monastic holdings, then it is likely that the land tie arose from a gift from the lord to the monastery and could indicate a strong social tie.\footnote{Baxter (2007) p. 190 uses a similar argument to argue for a connection between Earl Ælfgar and Crowland Abbey.} Using Domesday data for 1066, I will construct a network based on these ties and then see if connectedness is in anyway tied to the overall strength of the lords. In lieu of an objective measure of lord strength, I will use overall wealth of the lord as an indicator of strength, which will be my primary dependent variable of interest.

2.3 Hypothesis

My hypothesis is that Anglo-Saxon land-owners, especially earls, donated land to monasteries in order to secure their position in society and to act as a hedge against the changing whims of the monarch and fate, by giving them an alternative source of power than the king. I also hypothesize that these ties have a geographical significance. To test this hypothesis, I use social analytic and geographic techniques to investigate the 1066 Domesday records. I expect to find within the social network graph of propinquity land ties evidence of collusion between earls and religious monasteries. As a proxy for beneficial outcomes, I am going to see if patronage led to any more wealth or social standing for earls by giving them additional connections to sources of wealth and power. My motivation for this is the precedent set by Baxter,\footnote{Baxter (2007), p. 190} who used evidence on shared land ties to advance his argument of patronage between Earl Ælfgar to Crowland Abbey.
3 Data and Methods

3.1 Data Source—The Domesday Book

The data for this analysis comes from a recording of the Domesday inquest, a census initiated in 1086 by King William to account for all for all of the land under William’s control. The central purpose of the inquest was to record the value of all of the land in order to be able to effectively measure the tax obligation to the king for all of the land in the country. In fact, the word “domesday” is early English for “day of judgment,” or the day when the value and ownership of each piece of land was judged and accounted for. It recorded land holdings for both 1086 and 1066, on the last day of the reign of King Edward, William’s predecessor. It was also the most detailed accounting of land and men until the nineteenth century and has long been invaluable to researchers searching for information on the nature of society in the era surrounding the Norman Invasion.

There are disputes in the literature about even the purpose of the inquest. David Roffe, in his Decoding Domesday, has even postulated that the Domesday inquest was administered many years after 1086 as part of William’s son Rufus’ attempt to regain control hold of the kingdom after a rebellion, and did not actually take place in 1086 as the records themselves indicate.

The main form of the data is the recording of a land plot, its location (county, hundred, and vill), land value, value of the property on the holding (animals, mills, etc.) as well as the immediate Lord and the Lord’s Lord, or Overlord. I use as my main dependent variable the total amount of wealth of the Overlords, with the main independent variable being a centrality measure based on a social network constructed from land holding proximity. I count as a tie any two holdings in the same village, on the assumption that many instances of close proximity are indicative of a close social tie between the two land owners. There are many problems with the data, such as inconsistencies in reporting and the collection of data. The largest problem is missing values, and I will have to develop ways to deal with handling these missing values.

[48]The Domesday data was digitized by John Palmer and can be accessed at Palmer (2012).

[49]See Appendix A
Although a longitudinal study would be a useful analysis in order to demonstrate evidence of the power and influence of lords, the fact that the Domesday Inquest only recorded holdings for one moment in time prior to the Norman Invasion prohibits this type of analysis. Even if there is a history of Anglo-Saxon inquests before 1086, as James Campbell claims, no records remain. Using the 1086 component of the Domesday book would also be an unsatisfactory solution. The Norman records from 1086 are evidence from an entirely different political system than the Anglo-Saxon polity that preceded it. When William the Conqueror took control of England, he replaced most of the hierarchy and the major landowners, making a study of both sets of data impossible to compare against each other. Instead, we can work only on a single moment of data. In order to establish a measure of power and success, I instead will use the assumption that wealth and importance were not only correlated, but also that wealth stems from the accumulation of status over time, and indicates a life-time of successful political maneuvering.

The reasons for using wealth as a proxy for status and longevity is purely theoretical. The best evidence I can point to is the obvious correlation between wealth and status, at least partially. Table 1 shows the country’s largest landowners, and is a clear power hierarchy based on wealth. After the King and the Queen, the next most powerful lord is Earl Harold, who ends up ruling England for a brief moment after the death of King Edward, before the Norman Conquest. While he does not have the most wealth after the royal family, he does have the next highest number of holdings by a large margin, which provides some reason to believe that wealth and number of holdings can be appropriate metrics for measuring influence. Assuming the validity of using wealth as a proxy for influence, if there exists a correlation between social ties and wealth, then there will also be the corresponding case for the correlation between social ties and political success.

There are other problems with using Domesday data. In addition to problems common with any medieval data source, there are also problems associated with the collection of a large data set. Problems common to medieval sources include problems of recording information in writing and the trustworthiness of the sources. All records had to be written in hand, and there are certain

---

50Campbell (2003a)
to be many problems with the transcription of the records into the final written record. There were certainly many problems in generating the data too. Although the inquest was supposed to include a record of every land plot in the country, and the final result is impressive in its scale, it is incredibly unlikely that it was as comprehensive as the design indicates. This could be the result of many factors, from neglect or incompetence on behalf of the administrators, to a reluctance to provide information on behalf of those surveyed.

An additional complication in this particular case is that the inquest records results from twenty years earlier. The survey was conducted in 1086, but also recorded landowners in 1066, on the day on which “King Edward was both alive and dead,” before King William began his reign. It is doubtful that information from twenty years earlier would be entirely accurate, even for a society for which land ownership was pivotal. In addition, there were many disputes that were adjudicated in the process of the inquest. The inquest was not simply a passive collection of data, but actively constructed an image of reality. Information was certainly lost or fabricated in the process of the collection of data. Because of the highly personal nature of the construction of the data, there are likely to be inconsistencies across different administrators. The largest problem, however, is incompleteness in the dataset. There are many gaps and holes even in the data that did manage to get collected, and I will have to find a way to account for this missing information, possibly by using a technique such as multiple imputation.

Despite all of the flaws of using the Domesday Book as a historical data source, it is still an invaluable resource for exploring early English society, and is comprehensive enough that with careful diligence, valuable insights may still be extracted. I will be using the records to estimate the wealth of each landowner and then will use the location of each holding to establish the presence of land ties which will describe a social network graph, which I will analyze using the methods of social network analysis.
3.2 Methods

3.2.1 Social Network Analysis

The central strategy in this analysis is the use of the methods of social network analysis. This collection of techniques have been growing in sophistication throughout the twentieth century from its humble roots in the work of early theorists such as Georg Simmel, and have become a pivotal component of Sociology as well as several other fields in the social sciences. The primary focus of social network analysis is the relationship between actors rather than the actors themselves, which has been the traditional approach in most of the history of social science disciplines. The current authority for social network analyses is still Stanley Wasserman’s *Social Network Theory* which highlights the basic assumptions and techniques for the study of social networks. The most important of these assumptions is that the relationships between interacting units are significant and that, “[a]ctors and their actions are viewed as interdependent rather than independent, autonomous units.” The importance of kinship ties and a feud-like culture among the Anglo-Saxons validate the applicability of these assumptions. As much as in any other period of political action, Anglo-Saxon politics was highly personal. This is a culture that defined the loss of a lord as the greatest possible personal loss, as exemplified in such literary endeavors as *The Wanderer*. In addition to personal authority, there was an obvious need for a high-level of control and support mechanisms as demonstrated by a long history of inquests and competent tax extraction. Land-holding in particular, was subject to a wide variety of network considerations. The king arguably used land grants to award, motivate, and control his earls, keeping them competitive against each other.\(^{52}\) Thus, there are good reasons to look at all of the forms of ownership and social relations together at one moment in time to discover how they were related to one another.

