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Abstract

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 that 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-Code: I250, N130, N330, O100.

Keywords: human capital, historical development, legal institutions.

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1 Introduction

The late Middle Ages saw the first stirrings of the “Rise of the West.”¹ Between the years 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 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 11th century, then fifty more in the following four centuries—and the development of formal legal institutions and state administrative systems. In this paper 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 et al., 1988). While informative, the existing data on the Commercial Revolution are often limited in their frequency, in their geographic coverage, or in their 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.²

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 German³ cities, 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

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

²Morris (2010), among others, ranks China’s economic development in the Song Dynasty (960–1279 A.D.) 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.

³The 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 considered part of the Holy Roman Empire). For brevity, we use the anachronism “Germany” throughout the paper.

activity. The markets established under the grants took a variety of forms, and they were granted to cities large and small. This dataset thus captures economic changes in medieval Europe that occurred inside and outside major urban areas, spanning a large region, over a long period of time.

The primary purpose of this paper is to use these data on market grants to test whether universities had a causal effect on economic activity in medieval Europe.⁴ We study the effects of a unique natural experiment in university establishment: Church politics—the Papal Schism of the late 14th century—resulted in the arguably exogenous foundation of Germany’s first universities, and greatly increased Germans’ access to university training.⁵ 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 find 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

⁴The 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 4-year college spending across all states, and of research-related spending in states close to the technological frontier.

⁵Of course, even if the establishment of universities in 14th 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 14th 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 paper’s Conclusion.

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 km 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; 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 14th 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 an important one: universities trained lawyers, who became administrators, codified laws and regulations, and staffed and guided others through the legal systems that they helped to develop.⁶ Murphy et al. (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

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

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 et al. (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 8th and 9th 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. 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. 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.

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.⁷ DeLong and Shleifer (1993) emphasize the importance of constraints on executive power, which were developed in some of the new city-states that arose in the Middle Ages; Guiso et al. (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."⁸ 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

⁷Greif (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).

⁸Guiso et al. (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.

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 paper 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 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, 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.

2 Documenting the Commercial Revolution

2.1 Existing Evidence

Beginning around the tenth century, there was a revival of trade in Europe.⁹ 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 governmental, 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.”¹⁰

Unfortunately, only very limited data for the period are available to support this narrative.¹¹ 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.¹² In Figure 1, we present Buringh and van Zanden’s (2009) data on

⁹After 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).

¹⁰Some 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).

¹¹There 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.

¹²DeLong and Shleifer (1993) use city growth as a measure of economic development, and Acemoglu et al. (2005) and Acemoglu et al. (2011) use urbanization rates.

these indicators of economic activity. They clearly reveal the dramatic changes experienced in Europe between the years 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 Netherlands and in Belgium, respectively. Similarly, manuscript production soared in the late Middle Ages, rising from less than 100,000 manuscripts per century to over 4 million.

[Figure 1 about here]

Figure 1 matches the narrative presented above: 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 et al. (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 panel with relatively few observations. In the case of Germany, population data are available for only 21 cities in the year 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.¹³

2.2 New Evidence on the Commercial Revolution in Germany

The *Deutsches Städtebuch*, a series of volumes edited by Erich Keyser (1939–1964), 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 when 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 2).¹⁴

¹³Epstein (2000, p. 74) notes that “[t]he daily and weekly markets where most small-scale retailing took place” are often ignored by scholars. Britnell (2009, p. I.189) writes that “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.”

¹⁴To 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.

[Figure 2 about here]

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, and to coin money and to 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.¹⁵ 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.¹⁶ First, one can examine the association between a city's size—a commonly used measure of economic development in the pre-modern world—and the granting of market rights to that city. Using data from Bairoch et al. (1988), we find for both years 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, ed, 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 twenty years following the establishment of the first German university, is the focus of our empirical analysis of the impact of universities on market establishment. We

¹⁵Epstein (2000, p. 82); Britnell (1978, p. 192); Schmieder (2005, p. 49).

