

# MEDIEVAL UNIVERSITIES, LEGAL INSTITUTIONS, AND THE COMMERCIAL REVOLUTION\*

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We present new data documenting medieval Europe's Commercial Revolution using information on the establishment of markets in Germany. We use these data to test whether medieval universities played a causal role in expanding economic activity, examining the foundation of Germany's first universities after 1386 following the papal schism. We find that the trend rate of market establishment breaks upward in 1386 and this break is greatest where the distance to a university shrank most. There is no differential pre-1386 trend associated with the reduction in distance to a university, and there is no break in trend in 1386 where university proximity did not change. These results are robust to estimating a variety of specifications that address concerns about the endogeneity of university location. Universities provided training in newly rediscovered Roman and canon law; students with legal training served in positions that reduced the uncertainty of trade in the Middle Ages. We argue that training in the law, and the consequent development of legal and administrative institutions, was an important channel linking universities and greater economic activity in medieval Germany. *JEL* Codes: I25, N13, N33, O10.

## I. INTRODUCTION

The late Middle Ages saw the first stirrings of the “rise of the West.”<sup>1</sup> Between 900 and 1500, Europe experienced a Commercial Revolution and awoke from centuries of economic slumber, with cities growing and trade expanding. This flowering of the European economy set the stage for modern Europe's

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1. See, for example, Lopez (1976), North and Thomas (1973), Buringh and van Zanden (2009).

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exploration and colonization of the world, and its institutional and political development on the path toward modern growth.

The Middle Ages saw not only economic transformation in Europe but also the establishment of the first universities—first in Bologna in the eleventh century, then 50 more in the following four centuries—and the development of formal legal institutions and state administrative systems. In this article we consider the causal role that educational and legal institutions may have played in promoting economic activity.

Economic historians have documented medieval Europe's remarkable economic changes using a variety of sources: from the rise of fairs (Epstein 2000), to the physical expansion of cities (Verhulst 1999), the increased output of books (Buringh and van Zanden 2009), or the growth of population and urbanization (McEvedy and Jones 1979; Bairoch, Batou, and Chèvre 1988). Although informative, the existing data on the Commercial Revolution are often limited in their frequency, geographic coverage, or ability to capture economic change directly, making them difficult to use for identifying the causal factors that transformed Europe from a poor, rural, backward society (relative to the Chinese and Islamic civilizations) into an urban and commercial one.<sup>2</sup>

We begin by addressing the paucity of direct, systematic, and quantitative evidence on the timing and spread of the Commercial Revolution. We present data on the establishment dates of 2,256 German cities,<sup>3</sup> as well as the dates when these cities received grants to hold markets. We discuss a range of evidence suggesting that grants to hold markets are valid indicators of increased economic activity. The markets established under the grants took a variety of forms, and they were granted to cities large and small. This data set thus captures economic changes in medieval Europe that occurred inside and outside

2. Morris (2010), among others, ranks China's economic development in the Song Dynasty (960–1279) ahead of Europe's, and Mokyr (1990, ch. 9) explicitly compares Chinese and European technologies, noting China's "technological supremacy" in the Middle Ages (p. 209). Bosker and van Zanden (2008) compare urbanization rates between Western Europe and the Arab world and show that they were much higher in the latter until the late Middle Ages.

3. The modern state of Germany did not exist in the period under consideration; our data cover the regions of Germany within its 1937 borders (excluding East and West Prussia, which were not part of the Holy Roman Empire). For brevity, we use the anachronism "Germany" throughout the article.

major urban areas, spanning a large region, over a long period of time.

The primary purpose of this article is to use these data on market grants to test whether universities had a causal effect on economic activity in medieval Europe.<sup>4</sup> We study the effects of a unique natural experiment in university establishment: Church politics—the papal schism of the late fourteenth century—resulted in the arguably exogenous foundation of Germany's first universities and greatly increased Germans' access to university training.<sup>5</sup> Historical university matriculation records reveal that the establishment of these new universities led to a sharp increase—a tripling—in the number of Germans with some university training.

We present a simple model linking human capital to market establishment, which generates an estimating equation and clear predictions regarding market establishment in Germany around the time of the schism. In particular, we predict that there should be an increase in the trend rate of market establishment after the first German university was established in 1386, and that this break in the trend should be greater in cities with greater reductions in distance to a university. We test these predictions using our data on market establishment and find strong support for them across a broad range of specifications. There is a significant positive break in the trend rate of market establishment in Germany in 1386; moreover, the break is larger in areas experiencing greater reductions in distance to a university. Importantly, there is no differential pre-1386 trend associated with the reduction in distance to a university, and there is no break in the trend rate of market establishment in 1386 where university proximity did not change. We check whether there is evidence of trend breaks in years other than 1386 and establish

4. The causal effect of higher educational institutions on growth has, of course, been studied in other settings. For example, Aghion et al. (2009) study the impact of higher education spending on growth in the contemporary United States and find a significant positive effect of four-year college spending across all states and of research-related spending in states close to the technological frontier.

5. Of course, even if the establishment of universities in fourteenth-century Germany was exogenous with respect to commercial activity, one might still wonder about the external validity of the effect we estimate. We believe that the "local" treatment effect we identify in fourteenth-century Germany is informative about the role played by universities and human capital in medieval Europe more generally; we further discuss external validity in the conclusion.

that our findings are quite specific to the time when universities were first established.

While the timing of the schism was plausibly exogenous with respect to economic conditions, the locations of the first universities may have been selected according to their economic characteristics. We thus examine whether endogenous university establishment might explain our results. We drop all cities within 20 or 50 km of universities and use information on the identity of each city's ruling lord to drop cities in the same territory as a university. We also consider regional differences between cities experiencing an increase in access to a university in 1386 and those that do not: we drop cities close to the Rhine, and cities east of the Elbe. We estimate a model that allows the underlying trend rate of economic activity to vary with longitude; finally, we estimate the effects of university establishment exploiting only within-state variation. In each specification, we find evidence that the new universities affected market establishment.

The Middle Ages were a period that saw many political changes, some of which coincided with the establishment of Germany's first universities, and might also have affected patterns of market establishment. We examine the effects of changes in lords' jurisdiction over cities by excluding cities that experienced jurisdictional changes and subsequent market establishment from our analysis; we also drop cities in Württemberg, where city conflicts were prevalent in the late fourteenth century. One particular concern is that the papal schism may have affected economic outcomes through channels other than university establishment. We thus drop cities aligned with the French (rather than Roman) pope. In all of these specifications we find that our results are unchanged. We also conduct falsification exercises, examining market establishment trends in England and Italy, where the papal schism would have had political effects, but did not lead to the creation of new universities. We do not see changes in the rate of market establishment in either of these contexts.

Germany's first universities may have affected trade through several channels, but we present historical evidence indicating that the role of universities in developing legal and administrative institutions was likely important: universities trained lawyers, who became administrators, codified laws and regulations, and staffed and guided others through the legal systems that they

helped to develop.<sup>6</sup> Our analysis of the institutional environment of late medieval Germany, the introduction of Roman legal thinking in that period, and the careers of university-trained jurists supports this view. Murphy, Shleifer, and Vishny (1991) argue that more lawyers are harmful for growth, but their focus is on the contemporary era of modern (Schumpeterian) economic growth, driven by the innovation of new technologies. In that context, training engineers and scientists, rather than lawyers, is likely to be associated with increased economic activity. Our focus is on an era in which Smithian growth, driven by the expansion of trade and the division of labor, was paramount. In this setting, reducing the uncertainty of property rights through the development of a system of laws, and the training of lawyers to apply them, could certainly be conducive to economic activity. Moreover, Murphy, Shleifer, and Vishny (1991) cite the increased protection of property rights discussed by North and Thomas (1973) as an example of reduced taxes on productive activity that should increase income. Kuran (2011) and Coşgel (2011) view the development of legal institutions as playing an important role in expanding trade in another historical setting: the Islamic world in the eighth and ninth centuries. They also point to a lack of further development in legal institutions in subsequent centuries as playing a crucial role in later economic stagnation.<sup>7</sup>

The importance of institutional change for Europe's commercial revival has been highlighted by many scholars: Greif (1994), building on his analysis of informal contract enforcement among Maghribi traders (Greif 1989, 1993), emphasizes the role of formal institutions in supporting the larger-scale economic exchange that occurred in late medieval Europe.<sup>8</sup> DeLong and Shleifer (1993) emphasize the importance of constraints on executive power, which were developed in some of the new city-

6. The ability of the state to employ better-trained bureaucrats is an important determinant of a state's capacity (Brewer 1988; Besley and Persson 2009).

7. See also the essays in Ma and van Zanden (2011) for studies of the importance of formal legal institutions for economic development in a broad range of historical contexts.

8. Greif (1994, p. 936) writes, "To support collective actions and to facilitate exchange, an individualist society needs to develop formal legal and political enforcement organizations. Further, a formal legal code is likely to be required to facilitate exchange by coordinating expectations and enhancing the deterrence effect of formal organizations." See also Greif (2006).

states that arose in the Middle Ages; Guiso, Sapienza, and Zingales 2008, p. 9) describe how, with the rise of the institution of the free city-state in medieval Italy, “personal freedoms receive[d] legal protection against abuses of government officials, whose actions [were] subject to control of ad hoc institutions, including courts of law to which citizens could appeal.”<sup>9</sup> Epstein (2000) similarly points to important administrative changes underlying the expansion of commercial activity. Van Zanden (2009) follows Berman (1983) in arguing that the development of European legal systems in the Middle Ages set the stage for Europe’s political and economic development. Finally, Huff (2003) argues that the European university was an institution that was uniquely suited to promoting technical change and that the rise of universities can be seen as an important institutional turning point in the history of European science.

Existing work on medieval Europe has presented rich historical descriptions of the association between institutional and economic change, but has seldom been able to test for the presence of a causal link. Identifying the causal effect of institutional change is complicated because other, concurrent factors were certainly important to Europe’s economic revival: for example, Mokyr (1990, ch. 3) discusses the important technological improvements that took place in the Middle Ages, and Morris (2010) focuses on climate change—the medieval warm period—that made agriculture more productive. Thus, the question underlying this article is whether universities and legal institutions played *some* causal role in increasing economic activity in the Middle Ages, rather than rather than playing the *ultimate* causal role in driving all of the economic change in the period. In addition, the institutions that reduced market imperfections and increased trade in the Middle Ages were likely both *cause and consequence* of increased economic activity: North and Thomas (1973, p. 12), while viewing institutional change as a crucial factor in Europe’s economic development, write that “the revival of trade and commerce in the eleventh and twelfth centuries led not only to the proliferation of towns but to a host of institutional arrangements designed to reduce market imperfections. As new towns developed their own governments for administration and protection, they

9. Guiso, Sapienza, and Zingales (2008) argue that the free city-states also developed high levels of social capital, which then persisted into the modern era, affecting the growth rates of the (formerly) free cities.

necessarily evolved bodies of law to adjudicate disputes arising from these new conditions.” Our work attempts to disentangle the causal relationship between institutional and economic change.

We proceed as follows. In Section II, we provide an overview of the Commercial Revolution, presenting data collected by other scholars that point to a dramatic change in Europe’s economy and presenting and discussing our newly collected data on economic change in late medieval Germany. In Section III, we discuss the rise of universities in Europe during the Commercial Revolution, cover how the papal schism can be seen as an exogenous shock leading to the foundation of new universities in Germany, and present data on the effect of the new universities on the number of Germans with university training. In Section IV, we present a simple model of the link between universities and market establishment and derive our empirical strategy. In Section V we use our data on market establishment to test for a causal effect of the new universities on commercial activity. In Section VI, we propose that the mechanism linking university establishment to commercial activity was the training of jurists and the development of legal institutions. We discuss the importance of the development of formal legal institutions for supporting economic activity in the Middle Ages, then present historical evidence on the training and careers of lawyers in medieval Germany, arguing that individuals with legal training played an important role in supporting economic activity. In Section VII, we discuss our findings and offer some concluding thoughts.

## II. DOCUMENTING THE COMMERCIAL REVOLUTION

### II.A. *Existing Evidence*

Beginning around the tenth century, there was a revival of trade in Europe.<sup>10</sup> Increased trade and improved farming technology (which produced agricultural surpluses) allowed for larger urban populations. Robert Lopez (1976, p. 56) describes the Commercial Revolution as follows: “When food surpluses increased, it became possible to release more people for govern-

10. After the decline of the (Western) Roman Empire (in 476), there was little trade throughout Western Europe. There seems to have been a revival of economic activity in the Carolingian Empire, but it was not sustained. See van Zanden (2009).



mental, religious, and cultural pursuits. Towns re-emerged from their protracted depression. Merchants and craftsmen were able to do more than providing a fistful of luxuries for the rich.”<sup>11</sup>

Unfortunately, only very limited data for the period are available to support this narrative.<sup>12</sup> To compare economic development across European regions during the Middle Ages, Buringh and van Zanden (2009) rely on the fraction of a region’s population living in cities with populations greater than 10,000 and on manuscript production. Each should be correlated with the volume of economic activity: higher urbanization rates depend on trade, as goods must move from the country to the city; manuscript production would have been greater when incomes were higher and the demand for books (a luxury) was greater.<sup>13</sup> In Figure I, we present Buringh and van Zanden’s (2009) data on these indicators of economic activity. They clearly reveal the dramatic changes experienced in Europe between 900 and 1500: in 900, Western Europe had only about 1% of its population living in cities with more than 10,000 people; by 1500, the urbanization rate for Western Europe stood at over 8%, with peaks of over 10% and 20% in the regions of the Netherlands and Belgium, respectively. Similarly, manuscript production soared in the late Middle Ages, rising from fewer than 100,000 manuscripts per century to over 4 million.

Figure I matches the historical narrative of the Commercial Revolution: Europe changed dramatically between 900 and 1500. Yet the data presented are extremely coarse measures of economic change, available only at long time intervals, for a small number of regions. Even data available at the city level, for example, the Bairoch, Batou, and Chèvre (1988) data used by Buringh and van Zanden (2009), are generally limited to one observation of a city’s population per century, in an unbalanced

11. Some scholars have argued that no sustained increases of income per capita occurred before 1800 (Clark 2007). Still, even in a Malthusian world economic change is of great interest, as it may indicate an out-of-equilibrium period of higher income or a transition to a new, higher-income equilibrium. In addition, institutional and economic changes in the Middle Ages may have had persistent consequences (see, e.g., Acemoglu et al., 2005).

12. There is rich historical and archaeological evidence on the Commercial Revolution (for example, Verhulst 1999), but it is often not in a form that allows for the testing of quantitative hypotheses.

13. DeLong and Shleifer (1993) use city growth as a measure of economic development, and Acemoglu, Johnson, and Robinson (2005) and Acemoglu et al. (2011) use urbanization rates.