Wasserman lays out the basic assumptions for the study of social networks on page 4 of his *Social Network Theory*. In addition to assumption that relationships themselves are significant, the other assumptions are as follows: 2. “Relational ties (linkages between actors are channels for

---

51 Wasserman (1994), p. 4
52 Baxter (2007)
transfer or ‘flow’ of resources (either material or nonmaterial)” 3. “Network models focusing on individuals view the network structural environment as providing opportunities for or constraints on individual action,” and finally, 4. “Network models conceptualize structure (social, economic, political, and so forth) as lasting patterns of relations among actors.”

The validity of assumption 2 is the central hypothesis of this study. I am investigating the possibility that some sort of material benefit is being transferred across the social network. In particular, I am investigating whether Anglo-Saxon Earls, whose position in the hierarchy is highly vulnerable, receive any benefit from their ties to monasteries, who are very secure in their source of power, at least in the period of time I am studying. Power flow across ties is already well documented in personal economic relations, in the form of the reciprocal gift-giving relations of Marcel Mauss’s, *The Gift*. William Ian Miller, in his *Bloodtaking and Peacemaking*, extends the ideas of reciprocal giving to small-scale power relationships in saga-era Iceland (a period of time so close to Anglo-Saxon England chronologically and culturally that historians have a reasonable belief that their languages were co-intelligible53). Despite William Ian Miller’s comprehensive treatment of small-scale reciprocal action, there has not been any study that tried to identify these relations on a national level. Similarly, I am checking the validity of assumption 3 as well. If the ties that earls gain from their position in the social network provides them opportunity, I should be able to see a correlation between their centrality and the centrality of those they patronize with their overall wealth or position in society. The degree to which the network constrains their actions is obvious from my assumption that these ties were rather costly to form, being only evident in the form of donation of land to monasteries. The final assumption is upheld given the centrality of political life and land-ownership as the primary form of wealth and source of political power. Land ownership was a long-term relationship, as is the patronage between a baronial family and a monastery, which is a relationship could span several generations.

53The goading scene in *The Battle of Maldon* is the most vivid display of co-communication between the speakers of Old Norse and Old English.
3.2.2 Research Plan

With all of the assumptions of social network theory met, we can make a strong case for the Anglo-Saxon political landscape being a network, and we can test the validity of the network based on land-holding ties. In this way, we can use a quantifiable way to measure how important and embedded each actor is in this network. The primary measurement of an actor’s place within a network is the actor’s centrality, which will be a critical variable in our analysis. Although we would like to form a network based on personal relationships, we do not have explicit information about who strongly associated with whom. However, we do have a hypothesis based on the research done by Stephen Baxter that village ties can be used as a proxy for personal relationships. I am going to use these land ties to form a social network for Anglo-Saxon lords. These land ties will be determined by village-level propinquity ties as a proxy for a close relationship between two actors. If two actors share holdings in the same village, it is likely that there is some sort of connection between the actors. In the best case, these ties will prove to be an indicator of a donation between one actor to another, especially in the case of earl and monastic ties as Stephen Baxter analyzes in his work.

A visual representation of this network graph is given in Figure 1. As the graph indicates, there is a series of strong ties running from the top left through the bottom right of the graph. These include several key loci of network ties: The King and Queen, Earl Harold and the large monasteries at Bury and Ely. The main object of focus is the earls and their relationships to the monasteries. Once we have established a framework of thinking about how the earl-monastic ties are different than other types of ties, we can look at what makes the individual earls and individual monasteries different and see what conclusions we can draw about the nature of individual ties and if they seem to be beneficial in any way to those that held them.

To analyze these connections, there are several specific questions that will help scrutinize the role and importance of these connections, especially how they predict the wealth of the actors and the particular difference between the various groups of actors. To address these concerns, I have formulated a few specific questions:

1. Do centrality scores predict wealth?
Figure 1: Social Network Graph
2. How much did each earl donate to monasteries?

3. Is this different from how other actors donated to monasteries?

4. Did earls donate differently to different monasteries?

5. Did non-earls favor different monasteries?

6. Did richer earls donate more to monasteries than less important earls?

Altogether, these questions attempt to situate and frame the role that ties have in distinguishing different lords. If propinquity ties were random and were not motivated by geographical or social means, then there would not be any way to distinguish between the ties that any one landowner or group of landowners have from any other. These questions are designed to root out the exact nature of these differences to see what may drive the formation of link ties. No information about what distinguishes any group from another demonstrates randomness in the process, but difference allows us to begin to make claims about how ties were formed and for what purpose.

The main object of focus is the earls and their relationships to the monasteries. Once we have established a framework of thinking about how the earl-monastic ties are different than other types of ties, we can look at what makes the individual earls and individual monasteries different and see what conclusions we can draw about the nature of individual ties and if they seem to be beneficial in any way to those that held them. Furthermore, we will see if any of our analyses change when we only look at strong connections where there are multiple ties between earl and monastery. Finally, we will see how any of this correlates to both wealth and to centrality, to see which measure shows the stronger correlation with the formation of these ties.

3.3 Data

3.3.1 Key Variables

The key dependent variable that I will be investigating is the total value of a person’s holdings, to see if there is a correlation between size of total holdings and if there is anything that contributes
to an earl being able to hold onto these holdings in any measurable way, that is, through social networks. I will also be investigating the differences between different types of landowners to see if there is a substantial difference in the structures of their networks. In particular, I plan to look at earls, secular clergy, religious clergy, and other land holders as discrete types of individuals. If there are substantial differences between the structures of their networks, I can make a case that an individual’s social network was not created purely by chance but reflects to some degree their position in society. The key indicator of an actor’s structure in the social network is their score of network centrality, which will be one of the primary independent variables.

3.3.2 Centrality Scores

Network centrality is a measure of an actor “prominence,” which offers a way to distinguish between important and non-important actors. Wasserman explains the importance of actor centrality: “Prominent actors are those that are extensively involved in relationships with other actors. This involvement makes them more visible to the others.” This is important because, as Wasserman reports, “sociological and economic concepts such as access and control over resources, and brokerage of information, are well suited to measurement. These concepts naturally yield a definition of centrality since the difference between the source and the receiver is less important than just participating in many interactions.” Since close village-level ties are likely significant to an agrarian and hierarchical society, “those actors with the most access or most control or who are the most active brokers will be the most central in the network.” For the case of this study, we are not concerned why exactly these networks are formed, but rather assume that the more deeply embedded an landowner is in the network, the more they are able to support and sustain large property holdings. Several different measures exist to measure centrality, there are several including degree, closeness, and betweenness centrality, which are the most widely-used.