¹⁶We discuss the sources described here in more detail in the online appendix, Section OA.1.

find that 30 of these cities experienced some notable construction within 20 years of the year of the market grant or city incorporation (see the online appendix, Table OA.2).¹⁷ 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.¹⁸

Finally, we consulted a report on the markets existing in Germany in 1936, *Verzeichnis der Märkte und Messen im Deutschen Reich im Jahre 1936* (Statistisches Reichsamt, ed, 1935) and matched the markets in the report to the market establishments in our dataset between 1386 and 1406. We find that 60 of the 63 cities receiving market grants from 1386–1406 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 14th (or early 15th) 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.¹⁹

In Figure 3 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

¹⁷If 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 twenty-year window and control cities within a forty-year window is statistically significant at the 5% level.

¹⁸We discuss additional examples of construction following the granting of a market right in the online appendix, Section OA.1.

¹⁹We 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.

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 13th century; the average number of cities incorporated per year increased from less than one to approximately four. The granting of market rights also accelerated during the 13th century, albeit more slowly. During the 14th century, the comovement of city incorporations and market grants becomes evident, indicating a clear tendency toward both greater urbanization and expanded economic activity, a tendency which is not even reversed by the arrival of the Black Death of 1348. Toward the end of the 14th century, however, the two series begin to diverge. City incorporations subside, while the number of markets granted per year remains high, varying between approximately 2–6 markets per year.

[Figure 3 about here]

The data displayed in Figure 3 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.

3 University Establishment in Medieval Europe

3.1 Universities and the Commercial Revolution

At precisely the time when it experienced its Commercial Revolution, Europe also saw the creation of its first universities.²⁰ 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.

²⁰General references on the medieval universities include Rashdall (1895) and DeRidder-Symoens, ed (1992).

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 the year 1500, there were more than fifty (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.2.²¹ In Table 1, we provide a list of some of the universities founded in the Middle Ages, along with their foundation dates.

[Table 1 about here]

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 liberal arts was comprised of logic, grammar and rhetoric (the *trivium*) as well as arithmetic, geometry, music, and astronomy (the *quadrivium*), skills that may have been commercially useful.²² 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 importantly, 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.²³

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.

²¹Abramson and Boix (2012) show that urbanization and universities remain positively correlated in the early modern period.

²²Dittmar (2011b) argues that numeracy was crucial to merchants’ commercial success in early modern Europe.

²³See Greif (1993, 2000, 2006), Greif et al. (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.

3.2 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.²⁴ Rashdall (1895, p. 212) writes that in the 12th and 13th centuries, “Germany was too far behind the rest of Europe in culture and civilization for the spontaneous development of a University.” As Germany developed and demand for university training increased, constraints on the supply of universities remained binding. During the 14th century, the Church wished to limit the number of sites of theological and canon law training in order 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.”²⁵ 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).²⁶ The reason for the sudden foundation of several German universities was the Papal Schism, which both relaxed the the political constraint on university establishment, and also 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 Gregory XI 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.

²⁴Prague was part of the Holy Roman Empire. However, in following the convention of this paper, we use the anachronism “German” to refer only to the territory covered by our dataset, which does not encompass Prague and the Kingdom of Bohemia.

²⁵Thijssen (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.

²⁶Another 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.

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.²⁷

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 (in order to maintain orthodoxy) was loosened by the Schism, because Rome had lost the University of Paris' 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).²⁸ Thus, while there was certainly demand for university training among

²⁷Some exceptions to this pattern are described in Swanson (1979); we discuss the minority of German cities that were aligned with the Avignon Pope below.

²⁸Elsewhere 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).

German students, it took the (supply) shock of the Schism to transform Germany's educational institutions.

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 so 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 kilometers following the establishment of the first three German universities—the shade of city markers on the map in Figure 2 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 2, 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.²⁹ 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.³⁰

[Table 2 about here]

3.3 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 university training. Em-

²⁹We 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.

³⁰While 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 below (see Section V.B).

phasizing 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.³¹ 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.