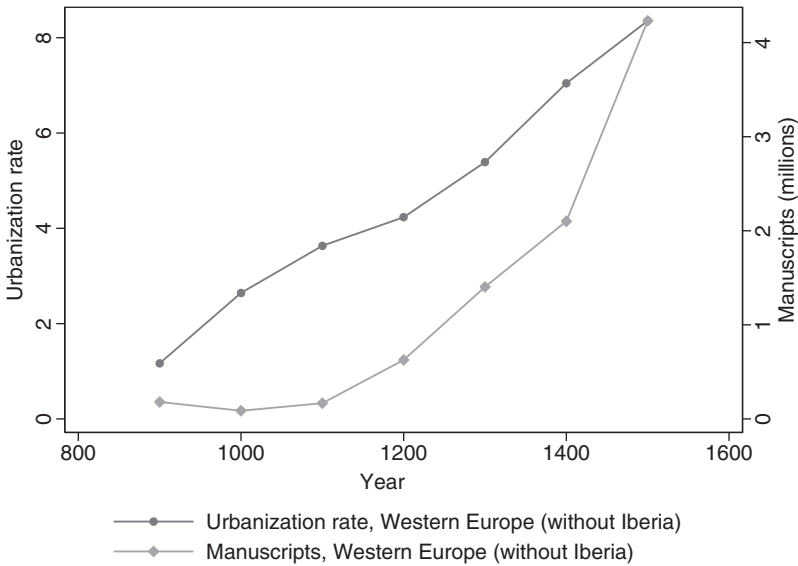


FIGURE I

## Indicators of Economic Development in the Middle Ages

Urbanization rate is the percentage of the population living in cities with more than 10,000 inhabitants. *Source:* Buringh and van Zanden (2009).

panel with relatively few observations. In the case of Germany, population data are available for only 21 cities in 1200, increasing to 128 cities in 1500. Furthermore, these data miss the developments that likely affected most Europeans at the time: the establishment of local markets and incorporation of smaller towns and cities.<sup>14</sup>

14. Epstein (2000, p. 74) notes that “the daily and weekly markets where most small-scale retailing took place” are often ignored by scholars. Britnell (2009, p. I:189) writes, “In the early days of urbanization, [village markets and small market towns] were the principal supporters of the growth of trade in the absence of earlier urbanized traditions. But they were not simply substitute for large towns or symbols of backwardness. They were numerous even in the most urbanized regions. . . . In the early fourteenth century they had a dual function, both serving the needs of local residents and acting as a source of supply for middlemen and other merchants.”

## II.B. *New Evidence on the Commercial Revolution in Germany*

The *Deutsches Städtebuch*, a series of volumes edited by Erich Keyser (1939–1974), compiles, for all of Germany, information on each incorporated city, including the date it was first mentioned in a document, the date it was formally incorporated, and the dates it received one or more “market privileges” from the emperor or a local lord to hold markets or fairs (the spatial distribution within Central Europe of the 2,256 cities included in the *Deutsches Städtebuch* is displayed in Figure II).<sup>15</sup>

The market privilege (or market right) was an official document that gave a city the right to hold a specific market (or fair); it also gave the local lord the right to tax trade in that market, coin money, and require its use in the market. In exchange for these rights, it required the lord to guarantee the protection of merchants en route to and present at the market—this included the provision of courts and the establishment of standard measures.<sup>16</sup> Many cities received multiple market rights, often granted in different years; the various grants established markets held on different dates or specializing in different products. Thus, a market right indicated that a city had the right to hold an *additional* market, but not necessarily the *first* market in a city or town (or a general right to hold markets); indeed, in some cities, the first market right was recognized since ancient times or was granted when the city was formally incorporated. For all 2,256 cities in the *Deutsches Städtebuch*, we collected data on their date of incorporation and on all of the years in which they were granted one or more market privileges throughout the Middle Ages.

Conceivably, in some instances market grants may indicate changes in the formality of economic institutions, rather than changes in economic activity itself. However, a variety of data and historical sources validate the granting of a market right as an indicator of increased economic activity.<sup>17</sup> First, one can

15. To be included, a “city” must have been incorporated prior to the compilation of the *Städtebuch*; the sizes of these cities today vary greatly from several hundred inhabitants to millions. Missing information and uncertainty regarding some dates are undeniable problems. However, it is generally clear when there is such uncertainty, and we do not include in our analysis market or city establishments whose dates are uncertain.

16. Epstein (2000, p. 82); Britnell (1978, p. 192); Schmieder (2005, p. 49).

17. We discuss the sources described here in more detail in the Online Appendix, Section OA.1.

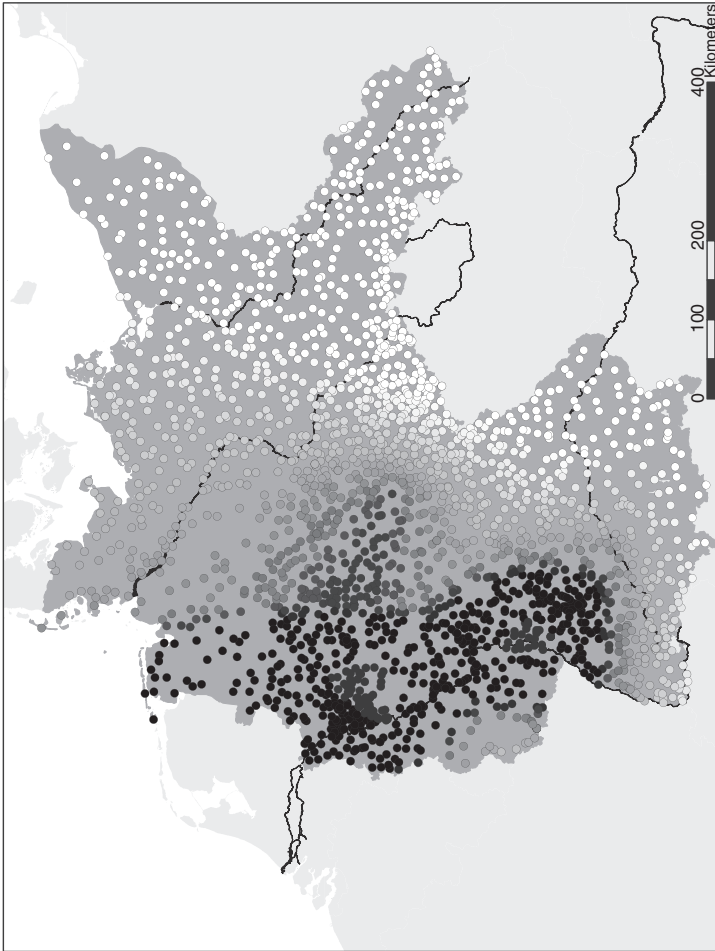


FIGURE II

Cities in the Data Set

Darker colors indicate larger reductions in distance to the nearest university as a consequence of the papal schism; shaded area indicates German lands on which we focus.

examine the association between a city's size—a commonly used measure of economic development in the premodern world—and the granting of market rights to that city. Using data from Bairoch, Batou, and Chèvre (1988), we find for both 1400 and 1500 strong positive correlations between receiving market grants in the Middle Ages and city size (see the Online Appendix, Table OA.1).

Second, we examined historical sources to determine whether the granting of a market right was associated with other observable indicators of economic activity in the historical record. The *Deutsches Städtebuch* (Keyser 1939–1974) and the *Handbuch der historischen Stätten Deutschlands* (Klose et al. 1958–) provide descriptions of notable new construction in each German city. We examined the historical construction records for the 63 cities receiving one or more market grants between 1386 and 1406—this period, covering the 20 years following the establishment of the first German university, is the focus of our empirical analysis of the effect of universities on market establishment. We find that 30 of these cities experienced some notable construction within 20 years of the year of the market grant (see the Online Appendix, Table OA.2).<sup>18</sup> For example, the city of Bacharach received a market grant in 1402. Around that time, a customs house was built and the city walls were extended to accommodate it. Then, five years after the market grant, a new city hall was built on the market square. Seventeen years after the market right was granted, a new merchants' hall was constructed. Overall, it appears that substantial new construction activity followed the granting of a medieval market right, suggesting real effects of the grant.<sup>19</sup>

Finally, we consulted a report on the markets existing in Germany in 1936, *Verzeichnis der Märkte und Messen im*

18. If we include also the 17 cities that were incorporated between 1386 and 1406 (and were possibly granted the right to hold a market together with the act of incorporation), 38 of these 80 cities experienced notable construction within 20 years of receiving the grant. We also randomly selected 80 comparison cities that did not receive a market grant or city incorporation between 1386 and 1406, and searched for evidence of construction activity in these cities between 1386 and 1426 (a conservative, 40-year time window). We found evidence of construction in only 23 of these 80 cities—the difference in construction activity between cities receiving market grants within a 20-year window and control cities within a 40-year window is statistically significant at the 5% level.

19. We discuss additional examples of construction following the granting of a market right in the Online Appendix, Section OA.1.

*Deutschen Reich im Jahre 1936* (Statistisches Reichsamt 1935) and matched the markets in the report to the market establishments in our data set between 1386 and 1406. We find that 60 of the 63 cities receiving market grants from 1386 to 1406 had functioning markets in 1936 (see the Online Appendix, Table OA.2). Among these 60 cities, the *Deutsches Städtebuch* provided information on the frequency of the market and/or the goods traded there for 50 of their medieval market grants. Of these 50 grants, we are able to successfully match 39 of them *across 500 years* on at least one market characteristic (frequency or goods traded), with no mismatch; moreover, in 14 cases, we find that the market existing in 1936 exactly matches the fourteenth- (or early fifteenth-) century market grant in both the frequency and type of market (see the Online Appendix, Table OA.2). Thus, based on a range of historical evidence, we are confident that the granting of a market right actually indicates increased commercial activity.<sup>20</sup>

In Figure III we show the number of city incorporations and market establishments between 1100 and 1500. The top graph displays absolute numbers of incorporations and market grants in 10-year moving averages; the bottom graph displays the cumulative number of cities incorporated or markets established at each point in time. The figure reveals a dramatic rise in city incorporations in the German lands in the thirteenth century; the average number of cities incorporated a year increased from less than one to approximately four. The granting of market rights also accelerated during the thirteenth century, albeit more slowly. During the fourteenth century, the co-movement of city incorporations and market grants becomes evident, indicating a clear tendency toward both greater urbanization and expanded economic activity, a tendency that is not even reversed by the arrival of the Black Death of 1348. Toward the end of the fourteenth century, however, the two series begin to diverge. City

20. We are not the first to treat the granting of a market privilege as an event marking market establishment. The work of historians of medieval Europe studying such grants supports the view that royal charters were often associated with the actual creation of new markets and were not simply the formal recognition of existing ones. Bindseil and Pfeil (1999, pp. 739–740) write that “The setting up of a marketplace became a legal privilege of the German King in the 9th century, implying the need of a deed of foundation for every market.” Britnell (1981, p. 211) and Masschaele (2002) discuss the case of England; Epstein (2000) uses legal documents as indicators of economic activity in Italy.

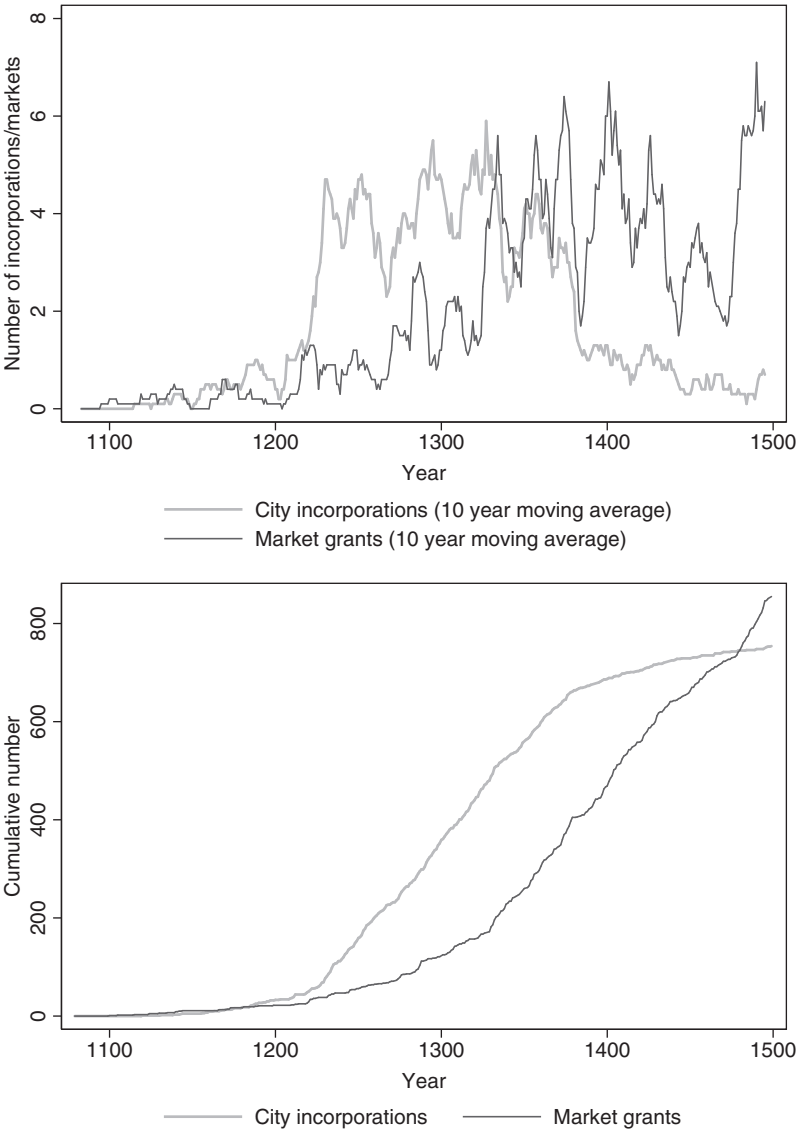


FIGURE III  
Absolute (10-Year Moving Average) and Cumulative Number of City  
Incorporations and Market Grants, Germany

incorporations subside, while the number of markets granted a year remains high, varying between approximately two and six markets per year.

The data displayed in Figure III provide a lens on commercial activity and urbanization that was experienced over the whole of Germany, not merely in its largest cities. The underlying, high-frequency information, available for each year, on literally hundreds of distinct changes in economic activity—market establishments and city incorporations—allows us to test hypotheses that would be difficult to evaluate using other, much coarser measures of economic outcomes.

### III. UNIVERSITY ESTABLISHMENT IN MEDIEVAL EUROPE

#### *III.A. Universities and the Commercial Revolution*

At precisely the time when it experienced its Commercial Revolution, Europe also saw the creation of its first universities.<sup>21</sup> The first university, the University of Bologna, was founded in the eleventh century by foreign students who were receiving training in the law: the Justinian Code of Roman civil law had just been rediscovered at this time, and Bologna had become a preeminent site of legal scholarship. Students in Bologna, many of them foreigners, formed a corporation of scholars (*universitas*) to obtain official recognition and protection of their rights.

Universities spread rapidly throughout Europe during the period of the Commercial Revolution. There were no universities in all of Europe before the Commercial Revolution began in the tenth century. By 1500, there were more than 50 (Verger 1992, pp. 62–65). Throughout the Middle Ages, the number of universities is highly correlated with contemporaneous levels of urbanization, as we show in the Online Appendix, Section OA.2.<sup>22</sup> In Table I, we provide a list of some of the universities founded in the Middle Ages, along with their foundation dates.

These medieval universities may have supported economic activity during the Commercial Revolution through a variety of channels. First, they produced human capital: training in the

21. General references on the medieval universities include Rashdall (1895) and DeRidder-Symoens (1992).

22. Abramson and Boix (2012) show that urbanization and universities remain positively correlated in the early modern period.