54 Wasserman (1994), p. 169
For this study, I am going to use the measure of closeness centrality. “The measure focuses on how close an actor is to all the other actors in the set of actors. The idea is that an actor is central if it can quickly interact with all others.” This measure is especially valid since an important lord might need to mobilize his resources and those of his allies quickly. In this case, an actor with a high centrality will have an advantage over an actor with a low centrality score, who would have to use more intermediaries to connect to all of the other important actors in the network. The formula for closeness centrality is:

$$C_C(v) = \frac{|V| - 1}{\sum_{t \in V \setminus v} d_G(v, t)}$$  \hspace{1cm} (1)

where $v \in V$ are vertices of the social network, $G$ is the graph, $d$ is distance between vertices. Table 2 shows the summaries from this statistic, as well as wealth and counts, both of which will be discussed below, for each lord. Since this centrality measure is an indication of how prominent an actor is in a network, I will be running regressions over this variable. I will first regress on this factor as an explanation of wealth, as centrality measures social importance instead of economic importance, and second, will use this measure of prominence as a way to weight the relative importance of different actors in determining the importance of their ties.

### 3.3.3 Domesday Data

The Domesday book contains information for 28,701 different plots of land over which I will run this analysis. For each piece of land we have the following information: the location of the parcel of land, who owns the parcel, and the quality and worth of the land. There are also numerous qualitative descriptions about what the land contains, but none of this is directly useful to our analysis. A map showing a visual description of some of this data is given in Figure 2.

The largest sub-unit of England is the county or shire. The largest counties, Yorkshire and Suffolk, have about 3,000 holdings each. The smallest, Rutland, has 23 holdings. The average is

---

60Freeman (1979), p. 215-239  
61PAS (2012)
Figure 2: Map of Domesday Entries
around 847 holdings. The next largest unit of land is a hundred. Smaller than a shire, a hundred is theoretically enough land to support a fighting force of 100 men. The largest hundreds have about 300 holdings, but these are the exception and most have only a few dozen holdings. The mean size is 39 entries per hundred.

A Vill is the smallest unit of land that we have recorded. It is by this measure that I will establish if two lords have a social tie. The largest vills have around 40-60 holdings, but the vast majority of them are very small, nearly all of which have less than 7 holdings, with a mean of 2.5 holdings per village. This number is small enough that sharing a village tie with another landowner is likely to be a relatively rare event, and interesting enough to run an analysis over.

Also contained in the Domesday data is information about the rulers of the land. There is a distinction in the data between two types of rulers. There is the overlord, who is the highest owner who has claim to a unit of land, and the Lord, who is has more immediate control over a plot of land. The largest Land-owner is, naturally, King Edward. The next several largest landowners are two abbeys, a secular clergyman (bishop) and an earl. This indicates that there was a diversity in the largest landowners. Table 1 shows the largest English landowners and Table 2 contains the summary statistics for these landowners. These are the immediate Lord over a plot of land. Often the lesser lords are small landowners, as indicated by the 1,313 units of land controlled by “one free man,” or a man of too little significance for his name to be recorded.

In addition to owner and location, we have several different pieces of information about the land itself. We measure the size of each holding as well, in the unit of hides. This measure is over every unit and subunit of land. The average is 1.5 hides per unit. There are 726 missing values, which makes using these values a variable in the analysis difficult, but not impossible. Value of holdings in 1066: This is the estimated value of the land in 1066, based on holdings. There are 13,040 missing values, which is significant. I will have to use various methods of extrapolation to fill out these values, which is approximately half of the total plots. The average value is approximately 5.365. And since the data also includes 1086 information, we also have the value of holdings in

---

62Hollister (1962)
1086. This is the estimated value of the land in 1086, when the inquest takes place. While not directly relevant to work on Anglo-Saxon England, this is a much more comprehensive data set than the 1066, but is differs in places from the 1066 data, but is still nevertheless a useful means for imputing missing 1066 data. The average value of a holding is 4.72, which demonstrates the difference with the 1066 values. A fuller summary analysis of land values follows in Appendix A, concerning the imputation of these missing values.

After the imputation, I aggregated the data to form composite scores for each lord, giving their overall wealth, and number of accounts. This aggregation also reduces the error inherent in imputations, as summing many normally distributed values together reduces the variation in the data. After aggregating, we can get a good sense of what comprises the Anglo-Saxon aristocracy by looking at the largest landowners, as in Table 1.

### 3.4 Data Description

Table 2 show the summary statistics for the aggregated lordship data. All of the data is right-skewed, as evidenced by the difference between the mean and median for each score. This difference would be accentuated if we had included more of the 1086 data. Censoring the data after 47 lords maintains a little bit of normality in the data. Figure 2 shows a visual of the social network generated by propinquity ties. Especially noteworthy is the most important nodes running largely from the top left hand corner to the bottom right hand corner of the graph, where the highest density of lines lay. The most important abbeys are in the top left, especially the abbey at Ely. In the middle are the most important earls, especially Earl Harold, who briefly becomes king after King Edward’s death, and the King and Queen themselves in the bottom right-hand corner. These few people are at the top of the wealth hierarchy, and seem to have the most distributed and powerful holdings in the kingdom. Likely, these are the primary seats of power in Anglo-Saxon England.
Table 1: Largest Landowners in Domesday Book, 1066