The data on student enrollment, presented in Figure 4, 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 per year (and total enrollment of German students, in Germany or abroad, averaged 527 per year from 1387–1406). This rise in German student enrollments was almost immediate: between 1387 and 1396, the average was already over 360 students per year in the three German universities (and around 470 German students per year including the foreign universities).

[Figure 4 about here]

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 impact 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

³¹A detailed description of the construction of student enrollment numbers and a full list of references is given in Appendix A. 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.

where their education was put to use.³² 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.”³³

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 5, 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.³⁴ It is clear from the figure that the majority of students enrolled in both 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 kilometers of their university. Finally, it is important to add that historical evidence suggests that students *returned* to their hometowns to use their acquired

³²See Wieacker (1995, p. 119) and Cobban (1975, p. 224).

³³Distance to a university continues to be an important determinant of human capital acquisition; see Card (1995).

³⁴We 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 5. Unfortunately, these sources do not allow us to further disaggregate the numbers on the origin of students by subject studied.

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.”

[Figure 5 about here]

4 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 below, 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.³⁵ 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 trend—at least within a fairly narrow window of time.³⁶ 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.³⁷

³⁵In Section VI, below, 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.

³⁶We 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 5).

³⁷This 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.

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

$$markets_{i,t} = \alpha_1 \cdot Year_t + \gamma \cdot h_{i,t} \quad (1)$$

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 above). 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:

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

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 $distance_{i,t-j}$, and so a stable level of human capital.³⁸ After the foundation of the University of Heidelberg, cities experienced a reduction in distance to a university. We define the following:

$$\Delta DistUniv_i = distance_{i,pre} - distance_{i,post},$$

where $distance_{i,pre}$ represents the pre-Schism minimum distance from city i to a university; we will measure it in our empirical section 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 zero in the case of all cities that, following the Schism, were no nearer to a university city than before.³⁹

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 1386.⁴⁰ As derived in Appendix B,

³⁸This is, of course, only approximately true, and only a good approximation for n not too large.

³⁹For 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.

⁴⁰The 8-year delay between the Schism itself and the foundation of the University of Heidelberg was due to the fact that

we obtain the following estimating equation:

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

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 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*

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).

be statistically significant. The ε_{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 will 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:

$$markets_t = \beta_0 + \beta_1 \cdot Year_t + \beta_2 \cdot Post_t + \beta_3 \cdot Year_t \cdot Post_t + \eta_t \quad (4)$$

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 zero, as this would imply an implausible, sudden effect on economic activity.⁴¹

5 Empirical Analysis

5.1 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 1386.⁴² The findings of Table 3, 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

⁴¹Note, 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 gradual increase in human capital), and with the high number of students matriculated already in 1386 (see Figure 4), 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.

⁴²The 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."

in Figure 6.⁴³ 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 6).

[Table 3 about here]

[Figure 6 about here]

The magnitude of the coefficient on $Year_t \cdot Post_t$, $\hat{\beta}_3$, can be interpreted as 0.151 additional markets per thousand cities for every additional year after 1386; this effect is large enough to reverse the negative pre-trend (coefficient on $Year_t$) of -0.061 . The effect of this reversal in trends can be observed in Figure 6, and suggests a change from 1.2 markets established per year, per thousand cities, in 1386 to just over 3 markets per year, per thousand cities, twenty 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 suggest that a significant fraction of them were a result of university establishment.⁴⁴

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 3, columns 2 and 3, one can see that the coefficient on $Year_t \cdot Post_t$ is positive and significant for the sample of cities with a large (above median) change in distance to a university, but not

⁴³Figure 6 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 (2) than in the years 1399 or 1401 (4 and 9, respectively).

⁴⁴We 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 below.

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 LOWESS smoothed market establishment rates, in Figures 7 and 8.