TABLE I  
UNIVERSITY ESTABLISHMENTS

University location	Foundation date
Bologna	end of 12th century
Vicenza	1204
Paris	beginning of 13th century
Oxford	beginning of 13th century
Montpellier	beginning of 13th century
Cambridge	1209–1225
Arezzo	1215
Salamanca	before 1218–1219
Padua	1222
Naples	1224
Vercelli	1228
Toulouse	1229
Orléans	around 1235
Siena	1246
Angers	1250
Lisbon	1290
Lerida	1300
Avignon	1303
Rome	1303
Perugia	1308
Pisa	1343
Prague	1347
Florence	1349
Pavia	1361
Cracow	1364
Orange	1365
Vienna	1365 (opened in 1383)
<i>Erfurt</i>	<i>1379 (opened in 1392)</i>
<i>Heidelberg</i>	<i>1386</i>
<i>Cologne</i>	<i>1388</i>
Turin	1404
<i>Leipzig</i>	<i>1409</i>
St. Andrews	1411
<i>Rostock</i>	<i>1419</i>
Louvain	1425
Basle	1459
<i>Tübingen</i>	<i>1476</i>

*Notes.* Universities in the territory considered “Germany” in our data set in italics. The foundation dates come from Verger (1992). Note that there is some ambiguity in the foundation dates of many of the early universities, so the numbers may differ slightly from those reported elsewhere.

*Source.* Verger (1992), pages 62–65.

liberal arts was composed of logic, grammar, and rhetoric (the *trivium*) as well as arithmetic, geometry, music, and astronomy (the *quadrivium*), skills that may have been commercially useful.<sup>23</sup> Second, they encouraged the formation of networks of mobile individuals who spoke Latin and who were trained in common subjects, using common texts. Perhaps most important, medieval universities trained a large number of individuals in canon and civil law (as we discuss in much more detail in Section VI). This specific type of human capital was especially important in medieval Europe, where the development of civil, administrative, and merchant law, the staffing of courts, and the enforcement of contracts was critical to solving the “fundamental problem of exchange” (Greif 2000): the resolution of uncertainty in economic transactions due to highly disaggregated political institutions, high costs of transportation and communication, and thus high risk of expropriation by the state or by one’s agent.<sup>24</sup>

Of course, the development of legal and educational institutions was very much a response to improving economic conditions—this was certainly true of medieval universities. Without identifying a source of exogenous variation in the establishment of universities, it is difficult to credibly establish a causal link between them and increased economic activity.

### *III.B. The Papal Schism as a Natural Experiment in University Establishment*

Throughout the Middle Ages, until 1386, German students had to travel abroad, to the universities of Paris, Bologna, Prague, or other cities, to receive a university education—there were not yet any German universities.<sup>25</sup> Rashdall (1895, p. 212) writes that in the twelfth and thirteenth centuries, “Germany was too far behind the rest of Europe in culture and civilization for the spontaneous development of a University.” As Germany

23. Dittmar (2011b) argues that numeracy was crucial to merchants’ commercial success in early modern Europe.

24. See Greif (1993, 2000, 2006), Greif, Milgrom, and Weingast (1994), and van Zanden (2009) for discussions of the institutions developed to solve problems of insecure property rights and uncertain contract enforcement in the Middle Ages.

25. Prague was part of the Holy Roman Empire. However, in following the convention of this article, we use the anachronism “German” to refer only to the territory covered by our data set, which does not encompass Prague and the kingdom of Bohemia.

developed and demand for university training increased, constraints on the supply of universities remained binding. During the fourteenth century, the Church wished to limit the number of sites of theological and canon law training to monitor teaching and prevent the spread of heresy, thus constraining university establishment; Rashdall (1895, p. 236) writes of popes' "policy of confining theological graduation to Paris."<sup>26</sup> In addition to political constraints on university establishment, the supply of faculty was another important constraint on German university establishment prior to the papal schism, as the historical absence of any German universities meant that Germany's scholars had long been based in universities abroad.

Between 1386 and 1392, however, there were three universities established in Germany: one in Heidelberg (founded in 1386), one in Cologne (1388), and one in Erfurt (1392).<sup>27</sup> The reason for the sudden foundation of several German universities was the papal schism, which relaxed the political constraint on university establishment and the constraint of limited faculty in the German lands.

From 1309 to 1378, a period known as the "Avignon papacy," popes resided in Avignon, France, rather than in Rome. In 1378, Pope Gregory XI moved the papal court back to Rome and died shortly thereafter. The election to replace him resulted first in the selection of Pope Urban VI, who remained in Rome, and then in the selection of Clement VII, who maintained his court in Avignon. Thus, beginning in 1378, there were two rival popes; secular lords chose to pledge allegiance to one or the other. France and Spain were loyal to the French pope, while the Holy Roman Empire and the Italian states were loyal to Rome.<sup>28</sup>

26. Thijssen (1998) studies academic censure for heresy at the University of Paris in the Middle Ages. Cantoni and Yuchtman (2013) discuss the political economy of university establishment in medieval Europe more broadly, focusing on spiritual and secular lords' general support of university education due (especially) to the usefulness of legally trained university graduates in administrative roles. Although it typically supported university education (by subsidizing study and hiring large numbers of graduates), the Church initially forbade university study and always closely monitored teaching to prevent heterodoxy.

27. Another university of the Holy Roman Empire, the University of Vienna, was officially established in 1365, but little actual teaching began until after the schism (in 1383). In addition, the University of Leipzig was founded in 1409.

28. Some exceptions to this pattern are described in Swanson (1979); we discuss the minority of German cities that were aligned with the Avignon pope later.

The split in the Church had important consequences for university students and faculty from Germany. Because there were no German universities at the time of the schism, many of them had studied and taught at French universities, such as the universities of Paris and Orléans. However, for theological reasons, in the years following the schism, the French universities became increasingly intolerant of individuals loyal to the Roman pope, such as German students and faculty. The University of Paris (Western Europe's preeminent center of scholarship on canon law and theology) issued a formal declaration in support of Clement VII in February 1383; Swanson (1979, pp. 68–74) writes of the “exodus” of Germans from Paris and the “the decline of the German nation at the University of Orleans” at that time.

Forced to leave the French universities, students and faculty returned to Germany, where universities were established to take them in. Importantly, the Roman pope's political constraint on university establishment (to maintain orthodoxy) was loosened by the schism, because Rome had lost the University of Paris's allegiance. Indeed, Rome not only needed to make up for the loss of the University of Paris, but also wished to compete with it. The rise of universities in Germany “gained further strength from the Schism, since the Roman Popes were always ready to grant the necessary bulls [establishing universities] as a means of weakening Paris, the great champion of the Avignon Pontiffs” (Rashdall 1895, p. 247).

The increased supply of eminent German scholars was also of critical importance, attracting other faculty and the first students to the new universities. Marsilius of Inghen, first rector of the University of Heidelberg, was a former rector in Paris and “one of the strong Urbanists who had left the University” (Rashdall 1895, p. 248). Another of the early rectors at Heidelberg was Conrad of Gelnhausen, “among the Germans who left Paris when Louis of Anjou clamped down on the university” (Swanson 1979, pp. 211–212).<sup>29</sup> Thus, although there was certainly demand for university training among German students, it took the (supply) shock of the schism to transform Germany's educational institutions.

29. Elsewhere in the Holy Roman Empire, the University of Vienna languished for nearly two decades until Henry of Langenstein, “one of the strongest opponents of Clement at Paris,” arrived, became the “soul” of the university, and attracted additional masters to the university (Rashdall, 1895, pp. 237–238).

The papal schism of 1378 produced a sharp change in university establishment in Germany; in a brief period of time, the distance to a university, and the cost of university attendance, shrank significantly for individuals across Germany. For the median city, the distance to the nearest university shrank by around 200 km following the establishment of the first three German universities—the shade of city markers on the map in Figure II indicates the change in distance to a university that resulted from the new universities' establishment (darker colors indicate a larger change in distance).

Importantly, the schism represented a source of variation in the creation of universities the timing of which was arguably exogenous with respect to the German economy (conditional on smooth underlying changes): the schism was a political event that did not coincide with any dramatic economic shifts of which we are aware. In Table II, we list several important economic changes that affected Germany in the centuries surrounding the papal schism: important institutional innovations, discoveries of precious metals, and the massive demographic shock of the Black Death were all important events that *did not* coincide with the papal schism.<sup>30</sup> We thus focus on the period around the schism to identify universities' contribution to Germany's economic development; we argue that this natural experiment can be used to credibly identify the causal effect of university establishment on economic activity.<sup>31</sup>

### *III.C. Numbers and Provenance of German Students after the Schism*

The newly founded universities in Germany dramatically reduced the distance to and the cost of attending a university for a large share of the population of the Holy Roman Empire. These changes did not simply reallocate German students from universities abroad to universities at home—they greatly expanded the number of Germans who were able to acquire some

30. We further examine the impact of economic shocks, political shocks, and the possibility of effects of the schism working through channels other than university establishment in section V.

31. While the timing of the papal schism was arguably exogenous with respect to the development of the German economy, the location of universities established following the schism certainly may have been correlated with other determinants of economic activity. We examine this issue in detail later (see Section V.B).

TABLE II  
ECONOMIC SHOCKS IN GERMANY, 1200–1500

Date	Event
13th century	Creation of “commercial” schools that teach reading, arithmetic, bookkeeping
Around 1250	Creation of the legal form of a corporation in Germany
1320	Discovery of gold in Hungary, decline of the Champagne fairs
By 1345	Financial instruments such as the promissory note widely used
1348	First wave of the Black Death hits Europe
1439	Invention of printing with movable type by Johannes Gutenberg in Mainz
1470–1490	Discovery of silver in Schwaz (Tyrol) and Schneeberg (Saxony)

*Sources.* Cipolla (1976), North (2000).

university training. Emphasizing the momentous effects that this change had on German society, Rashdall (1895, p. 214) writes,

The bulk of Germans at foreign universities [before the schism] were probably young nobles and well-born or well-beneficed ecclesiastics.... The career open to merit was [after the Schism] brought within reach of sons of the tradesmen and the artisan. Martin Luther could have hardly enjoyed a university education if he had had to go to Paris for it.

Here we move beyond anecdotal evidence and document the increased supply of German university students by presenting data on enrollments from the matriculation records of the first three German universities, at Heidelberg, Cologne, and Erfurt.<sup>32</sup> We also collected information that allows us to conservatively estimate the enrollments of German students at the Universities of Bologna, Orléans, Padua, Paris, and Prague, which likely hosted the vast majority of Germans studying abroad, thus allowing us to estimate the change in the number of Germans with some university training following the establishment of the new German universities.

32. A detailed description of the construction of student enrollment numbers and a full list of references is given in Appendix I. Less comprehensive data on German university student enrollments are presented in Coing (1964) and García y García (1992). Their estimates are consistent with our arguments here.



FIGURE IV

Number of German University Students, 1366–1406, by Location of Study

“Foreign” universities are Bologna, Padua, Paris, Orléans, and Prague. “German” universities are Heidelberg, Cologne, and Erfurt. See Appendix I for a discussion of sources and the assumptions underlying these estimates.

The data on student enrollment, presented in Figure IV, show a large increase in the number of German university students following the establishment of the first three German universities. From 1366 to 1385, German student enrollment (all of which was necessarily abroad) averaged 170 students per year. Between 1387 and 1406, the number of students in the three German universities alone averaged 400 a year (and total enrollment of German students, in Germany or abroad, averaged 527 per year from 1387 to 1406). This rise in German student enrollments was almost immediate: between 1387 and 1396, the average was already over 360 students a year in the three German universities (and around 470 German students a year including the foreign universities).

The matriculation records generally provide information on the number of university students, rather than university graduates. In fact, counting students (rather than graduates) more accurately captures the effect of medieval universities on human capital: many university students in the Middle Ages did not plan



to graduate, yet acquired human capital and were employed in positions where their education was put to use.<sup>33</sup> However, as an alternative measure of human capital, we also examine the change in the number of German university graduates after 1386, using the *Repertorium Academicum Germanicum* (RAG) database, and find evidence of approximately a doubling in the number of German university graduates from the 1366–1385 period to the 1387–1406 period (see the Online Appendix, Section OA.3 for details). Thus, the data on both students and graduates indicate a sharp increase in human capital in Germany after the first universities were established: thousands of additional students and hundreds of additional graduates between 1386 and 1406.

The large increase in German university students after 1386 is likely due to the smaller costs that attending a German university entailed, as opposed to traveling to Bologna or Paris. Young men were more likely to choose to attend a university if an educational institution was nearby. The historical literature certainly supports this view; for example, Schwinges (2000, p. 38) writes that many of the first university students “shared the common feature that the new university lay close their region of origin.”<sup>34</sup>

In fact, a closer analysis of the matriculation records reveals patterns consistent with this mechanism. The records of the University of Heidelberg (Toepke 1884; analyzed in Fuchs 1995) and of Cologne (Keussen 1892) indicate each student’s diocese of origin. In Figure V, we present the cumulative distribution functions of Heidelberg and Cologne students who enrolled between a university’s foundation date and 1410, by the distance between a university and its students’ dioceses of origin.<sup>35</sup> It is clear from the figure that the majority of students enrolled in both

33. See Wieacker (1995, p. 119) and Cobban (1975, p. 224).

34. Distance to a university continues to be an important determinant of human capital acquisition; see Card (1995).

35. We calculate the distances as great circle distances from the university to the seat of the diocese. Note that the city of Heidelberg belonged to the diocese of Worms; from a closer analysis of the single entries in the matriculation records, we determined that 40% (22 out of 55) of the students hailing from the diocese of Worms were actually natives of Heidelberg itself. We therefore present disaggregated figures for the city of Heidelberg and the remainder of the diocese of Worms in the top panel of Figure V. Unfortunately, these sources do not allow us to further disaggregate the numbers on the origin of students by subject studied.