<table>
<thead>
<tr>
<th>Lord</th>
<th>Wealth</th>
<th>Properties</th>
<th>Type</th>
<th>Centrality</th>
</tr>
</thead>
<tbody>
<tr>
<td>King Edward</td>
<td>30843.95</td>
<td>965</td>
<td>King</td>
<td>1.00</td>
</tr>
<tr>
<td>Earl Morcar</td>
<td>8244.73</td>
<td>285</td>
<td>Earls</td>
<td>0.77</td>
</tr>
<tr>
<td>Earl Harold</td>
<td>7519.54</td>
<td>507</td>
<td>Earls</td>
<td>0.92</td>
</tr>
<tr>
<td>Earl Edwin</td>
<td>7289.57</td>
<td>331</td>
<td>Earls</td>
<td>0.79</td>
</tr>
<tr>
<td>Queen Edith</td>
<td>3404.73</td>
<td>182</td>
<td>Queen</td>
<td>0.84</td>
</tr>
<tr>
<td>Earl Tosti</td>
<td>2747.58</td>
<td>246</td>
<td>Earls</td>
<td>0.81</td>
</tr>
<tr>
<td>Earl Siward</td>
<td>2565.60</td>
<td>40</td>
<td>Earls</td>
<td>0.54</td>
</tr>
<tr>
<td>York (St Peter), archbishop of</td>
<td>1943.49</td>
<td>126</td>
<td>Bishop</td>
<td>0.66</td>
</tr>
<tr>
<td>Winchester (St Peter &amp; St Swithun), bishop of</td>
<td>1864.68</td>
<td>92</td>
<td>Bishop</td>
<td>0.73</td>
</tr>
<tr>
<td>Canterbury (Christ Church), archbishop of</td>
<td>1766.76</td>
<td>101</td>
<td>Bishop</td>
<td>0.65</td>
</tr>
<tr>
<td>Ely (St Æthelthryth), abbey of</td>
<td>1401.51</td>
<td>163</td>
<td>Monastery</td>
<td>0.87</td>
</tr>
<tr>
<td>Ulf (Fenman)</td>
<td>1352.67</td>
<td>146</td>
<td>Other</td>
<td>0.71</td>
</tr>
<tr>
<td>Archbishop Stigand</td>
<td>1323.56</td>
<td>116</td>
<td>Bishop</td>
<td>0.84</td>
</tr>
<tr>
<td>Worcester (St Mary), bishop of</td>
<td>1209.53</td>
<td>85</td>
<td>Bishop</td>
<td>0.68</td>
</tr>
<tr>
<td>Glastonbury (St Mary), abbey of</td>
<td>1195.13</td>
<td>74</td>
<td>Monastery</td>
<td>0.62</td>
</tr>
<tr>
<td>Earl Godwin</td>
<td>1172.74</td>
<td>41</td>
<td>Earls</td>
<td>0.64</td>
</tr>
<tr>
<td>Earl Ælfgar</td>
<td>1092.98</td>
<td>108</td>
<td>Earls</td>
<td>0.79</td>
</tr>
<tr>
<td>Westminster (St Peter), abbey of</td>
<td>927.89</td>
<td>68</td>
<td>Monastery</td>
<td>0.61</td>
</tr>
<tr>
<td>(Bury) St Edmunds, abbey of</td>
<td>833.97</td>
<td>136</td>
<td>Monastery</td>
<td>0.77</td>
</tr>
<tr>
<td>Winchester (St Peter), abbey of</td>
<td>807.42</td>
<td>26</td>
<td>Monastery</td>
<td>0.52</td>
</tr>
<tr>
<td>Chester (St John), bishop of</td>
<td>792.35</td>
<td>93</td>
<td>Bishop</td>
<td>0.66</td>
</tr>
<tr>
<td>Earl Gyth</td>
<td>682.57</td>
<td>60</td>
<td>Earls</td>
<td>0.74</td>
</tr>
<tr>
<td>Ulf</td>
<td>610.55</td>
<td>154</td>
<td>Other</td>
<td>0.73</td>
</tr>
<tr>
<td>Salisbury (St Mary), bishop of</td>
<td>584.25</td>
<td>29</td>
<td>Bishop</td>
<td>0.53</td>
</tr>
<tr>
<td>Orm (son of Gamal)</td>
<td>552.01</td>
<td>67</td>
<td>Other</td>
<td>0.62</td>
</tr>
<tr>
<td>Canterbury (St Augustine), abbey of</td>
<td>537.35</td>
<td>28</td>
<td>Monastery</td>
<td>0.59</td>
</tr>
<tr>
<td>Ramsey (St Benedict), abbey of</td>
<td>522.88</td>
<td>81</td>
<td>Monastery</td>
<td>0.69</td>
</tr>
<tr>
<td>Abingdon (St Mary), abbey of</td>
<td>507.50</td>
<td>35</td>
<td>Monastery</td>
<td>0.62</td>
</tr>
<tr>
<td>Aluin</td>
<td>499.10</td>
<td>375</td>
<td>Other</td>
<td>0.81</td>
</tr>
<tr>
<td>Ralph the constable</td>
<td>479.80</td>
<td>80</td>
<td>Other</td>
<td>0.70</td>
</tr>
<tr>
<td>Lincoln (St Mary), bishop of</td>
<td>468.44</td>
<td>40</td>
<td>Bishop</td>
<td>0.63</td>
</tr>
<tr>
<td>Brictric</td>
<td>441.57</td>
<td>51</td>
<td>Other</td>
<td>0.53</td>
</tr>
<tr>
<td>Earl Leofwin</td>
<td>424.04</td>
<td>39</td>
<td>Earls</td>
<td>0.66</td>
</tr>
<tr>
<td>Brictric son of Algar</td>
<td>422.64</td>
<td>32</td>
<td>Other</td>
<td>0.55</td>
</tr>
<tr>
<td>Godric</td>
<td>400.27</td>
<td>342</td>
<td>Other</td>
<td>0.82</td>
</tr>
<tr>
<td>Ælfric</td>
<td>395.77</td>
<td>280</td>
<td>Other</td>
<td>0.74</td>
</tr>
<tr>
<td>Godwin</td>
<td>391.25</td>
<td>292</td>
<td>Other</td>
<td>0.79</td>
</tr>
<tr>
<td>Earl Waltheof</td>
<td>372.52</td>
<td>71</td>
<td>Earls</td>
<td>0.72</td>
</tr>
<tr>
<td>Edric of Laxfield</td>
<td>371.35</td>
<td>39</td>
<td>Other</td>
<td>0.69</td>
</tr>
<tr>
<td>Shaftesbury (St Edward &amp; St Mary), abbey of</td>
<td>352.57</td>
<td>21</td>
<td>Monastery</td>
<td>0.55</td>
</tr>
<tr>
<td>Siward (Barn)</td>
<td>347.89</td>
<td>60</td>
<td>Other</td>
<td>0.61</td>
</tr>
<tr>
<td>Edric (of Laxfield)</td>
<td>329.97</td>
<td>44</td>
<td>Other</td>
<td>0.77</td>
</tr>
<tr>
<td>London (St Paul), bishop of</td>
<td>329.96</td>
<td>19</td>
<td>Bishop</td>
<td>0.55</td>
</tr>
<tr>
<td>Wihtgar (son of Ælfric)</td>
<td>328.14</td>
<td>42</td>
<td>Other</td>
<td>0.70</td>
</tr>
<tr>
<td>Dover (St Martin), canons of</td>
<td>324.52</td>
<td>28</td>
<td>Monastery</td>
<td>0.57</td>
</tr>
<tr>
<td>Gospatric (son of Arnketil)</td>
<td>324.09</td>
<td>122</td>
<td>Other</td>
<td>0.66</td>
</tr>
<tr>
<td>Toki (son of Auti)</td>
<td>321.68</td>
<td>78</td>
<td>Other</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Table 2: Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Median</th>
<th>Mean</th>
<th>3rd Qu.</th>
<th>Max.</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wealth</td>
<td>321.7</td>
<td>584.3</td>
<td>1941.0</td>
<td>1281.0</td>
<td>30840.0</td>
<td>3.658e-13</td>
</tr>
<tr>
<td>Counts</td>
<td>24.0</td>
<td>145.0</td>
<td>232.5</td>
<td>236.0</td>
<td>2851.0</td>
<td>1.003e-12</td>
</tr>
<tr>
<td>Closeness</td>
<td>0.5227</td>
<td>0.6866</td>
<td>0.6931</td>
<td>0.7667</td>
<td>1.0000</td>
<td>0.2423</td>
</tr>
</tbody>
</table>

*p-values are from the Shapiro-Wilk test for normality
4 Results and Analysis

4.1 Analysis

The primary avenue of analysis is to see if network centrality was a positive correlate with wealth, using a linear regression. However, even if there was evidence of a positive correlation, that would still not be very significant because network centrality would be highly correlated with the number of holdings that lord has, without regard to the specific structure of their network.