[Figure 7 about here]

[Figure 8 about here]

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 noted above, 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 to a university (i.e., the coefficient on $Year_t \cdot Post_t$). In Table 3, 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).⁴⁵ $\Delta DistUniv_i$ 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

⁴⁵The Holy Roman Empire in the late Middle Ages was a complicated array of partly overlapping layers of sovereignty. For each city in our dataset we coded the highest liege lord (other than the Emperor) to which it was subject around 1386.

it affect our statistical inferences (see Table 3, 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 3, column 6). In both of these alternative datasets, we find no evidence of a differential pre-trend 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 will 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).⁴⁶

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 above regressions is that the timing of university establishment in Germany following the Schism was possibly endogenous. In addition, our results in Table 3 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 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; and 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%

⁴⁶We also report our city-year regressions with standard errors clustered at the territory level in the online appendix (Table OA.6).

confidence intervals, in Figures 9 and 10.⁴⁷ 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.

[Figure 9 about here]

[Figure 10 about here]

5.2 Endogeneity of University Location

The results above 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 3 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.

These alternative stories would explain a sharp change in market establishment rates precisely when universities were founded, and *near* those universities.⁴⁸ To examine the possibility that our results in Table 3 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

⁴⁷The online appendix reports graphs analogous to Figure 9 for the two subsamples of cities with above and below median changes in distance to a university (Figures OA.2 and OA.3).

⁴⁸Note that the results in Table 3 do not refer directly to the *proximity* of universities, but rather 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 .

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 are the Rhenish Palatinate (Heidelberg), the Archbishopric of Cologne (Cologne), and the Archbishopric of Mainz (Erfurt).⁴⁹ 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.⁵⁰

In Table 4, 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.⁵¹ The role played by the reduction in distance to a university can be seen in the corresponding panel data specifications of Table 4, 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.

[Table 4 about here]

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,

⁴⁹In 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.

⁵⁰All of the analyses in which we drop particular, potentially problematic, observations can also be conducted by allowing the sub-groups 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.

⁵¹The 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 sections below (Table OA.7). In every case (including specifications discussed below), our inferences from splitting the sample and using the time-series specification are consistent with those from estimating the panel specification.

1976; Dittmar, 2011a). More generally, given the clear association between longitude and the change in distance to a university seen in Figure 2, one wants to be sure that our results are not driven simply by our comparison of late 14th-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-1348.⁵² In 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 post-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 3). One might believe that the Black Death generated effects that accelerated across time; however, our findings in Figures 9 and 10 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 5, column 1, we present the results from estimating the specification in Table 3, column 1, but excluding cities near the Rhine. We continue to find a significant break in the trend. In Table 5, column 2, one can see that this break is again greater in cities with greater reductions in distance to a university.

⁵²Voigtländer and Voth (2012, 2013) show that the arrival of the Black Death had monumental consequences, resulting in changed incomes and urbanization, and also changing the composition of society through anti-Jewish pogroms.

Next, we address concerns that our results are driven by differential trends east versus west of the Elbe in the late 14th century. In Table 5, 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 3, 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 coefficient on $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ remains positive and statistically significant, and similar in magnitude to our baseline estimate (see Table 5, column 5).⁵³

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*.⁵⁴ 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 5, column 6, our results from this specification are quite similar to our baseline: we continue to see a significant, positive coefficient on $\Delta DistUniv_i \cdot Year_t \cdot Post_t$.

[Table 5 about here]

⁵³Note 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 (as one would have expected from Figure 2). However, the effect disappears once one accounts for the effects of $\Delta DistUniv_i \cdot Year_t \cdot Post_t$.

⁵⁴These 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.

5.3 The Impact of Political Shocks on Market Establishment

While the findings above 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 14th 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 7 cities with a recent jurisdictional change, and we estimate the specifications in Table 3, columns 1 and 4, after dropping these cities. 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 6, columns 1 and 2).

Another potential confounding factor is inter-city conflict, which was also common in the 14th 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 (Moraw, 1989; Schuler, 1977–1999). 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 3, 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 6, columns 3 and 4). Thus, the region in which inter-city 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 establish-

ment we observe in 1386.⁵⁵ For example, the Schism may have affected trade patterns; shifts in papal politics may have had broader impacts 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 Rome.⁵⁶ 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.⁵⁷ To examine whether the market establishment patterns we observe were driven by the cities loyal to Avignon, we estimate the specifications in Table 3, columns 1 and 4, after dropping the 223 cities loyal to the Avignon Pope. We find that our results are very similar to those in our baseline estimates (see Table 6, columns 5 and 6).⁵⁸

[Table 6 about here]

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 which experienced no significant changes in the number of universities in the baseline period we study.⁵⁹ 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).⁶⁰ The results presented in Table 7, columns 1

⁵⁵Note 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.