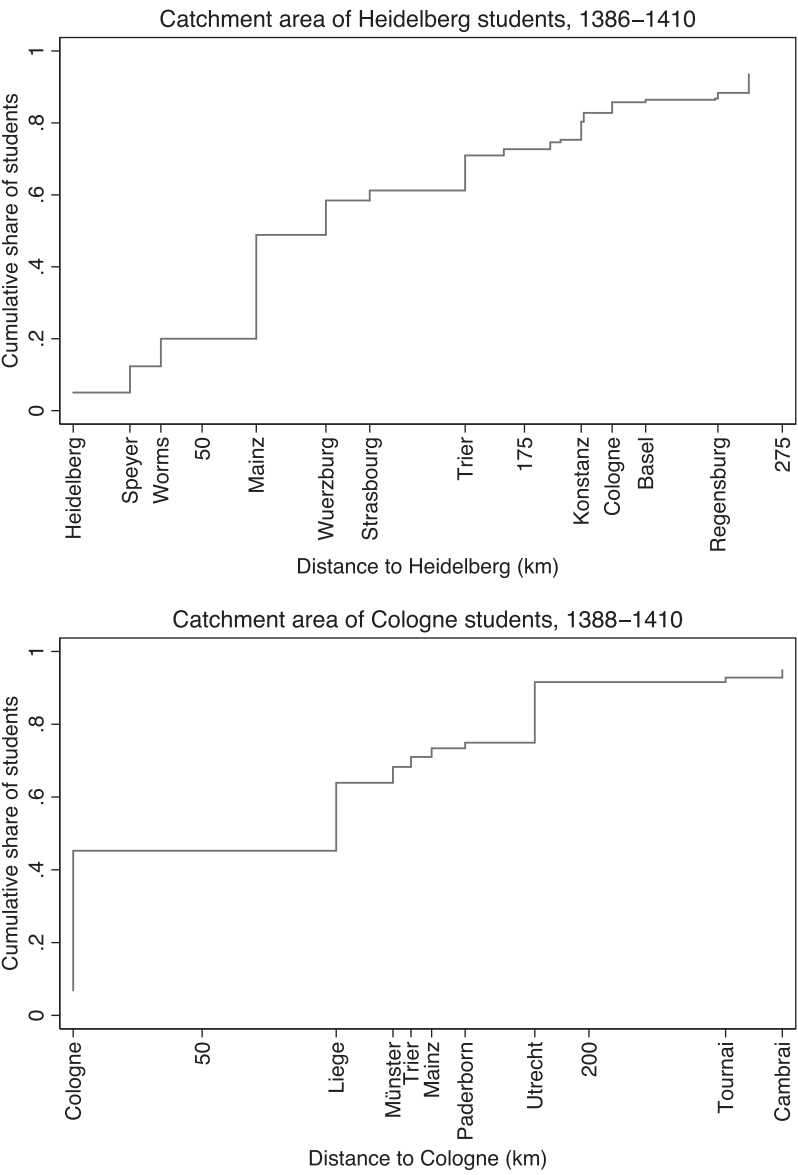


FIGURE V

Cumulative Distributions of Students at the Universities of Heidelberg and Cologne, by the Distance from a Student's Home Diocese to the University Attended

Source: based on Fuchs (1995) and Keussen (1892).

universities came from quite nearby. Over 40% of the students enrolled at the University of Cologne came from the diocese of Cologne itself. Around half of the Heidelberg students between 1386 and 1410 came from the three dioceses surrounding Heidelberg: Speyer, Worms, and Mainz. The vast majority of the students enrolled prior to 1410 came from within 200 km of their university. Finally, it is important to add that historical evidence suggests that students returned to their hometowns to use their acquired human capital; Wriedt (2000, p. 60) writes that most scholars who became urban officeholders “came from the same city where they later worked, or from neighboring cities.”

#### IV. A SIMPLE MODEL OF UNIVERSITY FOUNDATION AND MARKET ESTABLISHMENT

As a result of the papal schism, Germany was rapidly transformed from a land with no universities and relatively few students into a land with several universities and many students. We present a simple model that links university proximity, and thus human capital, to market establishment. It generates an empirical model of market establishment that we estimate later, as well as clear predictions regarding the effects of the papal schism and the subsequent establishment of Germany's first universities on economic activity.

Our assumption, supported by the empirical evidence in the previous section, is that medieval universities increased human capital in areas in closer proximity to them. This human capital, in turn, was important for supporting markets.<sup>36</sup> We model market establishment in medieval Germany as a function of (time-varying) underlying economic conditions, as well as human capital,  $h_{i,t}$ , which was time-varying and city-specific. Importantly, the demand for university training may have been a function of economic conditions, too. To the extent that economic changes affected the demand for human capital and market establishment smoothly over time, we can model these effects (and, in our empirical work, control for them) using a simple time

36. In Section VI, we argue that training in newly rediscovered Roman and canon law was especially useful. In the current model, we do not make any specific assumption about what sort of human capital was useful, and argue only that having a university in close proximity increased human capital, and thus the likelihood of establishing a market.

trend—at least within a fairly narrow window of time.<sup>37</sup> By controlling for smooth changes across time in the demand for universities, we can identify the effect of the new universities coming from the exogenous supply shock resulting from the papal schism. Thus, our focus is on studying market establishment within a relatively narrow window of time around the establishment of Germany's first universities.<sup>38</sup>

If we assume an additive, separable relationship between the time trend and human capital, we can write the market establishment function as follows:

$$(1) \quad \text{markets}_{i,t} = \alpha_1 \cdot \text{Year}_t + \gamma \cdot h_{i,t}.$$

Human capital is a stock: it will depend on the cumulative effect of access to education in the past. In medieval Germany, a crucial determinant of access to the human capital produced in universities was the distance to the nearest university (as shown before). Thus, we model the human capital stock in a city at any time as a (negative) linear function of the distance of that city to the nearest university in  $n$  past years:

$$(2) \quad h_{i,t} = - \sum_{j=1}^n \delta_{t-j} \cdot \text{distance}_{i,t-j}.$$

Prior to the papal schism and the establishment of the University of Heidelberg in 1386, German students attended university abroad; there was a stable value of  $\text{distance}_{i,t-j}$ , and so a stable level of human capital.<sup>39</sup> After the foundation of the University of Heidelberg, cities experienced a reduction in distance to a university. We define the following:

$$\Delta \text{DistUniv}_i = \text{distance}_{i,pre} - \text{distance}_{i,post},$$

where  $\text{distance}_{i,pre}$  represents the pre-schism minimum distance from city  $i$  to a university; we measure it in our empirical section

37. We generally model the effects of changing economic conditions using a linear trend common to all cities; as a robustness check, we also consider region-specific time trends in our empirical work (see Table V).

38. This makes the treatment effects estimated in the empirical section “local” in the sense that the effects of university establishment are estimated conditional on particular economic conditions and demand for university training. We believe these estimates are relevant: across Europe, university establishment occurred precisely when economic conditions were ripe.

39. This is, of course, only approximately true, and only a good approximation for  $n$  not too large.

as the minimum of the distance to the universities operating as of 1385 (Bologna, Paris, Prague, etc.). The post-schism distance to a university,  $distance_{i,post}$ , is computed as the minimum of  $distance_{i,pre}$  and the distance to one of the newly founded German universities in Heidelberg, Cologne, and Erfurt. Thus,  $\Delta DistUniv_i$  is bounded from below by 0 in the case of all cities that, following the schism, were no nearer to a university city than before.<sup>40</sup>

We define a post-university dummy variable,  $Post_t$ , which equals 1 for all years after 1386, and a linear time trend  $Year_t$ , normalized to be 0 in the “pivot year” of 1386.<sup>41</sup> As derived in Appendix II, we obtain the following estimating equation:

$$\begin{aligned} markets_{i,t} = & \alpha_0 + \alpha_1 \cdot Year_t + \alpha_2 \cdot Post_t + \alpha_3 \cdot Year_t \cdot Post_t \\ & + \alpha_4 \cdot \Delta DistUniv_i + \alpha_5 \cdot \Delta DistUniv_i \cdot Year_t \\ & + \alpha_6 \cdot \Delta DistUniv_i \cdot Post_t \\ (3) \quad & + \alpha_7 \cdot \Delta DistUniv_i \cdot Year_t \cdot Post_t + \varepsilon_{i,t}. \end{aligned}$$

Several terms on the right-hand side are of special interest. First, the term on which we focus our hypothesis testing is  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ : it will indicate whether cities with a larger reduction in distance to a university experienced a changed trend rate of market establishment after 1386. If the schism, and subsequent university establishment, led to the accumulation of human capital over time, and this human capital supported market establishment, we would expect this term to be positive and significant.

The  $Year_t \cdot Post_t$  term will indicate whether cities *not* experiencing any change in distance to a university nonetheless experience a change in the trend rate of market establishment after 1386. This term will have explanatory power if the schism

40. For all city-years  $it$  beginning in 1386, we treat distance to a university as the post-schism distance. Treating different cities (or years) differently as a function of the timing of the two other post-schism university establishments (Cologne and Erfurt) would raise concerns about endogeneity; hence, we calculate a single value of  $\Delta DistUniv$  for each city  $i$ , applied to all years, based on the three universities established between 1386 and 1392.

41. The eight-year delay between the schism itself and the foundation of the University of Heidelberg was due to the fact that the expulsion of German academics from French universities did not occur before 1381–1384 and to the time needed to grant a papal bull and set up a new institution of higher learning (Swanson 1979, pp. 58–74).

affected market establishment even where it did not reduce distance to a university. If the schism only affected market establishment rates through the change in distance to a university, this term should not be statistically significant.

The  $\Delta DistUniv_i \cdot Year_t$  term also provides an important falsification test: it indicates whether cities with a large change in distance to a university in 1386 had different trend rates of market establishment even before any reduction in distance occurred. If  $\Delta DistUniv_i$  is uncorrelated with economic conditions, then  $\Delta DistUniv_i \cdot Year_t$  should not be statistically significant. In standard difference-in-differences terminology, the term provides a test of parallel trends in the rate of market establishment between cities that would and would not experience a change in distance to a university following the schism.

Next, the  $\Delta DistUniv_i \cdot Post_t$  term tells us if there was an immediate jump in market establishment in 1386 in cities that experienced a reduction in distance to a university. Our hypothesized channel of human capital accumulation affecting market establishment leads us to expect that term will *not* be statistically significant. The  $\varepsilon_{it}$  term will capture shocks to market establishment specific to a city-year; in our empirical work we allow these shocks to be correlated across observations for each city.

In addition to looking at the city-level panel data, we take a more macro-level view of market establishment around the time of the establishment of the first German university. If we aggregate market establishments across cities in equation (3), we can examine time series variation in market establishment in all of Germany around 1386. Thus, we estimate:

$$(4) \text{markets}_t = \beta_0 + \beta_1 \cdot Year_t + \beta_2 \cdot Post_t + \beta_3 \cdot Year_t \cdot Post_t + \eta_t.$$

Equation (4) examines whether there is a change in the trend rate of market establishment in the pivot year, 1386 (the coefficient on  $Year_t \cdot Post_t$ ), and whether there is a discrete jump in the market establishment rate (the coefficient on  $Post_t$ ) at that time. If university establishment affected human capital accumulation, one would expect  $Year_t \cdot Post_t$  to be positive and significant. Moreover, one would not expect  $Post_t$  to be significantly different from 0, as this would imply an implausible, sudden effect on economic activity.<sup>42</sup>

42. Note, however, that we do expect the change in *trend* to occur immediately in 1386. This is consistent both with the assumptions of our empirical model (i.e., a

## V. EMPIRICAL ANALYSIS

V.A. *University Foundation and Market Establishment in Germany*

We begin our analysis by estimating the time-series equation (4) considering all of Germany from 20 years before through 20 years after 1386.<sup>43</sup> The findings of Table III, column (1), confirm the predictions of our model: there is a positive break in the trend rate of market establishment, and no immediate jump, in 1386. The predicted linear trends of market establishment pre- and post-1386 can be seen in Figure VI.<sup>44</sup> We also plot a locally weighted smoothing (lowess) of the market establishment data that does not impose any trend break in 1386. When we plot the smoothed market establishment rate against the linear trend break model, one can see that the model is a remarkably good fit for the data (see Figure VI).

The magnitude of the coefficient on  $Year_t \cdot Post_t$ ,  $\hat{\beta}_3$ , can be interpreted as 0.151 additional markets per 1,000 cities for every additional year after 1386; this effect is large enough to reverse the negative pretrend (coefficient on  $Year_t$ ) of  $-0.061$ . The effect of this reversal in trends can be observed in Figure VI, and suggests a change from 1.2 markets established per year, per 1,000 cities, in 1386 to just over 3 markets per year, per 1,000 cities, 20

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gradual increase in human capital) and with the high number of students matriculated already in 1386 (see Figure IV), some of whom would have attended for only a short period of time and then entered the labor market, rather than studying until receiving a degree. In addition, some of the students enrolling in Heidelberg or Cologne during the first years of these universities' activity had begun their studies in universities outside of Germany and finished their studies in the new universities within a short period of time.

43. The outcome variable in all of our regressions is the number of markets established per 1,000 cities, to facilitate comparisons of effects across specifications. In our time-series specifications, we observe yearly market establishment data at the region level in the raw data (the region may be all of Germany or subsets of it). We then multiply the number of markets established by 1,000 and divide by the total number of cities in the region considered. In the panel data, we observe yearly market establishment data at the city level in the raw data, and we multiply the value by 1,000 to convert the outcome into "markets per 1,000 cities."

44. Figure VI also shows that the change in trend after 1386 is not due to date heaping in the year 1400. In fact, Germany witnessed fewer market granting episodes in 1400 (two) than in the years 1399 or 1401 (four and nine, respectively).



TABLE III  
BASELINE ESTIMATES

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	Rate of market establishment					
Sample:	Time series			Panel		
		< Median $\Delta DistUniv$	$\geq$ Median $\Delta DistUniv$	City level	Territory level	Cell level
<i>Year</i>	-0.061 [0.053]	-0.025 [0.059]	-0.097 [0.061]	-0.004 [0.075]	0.087 [0.126]	0.018 [0.051]
<i>Post1386</i>	0.084 [0.807]	0.933 [1.152]	-0.765 [0.973]	1.726 [1.553]	-1.101 [2.219]	0.396 [1.418]
<i>Year <math>\times</math> Post1386</i>	0.151** [0.073]	0.015 [0.097]	0.287*** [0.084]	-0.086 [0.138]	-0.129 [0.205]	-0.068 [0.094]
$\Delta DistUniv$				-0.173 [0.413]	-0.808 [1.030]	-0.364 [0.250]
$\Delta DistUniv \times Year$				-0.032 [0.035]	-0.058 [0.060]	-0.030 [0.022]
$\Delta DistUniv \times Post1386$				-0.937 [0.630]	0.017 [1.069]	-0.232 [0.593]
$\Delta DistUniv \times Year \times$ <i>Post1386</i>				0.136** [0.059]	0.191* [0.108]	0.094* [0.049]
Constant	1.225* [0.615]	1.470** [0.684]	0.980 [0.784]	1.529* [0.829]	3.277 [2.307]	1.572*** [0.564]
Window (years)	1386 $\pm$ 20					
Observations	40	40	40	90,240	20,880	3,200
Number of cities	2,256	1,128	1,128			
Number of cross-sectional units				2,256	522	80

Notes. The outcome variable in all regressions is the number of markets established per 1,000 cities (see note 2 for additional details). In the time series specifications (columns (1)–(3)), the unit of observation is the year. In the panel data specifications, the unit of observation is the city  $\times$  year (column (4)), the territory  $\times$  year (column (5)), the 1-degree latitude 1-degree longitude cell  $\times$  year (column (6)). In columns (5) and (6), we sum the number of market establishments for all cities in a given territory in a given year (column (5)) or for all cities in a given 1-degree by 1-degree cell in a given year (column (6)), and then normalize the aggregate figure by the number of cities (in thousands) in the area considered. Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the level of cross-sectional units: cities (column (4)), territories (column (5)), or 1-degree by 1-degree cells (column (6)). \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

years later. A back-of-the-envelope calculation suggests the establishment of around 40 additional markets between 1387 and 1406 relative to the counterfactual in which market establishment had remained fixed at the 1386 level through 1406, and nearly 70 additional markets relative to the counterfactual in which market establishment followed the pre-1386 trend for another 20 years. These are large effects: we find 102 total market establishments between 1387 and 1406, and our calculations



FIGURE VI

Change in the Linear Trend Rate of Market Establishment, Whole Sample and Nonparametric (Lowess) Graph of Market Establishment Rates

Corresponds to the regression in Table III, column (1).

suggest that a significant fraction of them were a result of university establishment.<sup>45</sup>

We next wish to test for a link between reduced distance to a university and the change in the trend rate of market establishment. As a first approach, we simply divide our sample into two groups, based on the reduction in distance to the closest university,  $\Delta DistUniv_i$ . Equation (4) is then estimated separately for the sample of cities whose change in distance is above the median change and the cities whose change is less than the median change. We expect a larger change in the trend rate of market establishment in the sample of cities with large changes in distance to a university. Indeed, in Table III, columns (2) and (3), one can see that the coefficient on  $Year_t \cdot Post_t$  is positive and

45. We observe 102 total market establishments in 80 cities that received market grants in this period (some cities received multiple grants). We discuss whether our proposed mechanism of legal training could account for an additional 40 (or 70) markets later.