After investigating differences, I will start to look for differences in landowners to see if there are any significant differences between landowners by comparing percent monastic ties. The percent ties are derived by dividing the number of ties between an earl and a monastery over the number of holdings that earl has.

Therefore, it is necessary probe deeper, looking instead at the percent of ties for each lord instead of the sheer number counts. After looking at percents, I want to know if strategic targeting of the earls was in any way beneficial, and I can measure that by weighting the targets by the number of ties that each lord has with each monastery and pooling the results into a single variable for regression. If the correlation between percent monastic ties and the wealth of the earls is positive and statistically significant, a strong case can be made for the importance in propinquity land ties in constructing and maintaining wealth among Anglo-Saxon lords.

4.2 Results

4.2.1 Is there a difference in centrality for different types of landowners?

Which types of landowners are the most connected? Table 3 shows the difference in centrality between the different types of landowners.

The key finding is that while land ownership is highly unequal, difference in centrality is far more measured. Both the total land wealth and number of land holdings are highly unequal with a strong right-skew. However, the the centrality scores do not greatly reflect this. Closeness cen-
Table 3: Description of Closeness Centrality Statistics for Landowner Types

<table>
<thead>
<tr>
<th>Type</th>
<th>Min.</th>
<th>1st Qu.</th>
<th>Median</th>
<th>Mean</th>
<th>3rd Qu.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>King</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Queen</td>
<td>0.8364</td>
<td>0.8364</td>
<td>0.8364</td>
<td>0.8364</td>
<td>0.8364</td>
<td>0.8364</td>
</tr>
<tr>
<td>Earl</td>
<td>0.5412</td>
<td>0.6725</td>
<td>0.7543</td>
<td>0.7378</td>
<td>0.7931</td>
<td>0.9200</td>
</tr>
<tr>
<td>Bishop</td>
<td>0.5349</td>
<td>0.6301</td>
<td>0.6571</td>
<td>0.6559</td>
<td>0.6765</td>
<td>0.8214</td>
</tr>
<tr>
<td>Monasteries</td>
<td>0.5227</td>
<td>0.5787</td>
<td>0.6134</td>
<td>0.6411</td>
<td>0.6703</td>
<td>0.8679</td>
</tr>
<tr>
<td>Other</td>
<td>0.5287</td>
<td>0.6392</td>
<td>0.6970</td>
<td>0.6905</td>
<td>0.7481</td>
<td>0.8214</td>
</tr>
</tbody>
</table>

Closeness centrality in fact passes the Wilk-Shapiro test for normality. While there is certainly likely a positive correlation between wealth and network centrality, it is unlikely that centrality will be a significant driver of the vast differences in wealth recorded by the Domesday Book.

Although the ANOVA test finds a statistically significant difference in the groups for their centrality statistics, it is clear from a visual inspection of the data and from a Tukey test that the primary difference between the groups lies in difference between the King and the Queen and the rest of the kingdom. The other groups look relatively similar to each other in terms of their centrality in the social network formed by land ties. This seems to reject the hypothesis that different groups of landowners had vastly different ownership patterns from each other (aside from the King, of course). It may be that what is more important is the differing relationship between two specific groups, such as the relationship between the earls and the monasteries. Any information this specific is not supported by the data and thus more work still needs to be done to analyze the particulars of these relationships. While the earls do have slightly higher rates of centrality, this may be because they had more wealth in general than the non-royal landowners. To test this, I am going to see if there is in fact a correlation between wealth and centrality. Figure 3 shows the relationship between percent monastic ties and the wealth of the earls.
Figure 3: Wealth by Landowner Centrality

![Graph showing wealth by landowner centrality. The x-axis represents centrality, and the y-axis represents log(Wealth). Different symbols are used to represent different categories: King, Queen, Earls, Bishops, Monasteries, Other.](image)
4.2.2 Does centrality predict wealth?

The solid line in Figure 3 is the best-fit-line on all of the lords. The dotted line is the best-fit-line with only the earls. There is clearly an increase in Wealth along with centrality, and this is more important to earls than it is for the other landowners, since the regression line is steeper than it is for the group of lords as a whole. Despite the strong correlation between centrality and wealth, most of this effect has to do with the fact that the greater number of holdings is spurious to both variables. Indeed, when we take a regression accounting for the number of holdings a lord has, the centrality score is no longer a statistically significant predictor on wealth:

| Estimate  | Std. Error | t value | Pr(>|t|) |
|-----------|------------|---------|---------|
| (Intercept) | 5.5585 | 1.0828 | 5.13 | 0.0000 |
| Centrality | 1.0774 | 1.7645 | 0.61 | 0.5447 |
| Count | 0.0032 | 0.0016 | 2.03 | 0.0484 |

Whereas before the coefficient on Centrality was 3.8, and highly statistically significant with a coefficient of .003.

Clearly, this is not going to be a way forward. We are going to have to do a better job at drilling down more specifically into the exact nature of the relationship between earls and monasteries.

4.2.3 How much did each earl donate to monasteries?

Although we cannot know for certain how much each earl donated to the various monasteries, it is worth looking at the number of propinquity ties that each earl had with each monastery. Table 4 shows the number of such ties each earl had. Clearly, there were those who had more monastic ties than others, the largest of which is Earl Harold's startling 37 ties with the abbey at Ely. Harold had another large source set of ties at St. Edmunds as well. However, this may only be a conflation of the largest earl and the largest monastery. Certainly, Earl Harold needed a lot of connections in his

---

63 See Appendix B
64 See Appendix B
attempt to gain the crown after the death of King Edward, but to see if there is evidence of a larger
trend still needs to be seen.

To find relative frequencies of these ties, I calculated the percentage of locations that an earl
has with a monastery. As we can see, there is some large variance in the data. A particular case
is that of Earl Siward, who had zero connections with any of the large monasteries. He was the
earl of Northumbria, far removed from most of the rest of the English kingdom, including the
monasteries, which were concentrated in the south of the kingdom. Therefore, Siward would have
no reason or opportunity to share land ties with monasteries. There is less variance with the other
lords, but the most significant, Earl Harold, is not any more well connect than average, shedding
some doubt on my hypothesis that these types of holdings were beneficial to the earl’s maintenance
of power.