⁵⁶The 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).

⁵⁷The correlation between an indicator that a city was loyal to Avignon and $\Delta DistUniv_i$ is 0.259.

⁵⁸In 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).

⁵⁹The 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).

⁶⁰Results 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 the online appendix, Table OA.13).

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.

[Table 7 about here]

6 University Training and the Development of Legal Institutions

6.1 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 several plausible, non-exclusive 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.⁶¹ 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.⁶² The Justinian Code, "rediscovered" in the eleventh century, provided the foundation for a 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,

⁶¹Universities 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 kilometers away from the university cities themselves suggest, however, that these mechanisms do not play a predominant role in driving our findings.

⁶²We join legal scholars in attaching preeminent importance to the rediscovery of the Justinian code, as opposed to other codifications of that epoch, such as the *Sachsenspiegel*. We discuss how training in Roman law represented new, valuable human capital in medieval Europe in Cantoni and Yuchtman (2013).

too.⁶³

Roman law represented a significant improvement over the pre-existing 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 Ages⁶⁴—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.⁶⁵

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 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.⁶⁶ 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 develop-

⁶³Cobban (1975, p. 220) writes that, “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.”

⁶⁴See Mostert, ed (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).

⁶⁵Wieacker (1995, pp. 78–84). See also Stobbe (1860, p. 637) and Savigny (1834, vol. 3, p. 84).

⁶⁶The Church’s competence in cases which would today be regarded as purely belonging to secular law was substantial. Church tribunals dealt with *causae saeculares* in the following cases: *ratione peccati*, i.e., cases in which the subject matter was considered a sin and hence had to be confessed to a priest; *privilegium fori*, i.e., 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*, i.e., 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).

ment. 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, 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 14th 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, "[j]udgments 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.”⁶⁷ 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.

⁶⁷Vinogradoff (1929, p. 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.”

6.2 The Training and Careers of Jurists in the German Lands

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.⁶⁸ Unfortunately, we do not have data on the number of 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.⁶⁹ While 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 per 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).⁷⁰

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

⁶⁸The 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).

⁶⁹Law 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.

⁷⁰See online appendix, Section OA.3, for details on these estimates.

Germany: Wieacker (1995, p. 114) writes that “no comparable education in the *studium civile* was available in Germany.” Clark (1987, p. 653) writes that “[t]he 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 the 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.

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 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.⁷¹ 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 which was certainly active in 15th 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-15th century] it was indispensable if municipal liberties and franchises were to be defended by judicial means.”

⁷¹Some 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, “[L]aw 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).

University-trained lawyers—graduates and non-graduates—played a variety of important roles in city and territory administration and in protecting their polities’ rights. In the economically-vibrant Hanseatic League cities, “[s]ince 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 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.”⁷² It is important to emphasize that non-graduates 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].”⁷³

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 percent of students in Kuhn’s sample served in public administration jobs, not including individuals serving in administrative positions within the Church. In the sub-sample of

⁷²On 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.

⁷³Cobban (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.”

students who attended both Tübingen and Bologna—these were overwhelmingly students of law—an even larger fraction of students, around 30 percent, pursued public administration careers, and again, an additional significant share may have been administrators within the Church.⁷⁴

Beyond administration, the legally-trained played a crucial role in advocating on behalf of parties to disputes, and to adjudicating those disputes. In fact, many of the jurists employed by cities or territorial lords, discussed above, 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.⁷⁵ Over the course of the 15th 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 (*Schöffentühle*) and arbitration courts (*Schiedsgerichte*), where legally trained individuals could be active as arbitrators, assessors, or procurators who helped to resolve private disputes (Berman, 1983, p. 346; Wieacker, 1995, p. 119; Coing, 1964, p. 90).