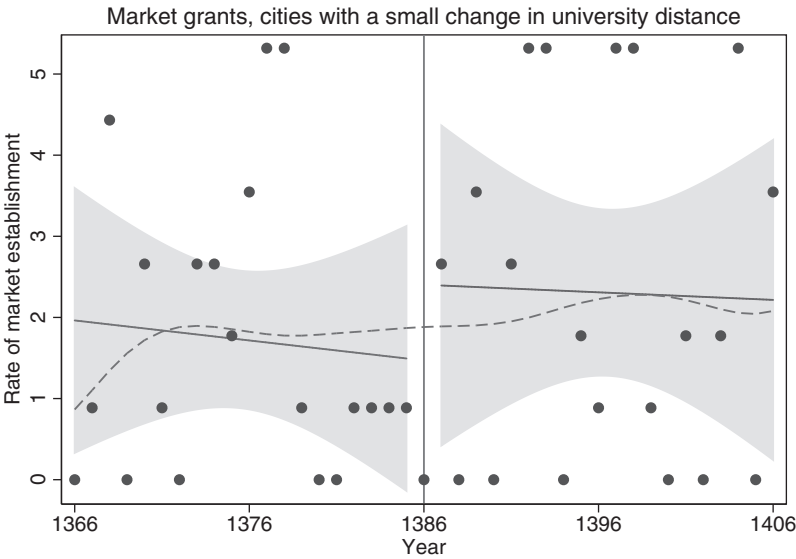


FIGURE VII

Change in the Linear Trend Rate of Market Establishment, Cities with a Small (Below Median) Change in Distance to the Closest University and Nonparametric (Lowess) Graph of Market Establishment Rates

Corresponds to the regression in Table III, column (2).

significant for the sample of cities with a large (above median) change in distance to a university, but not for regions with a small (below median) change in distance to a university. We plot the linear trends for these two regions, pre- and post-1386, as well as the lowest smoothed market establishment rates, in Figures VII and VIII.

To analyze the importance of the change in distance to a university using the entire sample of cities, we now turn to the city-level panel data and estimate equation (3). As already noted, if improved access to universities drove market establishment after 1386, one would expect to see a positive coefficient on the triple interaction term  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ . At the same time, we should not see a statistically significant pre-1386 trend rate of market establishment in places with larger changes in distance to a university (i.e., the coefficient on  $\Delta DistUniv_i \cdot Year_t$ ), nor should we see a significant change in the trend rate of market establishment in 1386 among cities with no change in distance

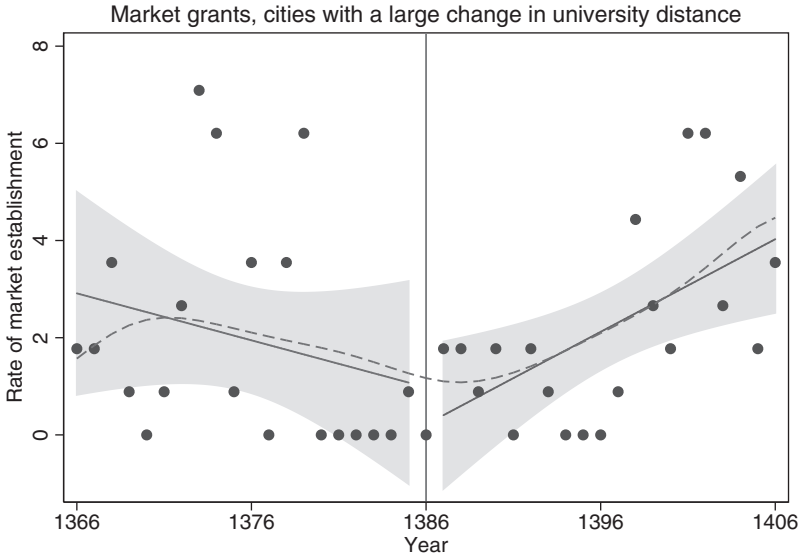


FIGURE VIII

Change in the Linear Trend Rate of Market Establishment, Cities with a Large (Above Median) Change in Distance to the Closest University and Nonparametric (Lowess) graph of market establishment rates

Corresponds to the regression in Table III, column (3)

to a university (i.e., the coefficient on  $Year_t \cdot Post_t$ ). In Table III, column (4), these predictions are confirmed: there is a significant, positive change in trend that is greater in cities experiencing a greater reduction in distance to a university, but no differential trends across these areas before 1386.

Our baseline panel specification used city-year-level data. A concern could be that this choice, resulting in over 90,000 observations in our baseline specification, distorts our statistical inferences, although standard errors are clustered at the city level. In addition, there might be general equilibrium effects of market establishment: a market in one city may replace (or simulate the creation of) a market in another, meaning the units of observation might not have been independent. To gauge the importance of the choice of city-year as the unit of analysis, we aggregate our data to larger units of observation.

We first consider as our outcome variable the number of markets established in a territorial lord's land in each year

(normalized as a rate per 1,000 cities).<sup>46</sup>  $\Delta DistUniv_i$  is now calculated as the average change in distance to a university across all cities in the relevant lord's territory. Estimating equation (3) using territory-year-level (instead of city-year-level) data does not affect our results, nor does it affect our statistical inferences (see Table III, column (5)). Alternatively, we aggregate our market establishment data to the level of 1-degree latitude by 1-degree longitude cells. Again, we find that areas experiencing a larger reduction in distance to a university experienced a greater positive break in the trend rate of market establishment after 1386 (see Table III, column (6)). In both of these alternative data sets, we find no evidence of a differential pretrend in areas with greater reductions in distance to a university, nor do we find positive trend breaks in areas with no reduction in distance to a university. In the following regression tables, we present results based on city-year level data; however, we replicate our panel regressions using territory-year and cell-year-level data in the Online Appendix (Tables OA.4 and OA.5).<sup>47</sup>

In the Online Appendix, Section OA.6, we consider variations on the time period studied (expanding and contracting the window of analysis around 1386), and on the outcome variable (examining the sum of market establishment and city incorporations, or examining an indicator, rather than count, of market establishment); in each case, we find evidence of a positive trend break in market establishment in 1386, concentrated in areas experiencing a large change in distance to a university.

An important concern with the foregoing regressions is that the timing of university establishment in Germany following the schism was possibly endogenous. In addition, our results in Table III might simply be capturing changes in trends that began before university establishment and that were more pronounced in areas that happened to experience reductions in distance to a university following the papal schism.

To evaluate the likelihood of either of these possibilities, we check whether alternative pivot years generate results similar to those above. These alternative pivot years can be thought of as

46. The Holy Roman Empire in the late Middle Ages was a complicated array of partly overlapping layers of sovereignty. For each city in our data set we coded the highest liege lord (other than the emperor) to which it was subject around 1386.

47. We also report our city-year regressions with standard errors clustered at the territory level in the Online Appendix (Table OA.6).

placebo tests: we expect to see trend breaks (in the time series specification) and a significant triple interaction term  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$  for pivot years around 1386, but not for other pivot years.

We thus estimate equation (4) 21 times on the full sample of cities; we estimate equation (3) 21 times on the full city-year panel. In a series of regressions, we use a 40-year window around every year between 1376 and 1396, changing the definition of  $Post_t$  accordingly. We plot the coefficients on  $Year_t \cdot Post_t$  or  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ , respectively, from these regressions, along with their 95% confidence intervals, in Figures IX and X.<sup>48</sup> One can see that the largest, most significant trend breaks occur very close to 1386. Ten years before Germany's first university was established, market establishment rates were not experiencing any sharp break in trend, as evidenced by the point estimate being close to 0. Analogously, after 1386 there is progressively less evidence of a change in trend. The sharp change in the trend rate of market establishment is quite specific to the time of university establishment in Germany.

#### *V.B. Endogeneity of University Location*

The foregoing results reveal a positive break in the trend in market establishment in 1386—when Germany's first university was established—and that this break in trend was most evident in areas that experienced the greatest reduction in the distance to a university during the papal schism. However, one might be concerned about the possibility that the location of universities, and thus  $\Delta DistUniv_i$ , was correlated with an unobserved variable that also stimulated economic activity around the time of the schism. For example, the results in Table III might have been due to a correlation between good leadership, or good local economic conditions, and university foundation. That is, a territorial lord may have founded a university, then founded many markets nearby; a prescient lord may have founded a university in anticipation of good economic times ahead. Alternatively, a positive local economic shock, leading to a surplus of agricultural goods, might have increased the demand for a university and also market establishment in close proximity.

48. The Online Appendix reports graphs analogous to Figure IX for the two subsamples of cities with above and below median changes in distance to a university (Figures OA.2 and OA.3).



FIGURE IX

Changes in the Trend Rate of Market Establishment (Coefficient on  $Year_t \cdot Post_t$ ) under Varying Pivot Years, 1376–1396

For each year between 1376 and 1396, we test for a trend break in that specific year, examining the 20 years before and after that year, as in the specification estimated in Table III, column (1).

These alternative stories would explain a sharp change in market establishment rates precisely when universities were founded, and near those universities.<sup>49</sup> To examine the possibility that our results in Table III were the result of endogenous university locations in response to local economic conditions, we estimate our baseline specifications on alternative samples of German cities: first, we exclude cities within 20 km of a university, then those within 50 km of a university. Next, using information on local territorial lords collected for each of our cities from the *Deutsches Städtebuch*, we exclude from our analysis the three lords' territories containing a university city: these

49. Note that the results in Table III do not refer directly to the *proximity* of universities, but to the *change in proximity*: the correlation between the change in distance to a university (as a result of the schism) and the actual distance to the newly founded universities is  $-0.678$ .



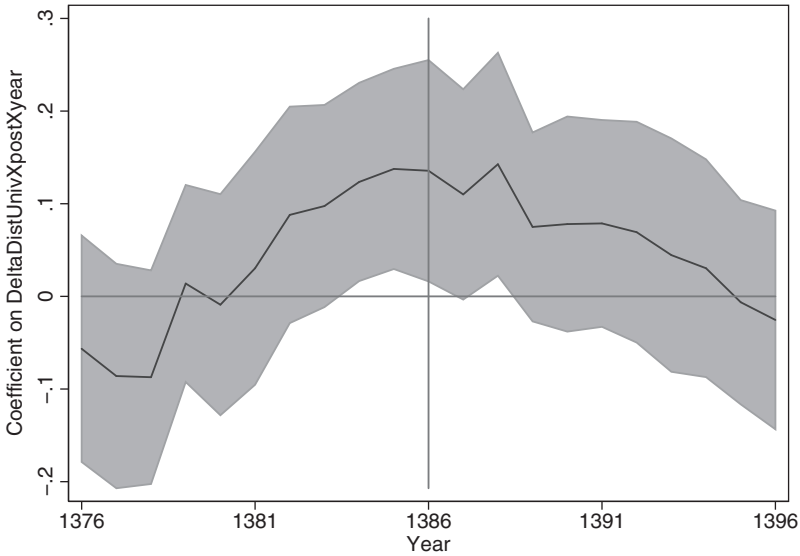


FIGURE X

Changes in the Trend Rate of Market Establishment (Coefficient on  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ ) under Varying Pivot Years, 1376–1396

For each year between 1376 and 1396, we test for a trend break in that specific year associated with  $\Delta DistUniv_i$ , examining the 20 years before and after that year, as in the specification estimated in Table III, column (4).

are the Rhenish palatinate (Heidelberg), the archbishopric of Cologne (Cologne), and the archbishopric of Mainz (Erfurt).<sup>50</sup> Note that dropping these territories also addresses concerns about political favoritism (perhaps resulting from the schism or some other political conflict) toward particular lords leading to university establishment and market grants in the same regions.<sup>51</sup>

50. In fact, the University of Cologne was established by the citizens of the (free) city of Cologne, rather than by the archbishop. Still, we exclude the territory of the archbishop to treat the three universities uniformly.

51. All of the analyses in which we drop particular, potentially problematic, observations can also be conducted by allowing the subgroups of concern to be treated as categories experiencing their own pre-schism trend rate of market establishment as well their own post-schism trend break (along with all lower-order terms). We present these analyses in the Online Appendix, Section OA.7, and the conclusions drawn are the same as those from the estimates presented in the main text.

TABLE IV  
SPATIAL ENDOGENEITY 1: LOCAL SHOCKS

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	Rate of market establishment					
Sample:	≥ 20 km from a univ.		≥ 50 km from a univ.		Not in the same territory	
	Time series	Panel, city level	Time series	Panel, city level	Time series	Panel, city level
<i>Year</i>	−0.061 [0.053]	−0.002 [0.075]	−0.048 [0.050]	−0.008 [0.077]	−0.040 [0.055]	0.012 [0.076]
<i>Post1386</i>	0.135 [0.810]	1.729 [1.565]	0.463 [0.765]	1.400 [1.601]	−0.155 [0.853]	1.141 [1.527]
<i>Year × Post1386</i>	0.148** [0.072]	−0.088 [0.139]	0.117 [0.071]	−0.058 [0.141]	0.127* [0.075]	−0.080 [0.140]
<i>ΔDistUniv</i>		−0.167 [0.430]		−0.374 [0.467]		−0.122 [0.471]
<i>ΔDistUniv × Year</i>		−0.035 [0.037]		−0.025 [0.039]		−0.031 [0.038]
<i>ΔDistUniv × Post1386</i>		−0.926 [0.650]		−0.594 [0.703]		−0.781 [0.680]
<i>ΔDistUniv × Year × Post1386</i>		0.137** [0.061]		0.111* [0.064]		0.124* [0.064]
Constant	1.226* [0.622]	1.513* [0.839]	1.096* [0.546]	1.687* [0.861]	1.341** [0.659]	1.543* [0.869]
Window (years)	1386 ± 20					
Observations	40	88,800	40	81,440	40	84,000
Number of cities/ cross-sectional units	2,220	2,220	2,036	2,036	2,100	2,100

Notes. The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see note 2 for additional details). In time series specifications (columns (1), (3), and (5)), the unit of observation is the year. In the panel data specifications (columns (2), (4), and (6)), the unit of observation is the city × year. Regions examined in the table are: all of Germany excluding areas within 20 km/50 km of Heidelberg, Cologne, and Erfurt (columns (1)–(4)); or all of Germany excluding the territories belonging to the Rhenish palatinate, the archbishopric of Cologne, and the archbishopric of Mainz (columns (5)–(6)). Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

In Table IV, columns (1), (3), and (5) one can see that there is a positive break in the trend rate of market establishment in 1386 even when we exclude cities within 20 km or 50 km of a university, or when we exclude cities in the same territory as a university.<sup>52</sup> The role played by the reduction in distance to a university

52. The Online Appendix reports additional results from estimating our time series specification separately for the samples of cities with above-median and below-median  $\Delta DistUniv_i$ , for each time-series specification discussed here and in later sections (Table OA.7). In every case (including specifications discussed

can be seen in the corresponding panel data specifications of Table IV, columns (2), (4), and (6): there is a positive and significant break in the trend rate of market establishment that is greater for cities with a larger change in distance to a university (see the coefficient on  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ ). This differential trend break was *not* entirely driven by cities extremely close to the universities themselves or by cities belonging to the lords whose territories contained the universities. Importantly, we do not see any differential pre-1386 trend associated with  $\Delta DistUniv_i$ , and we see no effect of the schism on post-1386 market establishment in cities experiencing no change in distance to a university.