4.2.4 Did earls donate differently to different monasteries?

In order to test if earls donate differently to different monasteries, I established a popularity score.
The “popularity” is the sum of tie percentage for every earl by monastery. Monasteries with higher
popularities then are the monasteries that represent the largest percentage of ties over most of
the landowners. The lowest scores are for the monasteries that were not well-represented in any
owner’s portfolio. This can be seen in the following table, which shows the popularity scores by
both earls and non-earls:
<table>
<thead>
<tr>
<th>(Bury) St Edmunds, abbey of</th>
<th>Ælfgar</th>
<th>Edwin</th>
<th>Godwin</th>
<th>Gyth</th>
<th>Harold</th>
<th>Leofwin</th>
<th>Morcar</th>
<th>Siward</th>
<th>Tosti</th>
<th>Waltheof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abingdon (St Mary), abbey of</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>13</td>
<td>19</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Canterbury (St Augustine), abbey of</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dover (St Martin), canons of</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ely (St Æthelthryth), abbey of</td>
<td>16</td>
<td>3</td>
<td>2</td>
<td>14</td>
<td>37</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Glastonbury (St Mary), abbey of</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ramsey (St Benedict), abbey of</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>11</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Shaftesbury (St Edward &amp; St Mary), abbey of</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Westminster (St Peter), abbey of</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Winchester (St Peter), abbey of</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
<td><strong>10</strong></td>
<td><strong>5</strong></td>
<td><strong>30</strong></td>
<td><strong>76</strong></td>
<td><strong>7</strong></td>
<td><strong>13</strong></td>
<td><strong>0</strong></td>
<td><strong>12</strong></td>
<td><strong>20</strong></td>
</tr>
<tr>
<td><strong>Percent of earl’s total holdings</strong></td>
<td><strong>0.18</strong></td>
<td><strong>0.03</strong></td>
<td><strong>0.05</strong></td>
<td><strong>0.19</strong></td>
<td><strong>0.11</strong></td>
<td><strong>0.11</strong></td>
<td><strong>0.05</strong></td>
<td><strong>0.00</strong></td>
<td><strong>0.05</strong></td>
<td><strong>0.19</strong></td>
</tr>
</tbody>
</table>
Table 6: Popularity for Land Ties by Monastery

<table>
<thead>
<tr>
<th>Monastery</th>
<th>Earl Popularity</th>
<th>Non-Earl Popularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Bury) St. Edmunds, abbey of</td>
<td>0.23</td>
<td>0.21</td>
</tr>
<tr>
<td>Abingdon (St. Mary), abbey of</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>Canterbury (St. Augustine), abbey of</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>Dover (St. Martin), canons of</td>
<td>0.06</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>Ely (St. Æthelthryth), abbey of</strong></td>
<td><strong>0.39</strong></td>
<td><strong>0.27</strong></td>
</tr>
<tr>
<td>Glastonbury (St. Mary), abbey of</td>
<td>0.04</td>
<td>0.10</td>
</tr>
<tr>
<td>Ramsey (St. Benedict), abbey of</td>
<td>0.15</td>
<td>0.11</td>
</tr>
<tr>
<td>Shaftesbury (St. Edward &amp; St Mary), abbey of</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Westminster (St. Peter), abbey of</td>
<td>0.02</td>
<td>0.09</td>
</tr>
<tr>
<td>Winchester (St. Peter), abbey of</td>
<td>0.00</td>
<td>0.03</td>
</tr>
</tbody>
</table>

So there are in fact abbeys that are more and less popular. Ely is by far the most important monastery, followed by Bury, and then all the others fall far behind.

4.2.5 Did non-earls favor different monasteries?

There are several distinct differences between these two groups. Most significantly, Ely is much less important for non-earls, comprising 39% of all earl ties, but only 27% of the other ties. This huge increase is likely due to Earl Harold’s ties, but it remains to figure out the exact role this particular monastery played in its relationship with the earls. Repeating this same experiment shows that Earl Harold has a .49 popularity with Ely but even without him, the earls as a group have a score of .38, indicating that the abbey at Ely is significant to both earls as a group and to Harold in particular. Ely is a cathedral city in Cambridgeshire, near the population center of the city. This only partially explains the huge significance that Ely had for the earls, especially for Earl Harold. This is likely the extent to which statistics will illuminate differences between specific earls and specific monasteries. At this point, more historical instead of statistical work would be necessary.
more illuminating, rather bibliographic or highlighted in such records such as charter records.

4.2.6 Did wealthier earls donate more to monasteries than less important earls?

The last thing to test is if there is any systematic relationship between the monastic ties an earl had and his total wealth. The Spearman correlation for the relationship between percent monastic ties and wealth is -.687, which indicates strong negative correlation. Seen visually, a scatterplot:

Figure 4: Percent Monastic Ties by Total Wealth for Earls

So the regression does not yield a statistically significant coefficient on wealth. Thus, the
degree to which an earl donates to monasteries is in no way indicative of overall wealth or power on behalf of the earl. Perhaps, though, there is a way to do the regression that incorporates the significance of the monasteries in addition to treating each monastery as identical.

4.2.7 Regression weighted by monastic prominence.

To test the degree to which the centrality of a monastery is important in contributing to the wealth of the earls, I create a weighted score for each monastery. The weighted variable is a score for each earl that is equal the sum of each monastery’s centrality times the percent that the earl had ties with the monastery. This procedure weights each monastery by its prominence. Then I pool the results for each earl to form one weighted score, along with robust regression methods. A full description of the robust regressions are given in Appendix C.
As the figure shows, there is no real difference in the regression when the significance of each monastery is incorporated. The full regression chart is as follows:

|                         | Estimate | Std. Error | t value | Pr(>|t|) |
|-------------------------|----------|------------|---------|----------|
| (Intercept)             | 7.3027   | 0.5775     | 12.64   | 0.0000   |
| Weighted Monastic Ties  | 1.8738   | 3.7317     | 0.50    | 0.6291   |
| R-sq: 0.03 | Adj. R-sq: -0.09 | N: 10 |         |          |

Although the correlation between wealth and centrality is positive, robust regressions and a re-
gression taken with Earl Harold taken out the negative relationship between weighted monastic ties and earl wealth is very clearly negative. So while the wealth of Anglo-Saxon earls are correlated with the amount of social ties they have, they are in general negatively impacted by the number of monastic ties they have. Earl Harold, however, defies this trend, and it seems that his monastic ties were very important to his wealth holdings. As it turns out, Harold is unusual in another way as well. After the death of King Edward in 1066, Earl Harold temporarily gains the throne and crowns himself king. His reign does not last long, however, and Duke William of Normandy invades, dethroning Harold and instituting Norman rule.

4.3 Summary of Results

This line of analysis fails to yield positive results, because more monastic ties did not correlate with more wealth or significance for Anglo-Saxon Lords. Although this provides evidence against my hypothesis, there are a few findings that support the idea that monastic ties may have been significant for at least certain landowners. Earl Harold is quite evidently a particular example, as his centrality is much higher than anybody other than the King and Queen, and his ties to the abbey at Ely seems to be an especially important relationship. However, the broad hypothesis, that there is a systematic relationship between earls and monasteries predicated on social network ties, does not seem to be supported by the data.