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 15th century the ecclesiastical tribunal of Strasbourg was authenticating about 300–600 documents per week (Coing, 1964, §25; Trusen, 1962, p. 66). Notarized contracts, authenticated documents, and written rules made legal institutions more effective and reduced the uncertainty of economic transactions.

⁷⁴In 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 percent of the Bologna graduates pursued careers in public administration, and another 31 percent pursued administrative careers in the Church.

⁷⁵Thanks 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 15th century; as a consequence, the use of Roman law in the administration of the Austrian territories diffused only much later, in the 16th and 17th centuries (Baltl, 1962, pp. 64–70).

The career of Dietrich von Bocksdorf, who studied at the universities of Leipzig and Perugia, then was a professor of law in Leipzig, provides an indication of the range of disputes resolved by German jurists in the mid-15th 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 1200 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; but, he also drafted opinions for rural communities and peasants, 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 on 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 15th century.

Several other exemplary careers of jurists trained in Roman law can be found, though the historical record is skewed towards 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. While these career paths are clearly outstanding, they are indicative of the variety of activities that trained jurists of the 14th and 15th 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 15th century Germany by individuals trained in law was substantial.

7 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 paper 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 then 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 century not only provides an ideal testing ground due to the exogenous introduction of universities, but 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 to 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.

A Data Appendix: 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.⁷⁶

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).

⁷⁶Rashdall (1895, p. 16) writes that following an influx of students from Bologna in the 14th century due to political turmoil there, “the new-comers must have constituted by far the larger part of the Paduan University.”

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’ enrollment of German students was reduced to 0, and when historical evidence indicates that the University of Orléans’ 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 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.

B Theory Appendix: Derivation of the Estimation Equation

Here we provide details on the derivation of our estimating equation for our panel dataset. Using the definition given in equation (2) of Section IV, 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 δ_{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:

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

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 δ_{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:

$$\begin{aligned} markets_{i,t} = & \alpha_0 + \alpha_1 \cdot Year_t + \alpha_2 \cdot Post_t + \alpha_3 \cdot Year_t \cdot Post_t + \alpha_4 \cdot \Delta DistUniv_i \\ & + \alpha_5 \cdot \Delta DistUniv_i \cdot Year_t + \alpha_6 \cdot \Delta DistUniv_i \cdot Post_t \\ & + \alpha_7 \cdot \Delta DistUniv_i \cdot Year_t \cdot Post_t + \varepsilon_{i,t} \end{aligned} \tag{A.1}$$

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Figures and Tables

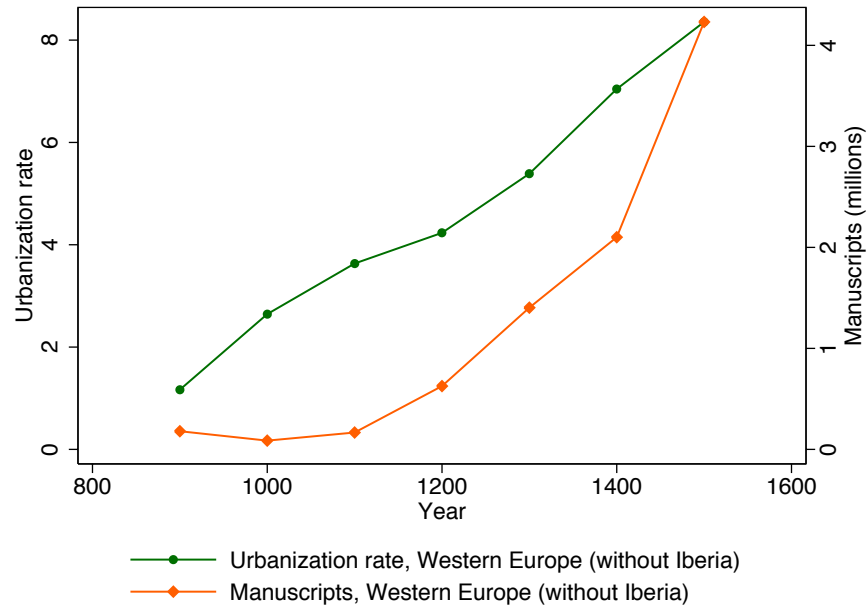


Figure 1: Indicators of economic development in the Middle Ages; urbanization rate is the percentage of the population living in cities with more than 10,000 inhabitants (source: Buringh and van Zanden, 2009).