Another concern about the location of the new universities is that cities with high values of  $\Delta DistUniv_i$  are generally concentrated in western Germany, close to the Rhine and near the economically vibrant Low Countries. Additionally, scholars have identified important institutional differences between Germany east and west of the Elbe following the Black Death of 1348 (e.g., Brenner 1976; Dittmar 2011a). More generally, given the clear association between longitude and the change in distance to a university seen in Figure II, one wants to be sure that our results are not driven simply by our comparison of late fourteenth-century economic activity across regions of Germany that differed in ways other than the change in distance to a university post-1386.

It is important, however, to point out that underlying differences across German regions that were associated with the post-1386 change in distance to a university would much more likely produce either a level difference in market establishment across regions (e.g.,  $\Delta DistUniv_i$  having a positive coefficient), or a different trend in market establishment, which would show up pre-1386 (i.e.,  $\Delta DistUniv_i \cdot Year_t$  having a positive coefficient). It would be much more difficult to explain why there would be a positive *break* in the trend rate of market establishment precisely in 1386, associated with  $\Delta DistUniv_i$ . Consider, for example, the Black Death, which certainly might have generated different trends in economic activity across Germany post-1348.<sup>53</sup> In

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shortly), our inferences from splitting the sample and using the time-series specification are consistent with those from estimating the panel specification.

53. Voigtländer and Voth (2012, 2013) show that the arrival of the Black Death had monumental consequences, resulting in changed incomes and urbanization, and also changed the composition of society through anti-Jewish pogroms.

principle, these different trends may even have been correlated with  $\Delta DistUniv_i$ , as the western part of Germany may have been especially economically vibrant after the plague (that is, post-1348). However, we find no significant differences in levels or trend rates of market activity associated with  $\Delta DistUniv_i$  prior to 1386 (see Table III). One might believe that the Black Death generated effects that accelerated across time; however, our findings in Figures IX and X show that there was no sign of any trend break in economic activity in general or associated with  $\Delta DistUniv_i$  prior to the mid-1380s.

One still might worry about the effects of time-varying economic shocks that are region-specific. To address concerns regarding regional differences across Germany driving our results, we begin by testing for a break in the trend rate of market establishment only on the sample of cities farther than 20 km from the Rhine. If cities near the Rhine experienced differential trends (or trend breaks) in economic activity, for example, because of their proximity to the Low Countries, we would not want this to drive our results. In Table V, column (1), we present the results from estimating the specification in Table III, column (1), but excluding cities near the Rhine. We continue to find a significant break in the trend. In Table V, column (2), one can see that this break is again greater in cities with greater reductions in distance to a university.

Next, we address concerns that our results are driven by differential trends east versus west of the Elbe in the late fourteenth century. In Table V, columns (3) and (4), we estimate our baseline specifications only for cities that are west of the Elbe; even in this restricted subsample, we continue to find very similar results.

Another way to determine whether diverging trends in market establishment in east versus west Germany are behind our results is to explicitly allow the pre-1386 and post-1386 trend rates of market establishment to vary with longitude. If trend breaks specific to eastern Germany drive our results, rather than the change in distance to a university, then controlling for longitude-varying trend breaks post-1386 should eliminate the trend break associated with the change in distance to a university. We thus estimate the specification in Table III, column (4), but include  $Longitude_i \cdot Year_t \cdot Post_t$  and all lower-order interactions and terms as controls. We find that the longitude-varying trend break post-1386 is *not* statistically significant, and the

TABLE V  
SPATIAL ENDOGENEITY 2: REGIONAL DIFFERENCES

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	Rate of market establishment					
Sample:	$\geq 20$ km from the Rhine		West of the Elbe		Longitude- varying trends	State-varying trends
	Time series	Panel, city level	Time series	Panel, city level	Panel, city level	Panel, city level
<i>Year</i>	-0.050 [0.053]	-0.014 [0.078]	-0.079 [0.066]	-0.021 [0.131]	-0.141 [0.293]	
<i>Post1386</i>	0.444 [0.837]	1.704 [1.624]	0.245 [0.978]	3.608 [2.788]	16.933** [8.154]	
<i>Year</i> $\times$ <i>Post1386</i>	0.108 [0.079]	-0.086 [0.143]	0.197** [0.089]	-0.119 [0.244]	-0.673 [0.707]	
$\Delta DistUniv$		-0.300 [0.474]		-0.333 [0.589]	-0.173 [0.413]	-0.231 [0.827]
$\Delta DistUniv \times Year$		-0.023 [0.039]		-0.027 [0.052]	-0.015 [0.056]	-0.065 [0.071]
$\Delta DistUniv \times Post1386$		-0.788 [0.715]		-1.589 [1.014]	-2.896** [1.362]	-2.325* [1.231]
$\Delta DistUniv \times Year \times$ <i>Post1386</i>		0.122* [0.065]		0.149 [0.091]	0.211* [0.120]	0.322** [0.153]
Constant	1.198* [0.605]	1.678* [0.875]	1.358* [0.749]	2.062 [1.417]	1.529* [0.829]	0.269 [0.962]
Window (years)	1386 $\pm$ 20					
Observations	40	81,000	40	70,360	90,240	90,240
Number of cities/ cross-sectional units	2,025	2,025	1,759	1,759	2,256	2,256

*Notes.* The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see note 2 for additional details). In time-series specifications (columns (1) and (3)), the unit of observation is the year. In the panel data specifications (columns (2), (4), (5), and (6)), the unit of observation is the city  $\times$  year. Regions examined in the table are: all of Germany excluding areas within 20 km of the Rhine (columns (1)–(2)); excluding areas east of the Elbe (columns (3)–(4)); or all of Germany (columns (5)–(6)). Column (5) shows results from estimating our baseline specification (Table III, column (4)) including controls for a city's longitude interacted with  $Year_t$ ,  $Post_t$ , and  $Year_t \times Post_t$  (coefficients not reported). Column (6) shows results from estimating our baseline specification including a full set of 18 regional (state) dummies interacted with  $Year_t$ ,  $Post_t$ , and  $Year_t \times Post_t$  (coefficients not reported). Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

coefficient on  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$  remains positive, statistically significant, and similar in magnitude to our baseline estimate (see Table V, column (5)).<sup>54</sup>

54. Note that the negative coefficient on  $\Delta DistUniv_i \cdot Post_t$  is offset by the coefficient on  $Longitude_i \cdot Post_t$  (not shown). Also, when the longitude-varying trend break is estimated alone, it is significant and negative, indicating that western parts of Germany, indeed, experienced a positive trend break, relative to the east

Finally, we consider a specification that adds to our baseline specification state-specific time trends, as well as state-specific trend breaks in 1386 (that is, interaction terms of  $Year_t$ ,  $Post_t$ , and  $Year_t \cdot Post_t$  with state dummies). We adopt the division of Germany into 18 states as in the volumes of the *Deutsches Städtebuch*.<sup>55</sup> This specification allows each state to follow its own pre-1386 trend rate of market establishment, and also allows each state to experience its own trend break in 1386 (as well as its own discrete “jump” in market establishment in 1386). In this setup, the effect of a change in university distance on market establishments is estimated only from the *within-state* variation of  $\Delta DistUniv_i$ . As can be seen in Table V, column (6), our results from this specification are quite similar to our baseline: we continue to see a significant, positive coefficient on  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ .

### V.C. The Impact of Political Shocks on Market Establishment

Although the findings presented so far suggest that differential economic shocks across regions of Germany (other than the new universities) likely did not drive our results, one might still be concerned that the many political changes occurring in Germany in the late fourteenth century may have affected market establishment. For example, changes in a city’s territorial lord—which were somewhat common in the period we study—may have resulted in new lords’ formalizing existing markets under their own authority for symbolic purposes or to extract rents. We examine each case of a market establishment between 1386 and 1406 to determine whether there was a jurisdictional change within the 10 years prior to the market establishment (information on changes in jurisdiction comes from the *Deutsches Städtebuch*). We identified seven cities with a recent jurisdictional change, and we estimate the specifications in Table III, columns (1) and (4), after dropping these cities.

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(as one would have expected from Figure II). However, the effect disappears once one accounts for the effects of  $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ .

55. These are Bavaria, Baden, Württemberg, Hesse, Rhineland-Palatinate, Saarland, Rhineland, Westphalia, Lower Saxony (including Bremen), Schleswig-Holstein (including Hamburg), Saxony, Thuringia, Saxony-Anhalt, Brandenburg (including Berlin), Mecklenburg, Silesia, and Pomerania (for the vast majority of cases, these states correspond to present-day Länder in the Federal Republic of Germany). A map showing these 18 states, and the locations of cities within them, is presented in the Online Appendix, Figure OA.4.

TABLE VI  
ACCOUNTING FOR POLITICAL SHOCKS

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	Rate of market establishment					
Sample:	Excl. market grants with jurisdictional changes		Excluding Württemberg		Excl. Avignonese obedience	
	Time series	Panel, city level	Time series	Panel, city level	Time series	Panel, city level
<i>Year</i>	−0.061 [0.053]	−0.004 [0.075]	−0.061 [0.051]	−0.011 [0.077]	−0.061 [0.053]	−0.004 [0.075]
<i>Post1386</i>	−0.073 [0.843]	1.659 [1.553]	0.242 [0.832]	1.879 [1.596]	0.084 [0.811]	1.729 [1.553]
<i>Year × Post1386</i>	0.150** [0.073]	−0.089 [0.138]	0.132* [0.075]	−0.090 [0.140]	0.152** [0.073]	−0.087 [0.138]
<i>ΔDistUniv</i>		−0.173 [0.414]		−0.097 [0.433]		−0.170 [0.415]
<i>ΔDistUniv × Year</i>		−0.033 [0.035]		−0.027 [0.036]		−0.033 [0.035]
<i>ΔDistUniv × Post1386</i>		−0.989 [0.628]		−0.975 [0.655]		−0.942 [0.633]
<i>ΔDistUniv × Year × Post1386</i>		0.136** [0.059]		0.125** [0.061]		0.137** [0.059]
Constant	1.229* [0.617]	1.532* [0.830]	1.187* [0.594]	1.511* [0.853]	1.230* [0.618]	1.527* [0.830]
Window (years)	1386 ± 20					
Observations	40	89,960	40	85,160	40	81,320
Number of cities/ cross-sectional units	2,249	2,249	2,084	2,129	2,033	2,033

*Notes.* The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see note 2 for additional details). In time-series specifications (columns (1), (3), and (5)), the unit of observation is the year. In the panel data specifications (columns (2), (4), and (6)), the unit of observation is the city × year. Regions examined in the table are: all of Germany excluding cities that received market grants between 1386 and 1406 and also experienced jurisdictional changes within the 10 years prior to the market establishment (columns (1)–(2)); excluding the state of Württemberg (columns (3)–(4)); or excluding cities aligned with the Avignon pope (columns (5)–(6); for the full list of territories affected see Section V.C). Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

Although we drop over 5% of the markets established in the post-1386 period from our analysis, we continue to find a significant, positive trend break in market establishment concentrated in cities experiencing a larger change in distance to a university (see Table VI, columns (1) and (2)).

Another potential confounding factor is intercity conflict, which was also common in the fourteenth century. During the period we study, Swabia in particular was a site of conflict,

with a coalition of cities fighting wars against neighboring territorial lords (Schuler 1977–1999; Moraw 1989). Conflict among cities may have resulted in the use of lawyers to redirect trade, rather than increase it; market rights could have been used in economic warfare to increase tax revenues or to hurt the markets of competing cities. To determine whether market rights granted in regions of conflict played an important role in generating our results, we estimate the specifications in Table III, columns (1) and (4), using the sample of cities excluding the state of Württemberg, which includes Swabia. We continue to find results similar to our baseline specifications (see Table VI, columns (3) and (4)). Thus, the region in which intercity conflict would have made lawyers and lords most likely to use market grants purely for strategic political reasons does not drive our findings.

We next ask whether some effect of the papal schism other than university establishment was likely to have changed economic activity and caused some part of the trend break in market establishment we observe in 1386.<sup>56</sup> For example, the schism may have affected trade patterns; shifts in papal politics may have had broader effects on economic and social life. One important concern is that the papal schism resulted in a small number of cities in the Holy Roman Empire aligning themselves with the pope in Avignon, rather than the one in Rome.<sup>57</sup> The resulting political fragmentation may have had economic consequences that were differential across German territories depending on which pope a territory recognized. Since cities aligned with Avignon had higher values of  $\Delta DistUniv_i$ , this might drive some of the trend break that we find.<sup>58</sup> To examine whether the market establishment patterns we observe were driven by the cities loyal to Avignon, we estimate the specifications in Table III, columns (1) and (4), after dropping the 223 cities loyal to the Avignon pope.

56. Note that to account for the changes in market establishment we observe, these other, unobserved economic effects would have had to be correlated with the reduction in distance to a university.

57. The territorial lords who, for some period of time, aligned themselves with Clement, the pope in Avignon, were the princes of Austria (Habsburg), Brabant, Cleves, East Frisia, Gleichen, Hoya, Katzenelnbogen, Lorraine, Luxembourg, Mark, Nassau, Saarbrücken, Schwarzburg, and Waldeck, as well as the prince-bishops of Mainz and Strasbourg (Hauck 1953, pp. 698–716).

58. The correlation between an indicator that a city was loyal to Avignon and  $\Delta DistUniv_i$  is 0.259.



We find that our results are very similar to those in our baseline estimates (see Table VI, columns (5) and (6)).<sup>59</sup>

We also undertake falsification exercises that can shed light on effects of the schism on economic activity through channels other than university establishment: we examine market establishment trends in England/Wales and Italy, which were exposed to the papal schism but experienced no significant changes in the number of universities in the baseline period we study.<sup>60</sup> If England or Italy experienced changes in market establishment rates in 1386, one would suspect that there were consequences of the schism for economic activity that worked through channels other than university establishment.

Because we lack any cross-sectional variation in Italy and England analogous to  $\Delta DistUniv_i$  in Germany, we simply run placebo tests for breaks in the trend rate of market establishment in these regions in 1386 using the time series model of equation (4).<sup>61</sup> The results presented in Table VII, columns (1) and (2), indicate that there was no change in the level or trend of the rate of market establishment in Italy or England in 1386. The schism did not affect market establishment rates in places that did not experience increased university establishment as a result. This evidence strongly points to increased access to universities as the causal factor explaining increased rates of market establishment in Germany after 1386.

## VI. UNIVERSITY TRAINING AND THE DEVELOPMENT OF LEGAL INSTITUTIONS

### VI.A. *The Importance of Legal Institutions in Medieval Europe*

How might the establishment of Germany's first universities have promoted the expansion of economic activity? There are

59. In the Online Appendix, we also discuss the possibility that political shocks outside of Germany may have had spillover effects, affecting patterns of German trade, and thus market establishment (see the Online Appendix, Table OA.12).