Figures 6 and 7 more deeply probe the relationship between Earl Harold and St. Æthelthryth, the monastery at Ely. The two maps show that there is a concentration of land ties between between Earl Harold and St. Æthelthryth’s monastery around Ely and East Anglia. On the other hand, Earl Harold has a particularly close connection to King Harold in Oxfordshire. These maps are plotted with a smoothed wealth density map with the holdings of Earl Harold overlayed with St. Æthelthryth and King Edward’s holdings respectively. The darkest locations on the map are at the two intersections that Earl Harold has with the two other lords, in East Anglia and Oxfordshire. While Earl Harold himself does not seem to have a particularly large amount of lands in these high-wealth areas, he does have deep connections with those who are very deeply involved in
those areas of wealth.
Figure 6: Map of Earl Harold and St. Æthelthryth versus Wealth Density

Figure 7: Map of Earl Harold and King Edward versus Wealth Density
5 Conclusion

This analysis did not support the initial hypothesis that earls systematically formed land ties with monasteries in order to preserve their wealth and status in the kingdom. While there is some evidence of a difference between landowners in terms of the number of ties they have formed, there is no evidence that monastic ties created any sort of material benefit for the earls. There is, however, some evidence that there are individual differences that may show that there is some effect between individual earls and monasteries, but these are not seen in the aggregate. Earl Harold’s strong ties with the abbey at Ely provides some evidence that there was a strong personal relationship between the earl and the abbey, which is situated at a particularly wealth area of the kingdom. Ann Williams summarizes the benefit that Earl Harold gains: “Harold’s wealth and power enabled him to gather friends.” Given the success of Harold in gaining the crown briefly after the death of King Edward, we can begin to question rather this relationship may have been instrumental in pre-Conquest English politics.

On the other hand, the inverse of the hypothesis may be in fact be valid. It could be that successful landowners did not need to rely on patronage to maintain their social positions, while more middling lords needed to make use of less formal sources of power. Although this conclusion is not supported in the literature, more research could be done to see if these results bear theoretic fruit.

In all, though, this analysis does not prove that Stephen Baxter was wrong. His own analysis focuses on only a subset of lords, that of the house of Leofwinson, and not necessarily the lords all together. In addition, it may be that wealth is not the most significant dependent variable as a measure of baronial success. It is likely that a bit more prosopographical work could yield a better indication about the the relative success of each of the earls and we could use that information as a dependent variable and better measure our theoretic variable of “success,” since wealth was only a rough proxy for the concept. An improved analysis would be to incorporate lord ties in addition

---

to proximity ties. We could make the case that lords holding monastic-owned lands have a very strong connection to their landlords.\textsuperscript{66} This would provide a deeper analysis than one based only the propinquity land tie used in this analysis.

Another reason for the failure of the analysis is the difficulties dealing with the data itself. Despite its completeness relative to other sources of the Middle Ages, there are numerous problems with the Domesday inquest, especially for the 1066 data. The data was taken down many years after the reported dates and there is no information about the types of landholding, where the owner got the land and what were the motivations behind any possible transfer of land in the first place. In some cases, there may be charters that indicate a transfer of land, but relatively few of these have survived to the present-day.\textsuperscript{67} Charter information is very far from complete, and interpretation is difficult given a high level of forgeries and ambiguity in the documents.

Given all of these limitations, inconclusive results are just that—inconclusive, and should probably not be assumed to be proof that any particular hypothesis is fully wrong or right, just that we cannot use these methods as part of proving it. Stephen Baxter uses some case-by-case knowledge of land ties, and this does not seem to be a good mechanism for wide-spread assumptions and instead is better to be taken on a case-by-case basis. Analysis would be improved by using more than just 50 landowners, and also it would be best if I incorporated holding information instead of just adjacency ties.

The analysis could be improved by using another source of social network ties which could be the relationship between land holders and land lords. A person holding land for an owner may be a very strong relationship and could even be encoding information about monastic giving. Stephen Baxter uses this type of analysis in the case of Burton Abbey in his \textit{Earls of Mercia}\textsuperscript{68}. The picture is obviously too complex for this very simple cursory analysis.

\textsuperscript{66}Baxter (2007), p. 181 uses this to support the patronage of the Leofwinesons to Burton Abbey
\textsuperscript{67}For a complete list of surviving Anglo-Saxon charters, see Peter Sawyer’s handbook, digitized at Kelly (2012).
\textsuperscript{68}Baxter (2007), p. 181
6 Appendicies

6.1 Appendix A—Missing Values

In order to solve the problem of missing values in the Domesday Book data, various imputations will be used. The data is listed by land plot, and gives the owner in both 1066 and 1086, the location of the land, its size, and its value in both years. I am interested in the total value of each plot in 1066, but this is missing for a significant proportion of the entries. Out of 28,791 total entries, 13,040 are missing 1066 values. However, the 1086 values are almost identical. A simple regression confirms this:

| Estimate | Std. Error | t value | Pr(>|t|) |
|----------|------------|---------|---------|
| (Intercept) | 0.0003 | 0.0003 | 1.07 | 0.2833 |
| 1086 Value | 1.0000 | 0.0000 | 47786.84 | 0.0000 |

Table 7: 1066 Value Predicted by 1086 Value

Where the R-squared value is 1.000 and the p-value is 0.000, which indicates a perfect correlation between the two values. The very few differences are likely to be scribal errors, and cannot be accounted for systematically without a loss of information. We can then substitute known 1086 values for missing 1066 information without any worry about the loss of data. After this imputation, there is now only 5,023 values missing from the data.

We may ask ourselves if there is any fundamental difference between the set of holdings that were missing 1066 data and those missing 1086 data. Since the distribution of the value of the holdings is in no way normal, the Wilcoxon rank sum test will show if there is a statistically significant difference between the two samples. The test yields a p-value = 2.2e-16, which gives good evidence that the two samples are different. Checking the means shows that the entries missing the 1066 data had an average 1086 value of 3.458, whereas the entries not missing the 1066 data had an average 1086 value of 5.365. This indicates that smaller land plots were more likely to have missing information about them. This should make sense given the nature of the data collection. However, we have a very good method for adding back the missing values, and we
should not worry too much about this missingness.

After the 1086 values, the next best indicator is the size of the land holding. Again, a simple regression will show the correlation between the two variables:

Table 8: Land Value predicted by Land Size

|                    | Estimate | Std. Error | t value | Pr(>|t|) |
|--------------------|----------|------------|---------|----------|
| (Intercept)        | 2.0484   | 0.0681     | 30.08   | 0.0000   |
| Size of Holding    | 0.4424   | 0.0040     | 109.46  | 0.0000   |

To impute the remain values, we use these coefficients to estimate the missing land value data. This is done by multiplying the land size of each entry by .44 and adding 2.05 to estimate the land values.

The R-squared value is less than the regression based on the 1086, and is instead rather low at .34, indicating that we are only recovering about 34% of the missing values by using the size of holding data to fill in gaps left by the 1086 data. However, both the intercept and coefficient are statistically significant, so we can use these values for our imputation without too much concern. This method might be improved by using multiple random imputations based on the data, but the standard errors of the coefficients are so small that it is unlikely to make much of a difference.