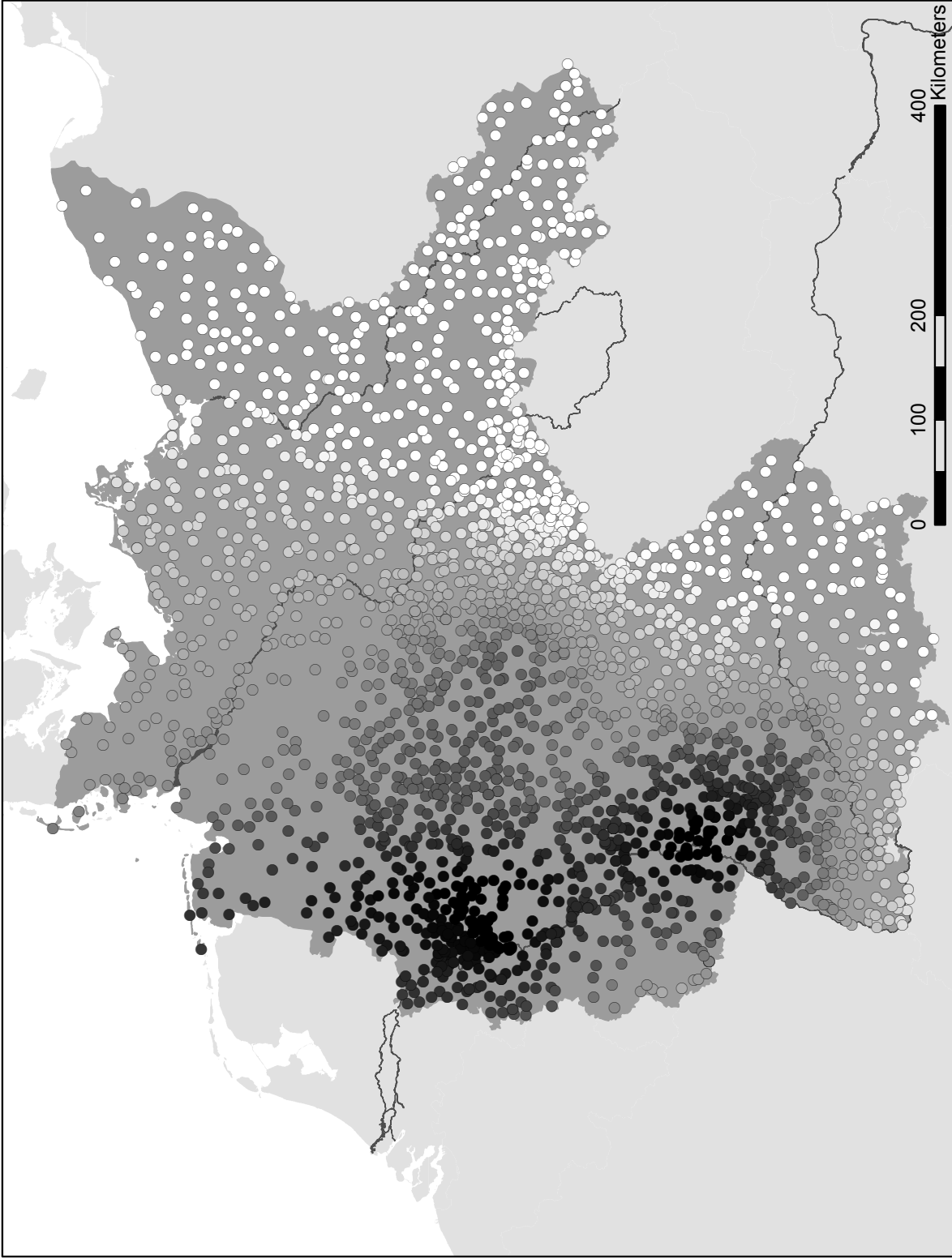


Figure 2: Cities in the dataset. Darker colors indicate larger reductions in distance to the nearest university as a consequence of the Papal Schism; shaded area indicates German lands on which we focus.