60. The market establishment data we were able to collect for Italy are for Naples, Sicily, and Lombardy, and come from Mira (1955), Grohmann (1969), and Epstein (1992). The English and Welsh market data were collected by Keene and Letters (2004).

61. Results are very similar if we use 1378, the year of the schism itself, as the pivot year; these regressions are reported in the Online Appendix (see Table OA. 13).

TABLE VII  
PLACEBO ANALYSES

Dependent variable:	(1)	(2)
	Rate of market establishment	
Sample:	Italy	England and Wales
<i>Year</i>	0.115 [0.097]	0.110 [0.075]
<i>Post1386</i>	0.305 [2.581]	-2.034* [1.177]
<i>Year × Post1386</i>	-0.008 [0.236]	-0.100 [0.089]
Constant	2.521* [1.257]	3.082*** [1.014]
Window (years)	1386 ± 20	
Observations	40	40
Number of cities	190	2,254

*Notes.* The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see note 2 for additional details). The unit of observation is the year. Regions examined in the table are: Italy in column (1) (i.e., Naples, Sicily, and Lombardy); England and Wales in column (2). Data on market establishments in Italy come from Mira (1955); Grohmann (1969); Epstein (1992); data on market establishments in England and Wales come from Keene and Letters (2004). Robust standard errors in brackets. \*Significant at 10%; \*\*significant at 5%; \*\*\*significant at 1%.

several plausible, nonexclusive mechanisms that may have been at work. As mentioned in Section III.A, university training in the liberal arts provided skills in mathematics, rhetoric, and logic that may have been useful in business and trade; the formation of social networks of skilled individuals, too, might have supported exchange.<sup>62</sup> We argue that training in Roman and canon law, and the consequent development of legal institutions likely represented a particularly important channel through which universities affected economic activity.

Europe’s Commercial Revolution occurred just as Roman law was reestablished in Europe.<sup>63</sup> The Justinian Code, “rediscovered” in the eleventh century, provided the foundation for a

62. Universities may have also increased commercial activity by directly increasing demand for goods and services or by generating agglomeration economies. Our findings of significant effects of university establishment more than 50 km away from the university cities themselves suggest, however, that these mechanisms do not play a predominant role in driving our findings.

63. We join legal scholars in attaching preeminent importance to the rediscovery of the Justinian Code, as opposed to other codifications of that epoch, such

legal system that could enforce contracts and define the relationship between the rulers and the ruled. The code became the core curriculum at Europe's first university, in Bologna, and over the centuries it formed the basis of the civil law curriculum in universities throughout Europe. Doctors of law at the universities wrote glosses on (interpretations of) the code and lectured on these; as their students spread throughout Europe, taking positions of influence, the legal system in which they were trained spread, too.<sup>64</sup>

Roman law represented a significant improvement over the preexisting systems of customary law. Whereas customary law was very local, Roman law was universally known across Europe; whereas customary law was highly traditional, based on kinship and superstition, Roman law was an authoritative yet flexible system that had been enriched by centuries of scholarship; whereas traditional law was informal and feuds were often preferred to trial, Roman law was written—contributing to the increasing importance of written evidence in the Middle Ages<sup>65</sup>—and based on a process of rational pursuit of truth (Berman 1983). Broadly applied, rule-based, written laws effectively reduced the uncertainty merchants faced in economic transactions. In the particular context of Germany, with its highly fractionalized territories, these advantages of Roman law were particularly salient.<sup>66</sup>

Though our primary focus is on Roman law, the importance of canon law in many spheres of public life in medieval times should not be neglected. Training in canon law, like Roman law, occurred in the medieval universities; indeed, most students studying law in medieval universities studied both canon and

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as the *Sachsenspiegel*. We discuss how training in Roman law represented new, valuable human capital in medieval Europe in Cantoni and Yuchtman (2013).

64. Cobban (1975, p. 220) writes, "The products of Europe's law universities . . . were readily absorbed into royal, imperial, or papal service as counsellors [and] as judges. . . . By means of this graduate recruitment, the principles of Roman and canon law permeated the governmental structures of Europe. In this sense, the law universities were agencies of cardinal importance in shaping the very texture of, and juristic principles underlying, European political organization."

65. See Mostert (1992) on this process, known as *Verschriftlichung* / *verschriftelijking*. On the written component of canon law, see Coing (1964, p. 79), and on the increasing use of written records in city and maritime courts, see Berman (1983, p. 355).

66. Wieacker (1995, pp. 78–84). See also Stobbe (1860, p. 637) and Savigny (1834, p. 3:84).

Roman law—*utrumque ius* (both laws), as it was commonly expressed. Because contracts relied on promises and sworn oaths, the Church played a role in contract enforcement, even when the parties to the contract were not clerics.<sup>67</sup> As pointed out by Berman (1983, p. 250), “the canonists were able, with the help of Romanist legal science, to create a subsystem of contract law within the system of canon law as a whole.”

The increasing numbers of legally trained administrators and the application of Roman and canon law across all spheres of public life could have had a series of positive effects on economic development. The legal historian Harold Berman argues that the rediscovery of Roman law, and the increasing development and sophistication of European legal systems (canon, Roman, and merchant law), fundamentally shaped the development of Europe’s states by bringing a new approach to the resolution of conflicts among various lords, secular and religious (Berman 1983). Conflicts between secular and religious authorities had plagued Europe during the better part of the Middle Ages; disputes existed among various secular jurisdictions as well (e.g., cities or feudal lords). Moraw (1989, p. 639) writes that economic success for cities in the Middle Ages “was a matter of urban ‘foreign policy’”; cities needed to establish their legal rights in a context of “multiplicity and lack of clarity of seigniorial rights.” Resolving these competing claims ultimately served to support and stabilize the process of state formation. Stronger polities, with effective administrators, and in which multiple layers of sovereignty were simplified and overlapping entitlements solved, found it easier to establish courts, organize economic activity, and establish markets.

The development of courts of law is another indicator of how Roman law permeated the public sphere in Europe. Stein (1999,

67. The Church’s competence in cases that would today be regarded as purely belonging to secular law was substantial. Church tribunals dealt with *causae saeculares* in the following cases: *ratione peccati*, that is, cases in which the subject matter was considered a sin and hence had to be confessed to a priest; *privilegium fori*, that is, the participation of a cleric as a plaintiff or defendant, or other special categories, such as Jews and sometimes even university students; and *denuntiatio evangelica*, that is, the evident necessity to apply moral or theological reasoning (Wieacker 1995, pp. 51–53). Moreover, cases were often brought to the attention of ecclesiastical tribunals even if they did not strictly belong to their field of competence because of their perceived independence and better ability to enforce sanctions (Kroeschell 1973, p. 23).

p. 86) writes that “states in continental Europe gloried in their new found ‘sovereignty’, and set up professional courts . . . [that] uniformly adopted a variant of the Romano-canonical procedure.” For example, in the economically vibrant Low Countries, courts played an important role in resolving (often international) commercial disputes in the middle of the fourteenth century (Gelderblom 2005, 2011; Dijkman 2011). The spread of Roman legal thinking to courts across Europe, and across Germany’s fragmented territories, made adjudication over commercial disputes much more predictable. As judges increasingly became trained following a common curriculum of studies, and were thus expected to follow those principles when passing judgments, contracting was made easier in the expectation of more certain procedures of adjudication and dispute resolution. Greater access to information about these rules may have been important, too: judges relying on written law were more predictable than judges relying on unwritten principles.

These mechanisms were very much at work in the specific case of Germany. The granting of formal market rights in Germany required the establishment of a market court. In traditional courts based on customary law, “judgments were taken by the ‘Ding’, which often met only four times a year. The procedural rules were very time-consuming. . . . The law was of an agricultural, Germanic origin and not at all suited for the needs of efficient trade by mobile traders” (Bindseil and Pfeil 1999, p. 741); in contrast, market courts based on modern, Roman law could act much more swiftly, issuing rulings that were meaningful across jurisdictions. The late medieval market courts were economically consequential: Bindseil and Pfeil (1999, p. 750) write, “As one of the crucial elements of a medieval market consisted in the establishment of a market law and a market court, investment to set up these institutions had to be undertaken. This required preparatory work by lawyers, training of the market overseers and legal documentation. The ability of the market court and administration was certainly a major element in the assessment of the market quality by the users of the market.”

Finally, legislation and the evolution of contractual norms led to the adoption of Roman contract law across Europe. Berman (1983, p. 245) writes that Roman law “had achieved a very high level of sophistication in the field of contracts, and . . . could be applied in the twelfth century to the newly

burgeoning commercial life in Western Europe.” Stein (1999, p. 66) notes that in a French treatise, written by Philippe de Beaumanoir around 1280, “the section on contracts, a subject that was not highly developed in local customs, drew considerably on Roman sources.”<sup>68</sup> The Roman law “toolkit” became even easier to apply as it spread and gained acceptance in the thirteenth and fourteenth centuries. Uniform contractual norms across polities served as a coordination device (Postema 1982; McAdams 2000) and reduced the uncertainty of exchange.

For all of these reasons—more clearly defined state institutions and jurisdictions, more predictable adjudication, and greater uniformity of legal contracts—a better-developed formal legal system should have reduced the uncertainty and risk associated with trade in the Middle Ages and increased commercial exchange. Greater merchant activity in a more predictable environment, and the improved administrative capacity of territorial lords would have jointly provided stronger incentives for the creation of new markets.

#### VI.B. *The Training and Careers of Jurists in the German Lands*

1. *Legal Study in Germany.* To support our proposed mechanism of legal institutions linking the first German universities to increased market establishment, it is important to determine how many of the students enrolled in the first German universities studied law, what their careers were, and whether their numbers and influence could plausibly explain the increase in the number of markets established between 1386 and 1406. We begin by presenting data on the numbers of law students in Germany’s first three universities. Among the more than 2,000 students matriculated at the University of Cologne between 1388 and 1410, we find that nearly a quarter (24%) studied law.<sup>69</sup> Unfortunately, we do not have data on the number of

68. Vinogradoff (1929, pp. 138, 143–144) writes that in the Middle Ages, “it became more and more usual for parties to a suit to submit the points in dispute to the arbitration of doctors of law,” and that the influence of Roman law was “especially manifest in the law of contracts.”

69. The records show 2,380 students matriculating between 1388 and 1410. Of these, 352 students (all students who matriculated between 1391 and 1395) have missing data on the faculty in which they studied. Of the remaining 2,028 students, 482 studied law (Keussen 1892).

Heidelberg students studying law; however, Fuchs (1995, Table II) shows that 14% of Heidelberg *graduates* before 1450 were in law; this is slightly above the fraction of Cologne graduates in law—which was 13% over the same period.<sup>70</sup> Although we also lack precise numbers for Erfurt, we believe that the fraction of students studying law was likely significant there as well: Coing (1964, p. 66) estimates that more students graduated in law from Erfurt than from Cologne or Heidelberg over the period 1386–1540, and Walther (2000, p. 116) notes that “the Erfurt law faculty attracted clerks not only from Franconia and the German Midlands, but also from the northern German cities and towns of the Hanseatic League.” If we assume that of the 400 students enrolled in the three universities each year between 1387 and 1406, 20% were studying law, this would amount to 80 law students a year at the first German universities across their first 20 years. The *Repertorium Academicum Germanicum* provides evidence on the number of German law graduates, which more than tripled from the 1366–1385 period to the 1387–1406 period (an increase by 150 individuals).<sup>71</sup>

It is important to note that unlike training in the arts, which could be acquired to some extent at cathedral schools or other *studia*, university training in law did not have close substitutes in medieval Germany: Wieacker (1995, p. 114) writes that “no comparable education in the *studium civile* was available in Germany.” Clark (1987, p. 653) writes that “the study of law in continental Europe has been associated for centuries with instruction at the university. To a significant extent this defines *the* salient characteristic of the civil law tradition” (emphasis in original). Thus, the increased university training in law does not reflect a reallocation of students to universities from other sites of legal training; increased legal training in Germany was made possible by the establishment of the new universities.

*2. The Careers of Jurists in the German Lands.* The development of states with trained administrators, the clarification of lords’ and cities’ jurisdictions, the development of formal courts, and the reduction of uncertainty in commercial exchange were all

70. Law represents a smaller fraction of graduates than of students, because (relative to the bachelor of arts degree) it was an advanced degree, and because legal studies for even a short course provided valuable skills.

71. See Online Appendix, Section OA.3, for details on these estimates.



driven forward by individuals trained in law in the first German universities. Here we present historical evidence on their careers.

Historians have long drawn clear links between university training and careers in secular and Church administrations. University graduates in law often worked in exalted positions, serving on courts and as counselors to cities, lords, and bishops.<sup>72</sup> This was the product of a recruitment strategy of territorial lords and city councilors, who valued the legal training that the universities provided—a recruitment strategy that was certainly active in fifteenth century Germany. Walther (2000, p. 124) writes,

Since they had founded the University at Heidelberg, the Palatine Electors systematically undertook to tie all law doctors of their university to themselves.... Thus, they secured the expertise of these “learned counsellors” for their own good use. In the same way, Imperial cities not only came to realize that employing “learned counsellors” as lawyers (*syndici*) or consultants was useful. In fact, especially in [the mid-fifteenth century] it was indispensable if municipal liberties and franchises were to be defended by judicial means.

University-trained lawyers—graduates and nongraduates—played a variety of important roles in city and territory administration and in protecting their polities’ rights. In the economically vibrant Hanseatic League cities, “since the middle of the fifteenth century, holding a doctorate in law was common among [the] *syndics* [i.e., administrators], some of them being prominent scholars of their time.... More intensive than other cities, Nuremberg

72. Some of the legally trained (generally doctors of law) were also able to pursue careers at the highest levels of government. Moraw (1986, p. 143) finds that the central administration of the Holy Roman Empire was a substantial employer of university graduates trained in the law: between 1273 and 1493, at least 230 jurists served in the Imperial Court. Most of these served in the century following the establishment of the first universities in Germany, both in an administrative capacity and in a judicial court, the *Reichskammergericht*. García y García (1992) writes, “Law graduates, both clerics and laymen, held official posts with various authorities, from the imperial and royal chanceries downwards. Both in the church and in civilian employment men of law held economic as well as administrative posts.” See also Vinogradoff (1929, p. 133), Coing (1964, §26), Moraw (1992, p. 273), and Wieacker (1995, pp. 65–67).



bound jurists in the fifteenth century and employed them as counsels of the [city] council, so that five or more of them were working at the same time" (Schwinges 2000, p. 57). In cities such as Mühlhausen, Erfurt, Augsburg, Bern, and Strasbourg, individuals trained in law worked for the city chancellery, advising on laws and regulations and working as diplomats who could protect a city's rights in jurisdictional disputes (Schwinges 2000, pp. 57–58).