After this test, we are still missing 400 values, which we must simply replace using the total mean value of the 1066 values, 4.598, since we have no other information concerning what those missing values might be. Since the presence of those holdings and their locations are incredibly important to our analysis, we cannot simply throw out these values.

I use another Wilcoxon rank sum test to check for a difference in the population that is missing the 1086 value data. The results are the same, giving a p-value of less than 2.2e-16. The means are similar to those missing the 1066 data and not, with those missing the 1086 data having a mean value of 3.752 in size of land holdings, and those not missing the 1086 data having a mean value of 5.365 in size of land holdings. Both this and the analysis of the missing 1066 data indicates that smaller plots were recorded more poorly than large, expensive plots. This should not concern us at all, since we are aggregating the land by owners, the large plots are more important anyhow, and
since we are leaving out the smallest landowners, who are more likely to be the owners of small plots, we are removing and aggregating away much of our differences and loss of data.
6.2 Appendix B—Additional Tables

Table 10 shows the result for the ANOVA comparing the centrality statistics for each landowning type. Group 1 is the King, 2 is the Queen, 3 is the earls, 4 are the secular clergy, 5 are the monasteries, and 6 is the other landowners. Since the p-value is less than .05, we can reject the null hypothesis that there is no difference between the 6 groups. Table 11 shows the Tukey test on the ANOVA to see which groups are statistically different.

<table>
<thead>
<tr>
<th>Table 9: ANOVA for Centrality Statistics by Landowner Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Df</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>type</td>
</tr>
<tr>
<td>Residuals</td>
</tr>
</tbody>
</table>

Table 11 shows the Tukey test for the ANOVA comparing the difference in actor tie strength with monasteries. Because all of the scores are well above the .05 required to reject the null hypothesis, there is not sufficient evidence to claim that there is a difference in the amount of land ties formed by each group. The largest difference between groups is the one between the secular clergy and other landowners, but there is not enough evidence to claim statistical significance.
### Table 10: Difference Between Actor Donation by Type

<table>
<thead>
<tr>
<th></th>
<th>diff</th>
<th>lwr</th>
<th>upr</th>
<th>p adj</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>-0.02268344</td>
<td>-0.55975821</td>
<td>0.5143913</td>
<td>0.9999951</td>
</tr>
<tr>
<td>3-1</td>
<td>0.01146037</td>
<td>-0.38684495</td>
<td>0.4097657</td>
<td>0.9999993</td>
</tr>
<tr>
<td>4-1</td>
<td>-0.01239251</td>
<td>-0.41270441</td>
<td>0.3879194</td>
<td>0.9999990</td>
</tr>
<tr>
<td>6-1</td>
<td>0.08208498</td>
<td>-0.30937216</td>
<td>0.4735421</td>
<td>0.9883623</td>
</tr>
<tr>
<td>3-2</td>
<td>0.03414381</td>
<td>-0.36416151</td>
<td>0.4324491</td>
<td>0.9998379</td>
</tr>
<tr>
<td>4-2</td>
<td>0.01029093</td>
<td>-0.39002097</td>
<td>0.4106028</td>
<td>0.9999996</td>
</tr>
<tr>
<td>6-2</td>
<td>0.10476842</td>
<td>-0.28668873</td>
<td>0.4962256</td>
<td>0.9659250</td>
</tr>
<tr>
<td>4-3</td>
<td>-0.02385288</td>
<td>-0.19834479</td>
<td>0.1506390</td>
<td>0.9984292</td>
</tr>
<tr>
<td>6-3</td>
<td>0.07062462</td>
<td>-0.08246525</td>
<td>0.2237145</td>
<td>0.7391684</td>
</tr>
<tr>
<td>6-4</td>
<td>0.09447749</td>
<td>-0.06375968</td>
<td>0.2527147</td>
<td>0.4866264</td>
</tr>
</tbody>
</table>
6.3 Appendix C—Regression Assumptions

As the solid line in Figure 5 shows, there is now a positive correlation between weighted percent monastic ties and earl wealth. The full regression chart is as follows:

|            | Estimate | Std. Error | t value | Pr(>|t|) |
|------------|----------|------------|---------|----------|
| (Intercept)| 7.3027   | 0.5775     | 12.64   | 0.0000   |
| dep5       | 1.8738   | 3.7317     | 0.50    | 0.6291   |

R-sq: 0.03  Adj. R-sq: -0.09  N: 10

The P-value shows that this regression is not statistically significant. To get a better idea of the flaws in the model, I will test the assumptions of the regression.

A plot of the residuals tests for heteroskedasticity:

Figure 8: Heteroskedasticity

Especially with the outlier in the end, there is significant evidence of heteroskedasticity. There is a clear downward trend for low values of weighted percent ties, with an upward trend to reach the outlier. The next assumption of the regression is normality of the residuals. A Q-Q plot tests for this:
Since these residuals fall very close to the center line, there is good evidence that the residuals are normal. The last test is to see if any outliers exert too much leverage:

**Figure 10: Residual Leverage**
By looking at the Cook’s Distances, it seems that Earl Harold is a very large and significant outlier, and is very much influencing the regression.

Since there is the presence of an outlier in Earl Harold that has a very large Cook’s distance as shown in Figure 7, I do not trust the Ordinary Least Squares Regression to be a good model. So I am going to try two robust Regression estimations, the Least Median Squares Regression and Least Trimed Squares Regression. They are shown in the dotted and dashed lines in figure 5 respectively.

Table 11: Robust Regression

<table>
<thead>
<tr>
<th></th>
<th>LMS Estimate</th>
<th>LTS Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>7.89</td>
<td>11.52</td>
</tr>
<tr>
<td>dep5</td>
<td>-14.37</td>
<td>-46.58</td>
</tr>
<tr>
<td>N: 10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Both of these regressions yield a negative correlation with the independent variable, suggesting that there is a negative rather than positive correlation between weighted monastic ties and total earl wealth.

The outlier with by far the most leverage in the regression analysis by Cook’s Distance in Figure 8 is Earl Harold. Removing him from the regression returns a negative slop on weighted monastic tie strength, as shown in the dot-dashed line in Figure 5. The full regression chart is as follows:

Table 12: Weighted Monastic Ties without Earl Harold

|           | Estimate  | Std. Error | t value | Pr(>|t|)  |
|-----------|-----------|------------|---------|----------|
| (Intercept) | 8.7203    | 0.6995     | 12.47   | 0.0000   |
| dep5      | -16.6375  | 7.6496     | -2.17   | 0.0661   |

Removing Earl Harold as an outlier brings the slope close to the two robust regression measures, showing how good those methods are at adjusting for misleading variables, especially the Least Median Squares Regression. With Earl Harold taken out the negative relationship between weighted monastic ties and earl wealth is very clearly negative and very nearly statistically signif-
icant with a p-value of .0661.
7 Bibliography


Freeman, I. C. “Centrality in Social Networks I: Conceptual Clarification.” Social Network, 1.


Weber, Max. “Politics as Vocation.”