In addition to individuals working within the city chancellery, Schwinges (2000, p. 58) notes the importance of "procurators and syndics . . . employed to represent the town in cases and at court."<sup>73</sup> It is important to emphasize that nongraduates served in the same positions as graduates—positions as chroniclers, notaries, or procurators—but often in the smaller cities and towns. Wieacker (1995, p. 119) writes of German law students: "Those who for social or economic reasons did not become doctors or complete the full law course could still have a sense of belonging to a respected profession, and suitable positions . . . were open to them in smaller principalities and cities [for example, posts] as court secretary, city secretary, or agent. . . . This group probably had more effect than any other on the day-to-day progress of [Roman law in Germany]."<sup>74</sup>

Some data on the careers of medieval university students are available, which indicate their important role in manning Germany's secular and Church administrations in a slightly later time period. Kuhn (1971) collected information on 1,627 students from Tübingen University from the years 1477 to 1534. Around 20% of students in this sample served in public administration jobs, not including individuals serving in administrative positions within the Church. In the subsample of students who

73. On jurists serving cities and territories in Germany, and influencing their jurisdiction as well as their economic policy, see also Dotzauer (1977) and Nicholas (1977, pp. 156–159). One example of a specific policy implemented by administrators to support trade was the creation of brokerage regulations. Boerner and Quint (2010) argue that these medieval regulations governing commercial transactions were successful in solving incentive and allocation problems and increasing the welfare of a city's population.

74. Cobban (1975, p. 224) writes of England: "From the beginning of the reign of Henry III there were at Oxford a number of teachers who specialized in the 'useful' subjects which had a direct application to the practical problems of business administration. . . . Probably many of the youthful students who attended these practical courses had never at any time intended a university degree, but had come to take a rapid course in business administration to qualify for a modest post."

attended both Tübingen and Bologna—these were overwhelmingly students of law—an even larger fraction of students, around 30%, pursued public administration careers, and again, an additional significant share may have been administrators within the Church.<sup>75</sup>

Beyond administration, the legally trained played a crucial role in advocating on behalf of parties to disputes and adjudicating those disputes. In fact, many of the jurists employed by cities or territorial lords, already discussed, were involved in dispute resolution—one of the first activities of jurists working for both secular and ecclesiastic administrations of the empire was as arbitrators, adjudicating disputes between cities, territories, and the Church.<sup>76</sup> Over the course of the fifteenth century, individuals trained in the law served on regular courts in addition to resolving arbitration cases.

In addition to supporting markets by resolving disputes among territories and clarifying jurisdiction, the influence of jurists on the establishment and success of markets was often more direct, as individuals with legal training often adjudicated commercial disputes or represented the disputants. Professional jurists increasingly sat on the market courts; the same was true for private lay courts (*Schöffenstühle*) and arbitration courts (*Schiedsgerichte*), where legally trained individuals could be active as arbitrators, assessors, or procurators who helped resolve private disputes (Coing 1964, p. 90; Berman 1983, p. 346; Wieacker, 1995, p. 119).

75. In Cantoni and Yuchtman (2013), we present data from Kuhn (1971) and also consider the careers of 1,212 law graduates from the University of Bologna (of all nationalities), from 1070 through 1619, as recorded by Alidosi (1623). We find that 21% of the Bologna graduates pursued careers in public administration, and another 31% pursued administrative careers in the Church.

76. Thanks to the large number of legally trained individuals following the establishment of the first German universities, characteristic elements of Roman law entered the political, judicial, and commercial spheres even before the formal adoption of Roman law in the Holy Roman Empire, a process known as *Frührezeption* (early reception); see Trusen (1962), Coing (1964), and Wieacker (1995). It is interesting to observe that in nearby Austria, where Roman law was not taught, it did not enter the public sphere either. The university of Vienna taught only canon law during the whole fifteenth century; as a consequence, the use of Roman law in the administration of the Austrian territories diffused only much later, in the sixteenth and seventeenth centuries (Baltl 1962, pp. 64–70).

The work of legally trained judges and advocates was complemented by individuals with legal training serving in other positions. Public notaries, who were often linked to the Church, played an important role in securing formal property rights (Wieacker 1995, pp. 85–86). The Church was also very active in the authentication of documents: for example, around the middle of the fifteenth century the ecclesiastical tribunal of Strasbourg was authenticating about 300–600 documents a week (Trusen 1962, p. 66; Coing 1964, §25). Notarized contracts, authenticated documents, and written rules made legal institutions more effective and reduced the uncertainty of economic transactions.

The career of Dietrich von Bocksdorf, who studied at the universities of Leipzig and Perugia and then was a professor of law in Leipzig, provides an indication of the range of disputes resolved by German jurists in the mid-fifteenth century—many of which were commercial in nature. Bocksdorf was often involved in the resolution of disputes over debt, and conflicts among townspeople, cities, and lords, over trade and jurisdiction. For example, in 1456 Bocksdorf defended the merchant Niklaus Müller, who was accused of not honoring a note of 1,200 guilders, contracted on a yearly fair with another merchant, Heinrich Greifvogel (though most disputes involved smaller sums, 50–200 guilders). Bocksdorf drafted hundreds of expert opinions on behalf of princes, the nobility, and bishops; he also drafted opinions for rural communities and peasants and for townspeople and for the cities in which they lived. One of these involved the resolution of a classic conflict over negative production externalities: a group of fishermen on a river in Saxony sued the owners of a foundry further up the river, which, they claimed, polluted the river with metal pieces (Wejwoda, 2012). The resolution of economic disputes by people like Bocksdorf affected very broad swathes of society in the fifteenth century.

Several other exemplary careers of jurists trained in Roman law can be found, though the historical record is skewed toward those engaged in affairs of state. Winand von Steeg studied at the University of Heidelberg from 1394 until 1401. His various occupations included teaching law in Würzburg, working as a canon, and serving as an envoy of the city of Nuremberg to the Council of Constance (1414–1418), which resolved the papal schism. Steeg was also involved in resolving economic disputes: he acted as an arbitrator in a dispute about custom payments for transit shipments on the Rhine and was asked to deliver expert testimony on

the legality of the purchase of rents (*Repertorium Academicum Germanicum* 2013). Muther (1876, pp. 26–29) describes the activities of Arnold Westphal: he taught law in Erfurt, Leipzig, and Rostock; was nominated bishop of Lübeck; wrote legal treatises; was asked for his legal advice by the rulers of Schleswig-Holstein and Denmark; and arbitrated in Prussia. Although these career paths are clearly outstanding, they are indicative of the variety of activities that trained jurists of the fourteenth and fifteenth century could have engaged in.

University training in the law was thus closely linked to occupations that increased the supply of markets and the demand for them: legally trained administrators and judges reduced the cost of establishing markets for cities and territories; more predictable adjudication reduced the uncertainty of contracting and engaging in commercial activity in medieval Germany, increasing merchants' demand for markets.

In our empirical analysis of market establishment (Section V.A), we found that the foundation of Germany's first universities was associated with the establishment of 40–70 additional markets between 1386 and 1406; in our analysis of the effects of the new universities on legal training in Germany (Section VI.B), we estimated that there were several hundred additional legally trained individuals, and 150 additional law graduates between 1386 and 1406. If 30% of the 150 graduates in law took administrative positions, these 45 individuals, working for territorial lords with jurisdiction over multiple cities and towns, could have had an effect on scores of cities. The potential impact of legal training appears even larger when considering the effects of graduates working in administrative positions in the Church, and especially the hundreds of individuals with some legal training but no formal degree, who worked in the administrations of small cities and towns. Thus, the transformation of administrative and legal institutions in fifteenth-century Germany by individuals trained in law was substantial.

## VII. CONCLUSION

Understanding the “rise of the West” is a monumental task, made more difficult by the fragmentary data available for the late medieval period when it began. To begin to study the economic aspects of the transformation of Europe requires systematic

evidence on economic activity. Our evidence on medieval German city incorporation and market establishment indicates remarkable changes in economic activity: hundreds of markets were established in Germany during the late Middle Ages.

These data allow us to test whether medieval universities played a causal role in the increased economic activity we observe. Medieval Germany experienced a plausibly exogenous shock to its human capital stock through the universities established there during the papal schism. The evidence presented in this article suggests an important, causal role for universities in the development of markets in medieval and early modern Germany.

While identifying the channel linking universities' proximity to market establishment is difficult, historical evidence indicates the importance of legal training provided by medieval universities. The number of German law students dramatically increased following the establishment of the first universities there; many of them went on to legal and administrative careers in which they helped develop new legal institutions, thus reducing the uncertainty of engaging in trade. We suggest that the development of formal legal institutions thus played a key role in promoting economic transformation.

The "natural experiment" in university establishment that we analyze occurred well into the late Middle Ages and outside the most commercially successful parts of medieval Europe. Still, we think that the experience of Germany in the late fourteenth and early fifteenth centuries not only provides an ideal testing ground due to the exogenous introduction of universities, we also believe that these insights reveal the importance of universities and (and legal institutions' development) throughout Europe in the Middle Ages. The channel from universities to legal training, to careers in public administration and Church administration was clearly exhibited among the University of Bologna's medieval graduates, who came from across Europe (Cantoni and Yuchtman, 2013). With regard to France, Swanson (1979, p. 15) writes that "universities became the training schools for the bureaucrats of both secular and ecclesiastical chanceries; . . . from the beginning of the thirteenth century the law graduates of the French provincial universities dominated the personnel of the French chancery." These public administrators (including those within the Church) helped establish the political institutions that scholars such as Berman (1983), DeLong and Shleifer (1993), and

Epstein (2000) argue were crucial to Europe's medieval economic growth.

#### APPENDIX I. CONSTRUCTION OF STUDENT ENROLLMENT NUMBERS

Enrollments of German students at the newly founded German universities are directly available from Toepke (1884) for Heidelberg, Keussen (1892) for Cologne, and Weissenborn (1881) for Erfurt.

Useful, general information on the interpretation of matriculation records of Germans abroad is contained in Courtenay (2000).

For Bologna, we use the data from Friedländer (1887). We assume that the number of Germans in Padua was identical to that in Bologna, though this is likely a significant overestimate.<sup>77</sup>

For the University of Paris, data on individuals in the German-English nation who "determined" (roughly, received the bachelor's degree) are available (Denifle 1889); we assume that one-tenth of all students determined, and that one-third of the German-English nation were from the German lands of the Holy Roman Empire—the majority were from England, Belgium, and the Netherlands (Denifle 1889).

For Orléans, we have data on the number of German students enrolled in 1378 (Fournier 1888). We assume that the enrollment level was constant at the 1378 level for all years except during the period 1384–1392 (inclusive), when the University of Paris's enrollment of German students was reduced to zero, and when historical evidence indicates that the University of Orléans's population of German students was sharply reduced (see Section III.B). During this period, we assume a two-thirds reduction in the number of German students enrolled at Orléans.

For Prague, we use the matriculation records in University of Prague (1830). We sum the numbers from the law faculty and the philosophy faculty. Students enrolled in the law faculty are recorded with their nation of origin; we consider those hailing

77. Rashdall (1895, p. 16) writes that following an influx of students from Bologna in the fourteenth century due to political turmoil there, "the new-comers must have constituted by far the larger part of the Paduan University."

from the Bavarian or Saxon nation as “Germans.” Matriculation records for the philosophy faculty do not record the place of origin; we take the numbers of students who *inceperunt* (began their studies) and multiply it by the share of students from the Bavarian and Saxon nations in the law faculty.

## APPENDIX II. DERIVATION OF THE ESTIMATION EQUATION

Here we provide details on the derivation of our estimating equation for our panel data set. Using the definition given in equation (2), we can write each city’s level of human capital at a point in time as a function of its pre-schism level of human capital,  $h_{i,1386}$ , the post-university dummy,  $Post_t$ , each city’s change in distance to a university following the papal schism,  $\Delta DistUniv_i$ , and the coefficients  $\delta_{t-j}$ . To see this, note that for  $t \leq 1386$ :

$$h_{i,t} = - \sum_{j=1}^n \beta_{t-j} \cdot distance_{i,t-j} = -distance_{i,pre} \cdot \sum_{j=1}^n \beta_{t-j} \equiv h_{i,1386}.$$

In 1387 (and analogously, for the years after 1387), the level of human capital in cities with positive values of  $\Delta DistUniv_i$  can be written as:

$$\begin{aligned} h_{i,1387} &= -\beta_{t-1} \cdot distance_{i,1386} - \beta_{t-2} \cdot distance_{i,1385} \\ &\quad - \beta_{t-3} \cdot distance_{i,1384} - \dots \\ &= -\beta_{t-1} \cdot (distance_{i,pre} - \Delta DistUniv_i) - \beta_{t-2} \cdot distance_{i,pre} \\ &\quad - \beta_{t-3} \cdot distance_{i,pre} - \dots \\ &= h_{i,1386} + \beta_{t-1} \cdot \Delta DistUniv_i. \end{aligned}$$

Thus, prior to 1387, human capital in our model will be approximately flat at the level  $h_{i,1386}$ ; for 1387 and the following years, human capital is equal to:

$$h_{i,t} = h_{i,1386} + Post_t \cdot \Delta DistUniv_i \cdot \sum_{j=1}^{t-1386} \delta_{t-j}.$$

To simplify, we approximate the unknown series of  $\delta_{t-j}$  with a time trend and plug this back into equation (1). This yields, after redefining coefficients:

$$\begin{aligned} markets_{i,t} &= \alpha_1 \cdot Year_t + \gamma(h_{i,1386} + \Delta DistUniv_i \cdot Year_t \cdot Post_t) \\ &\equiv \bar{h}_{i,1386} + \alpha_1 \cdot Year_t + \alpha_7 \cdot \Delta DistUniv_i \cdot Year_t \cdot Post_t, \end{aligned}$$



where the variable  $Year_t$  is normalized to equal 0 in the pivot year.

Though not predicted by the model, reduction in distance to a university ( $\Delta DistUniv_i$ ) and the papal schism ( $Post_t$ ) might both be associated with characteristics that directly affect market establishment in the level, in trends, or in their interactions. To account (and test) for these possible relationships, we include level and interaction effects of  $\Delta DistUniv_i$  and  $Post_t$ . This yields the following equation:

$$\begin{aligned} markets_{i,t} = & \bar{h}_{i,1386} + \alpha_1 \cdot Year_t + \alpha_2 \cdot Post_t + \alpha_3 \cdot Year_t \cdot Post_t \\ & + \alpha_4 \cdot \Delta DistUniv_i + \alpha_5 \cdot \Delta DistUniv_i \cdot Year_t \\ & + \alpha_6 \cdot \Delta DistUniv_i \cdot Post_t. \\ & + \alpha_7 \cdot \Delta DistUniv_i \cdot Year_t \cdot Post_t \end{aligned}$$

The city-specific intercepts  $\bar{h}_{i,1386}$  can be accounted for with city fixed effects. However, because the coefficients on the interaction terms of interest are invariant to the inclusion of city fixed effects, we do not include the fixed effects in our regressions. We therefore use the following estimation equation:

$$\begin{aligned} markets_{i,t} = & \alpha_0 + \alpha_1 \cdot Year_t + \alpha_2 \cdot Post_t + \alpha_3 \cdot Year_t \cdot Post_t \\ & + \alpha_4 \cdot \Delta DistUniv_i + \alpha_5 \cdot \Delta DistUniv_i \cdot Year_t \\ & + \alpha_6 \cdot \Delta DistUniv_i \cdot Post_t. \\ (5) \quad & + \alpha_7 \cdot \Delta DistUniv_i \cdot Year_t \cdot Post_t + \varepsilon_{i,t} \end{aligned}$$

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#### SUPPLEMENTARY MATERIAL

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