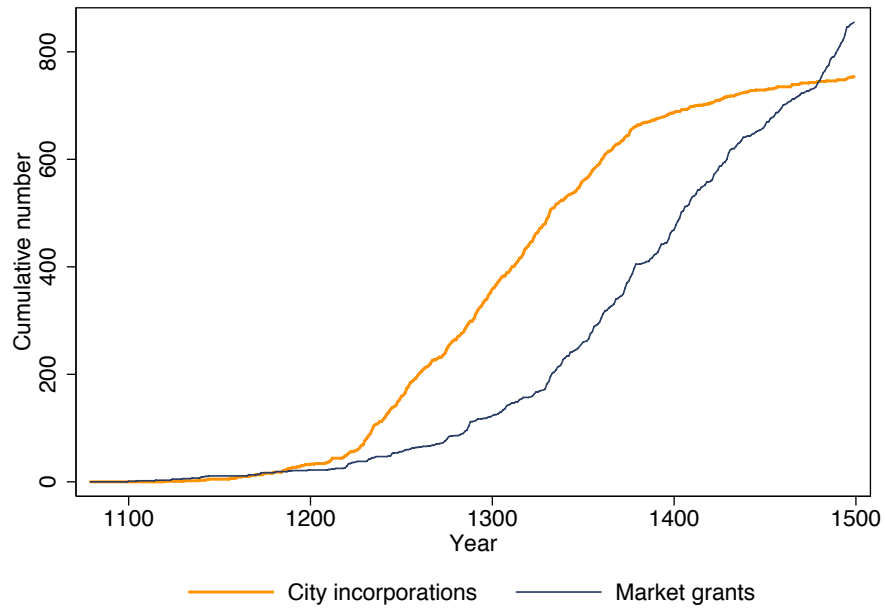
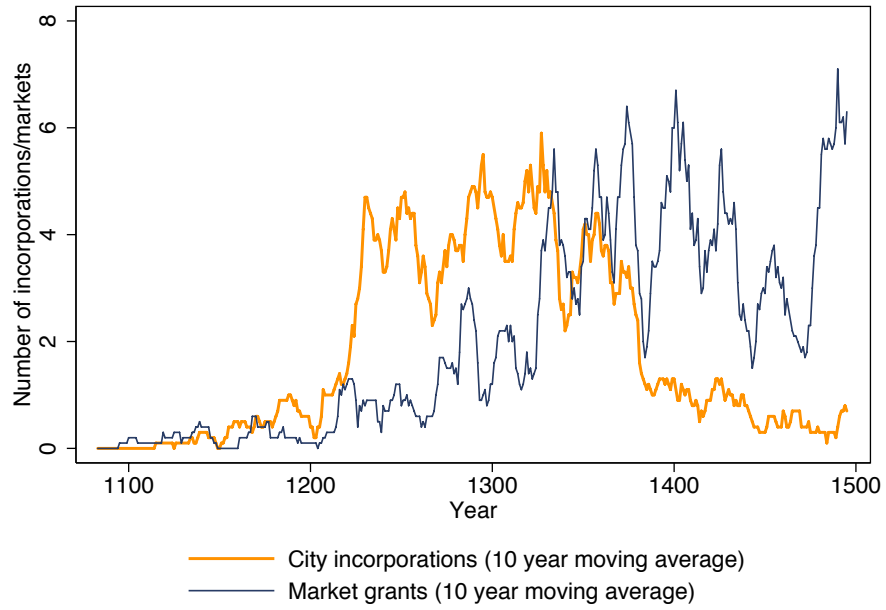


Figure 3: Absolute (10 year moving average) and cumulative number of city incorporations and market grants, Germany.

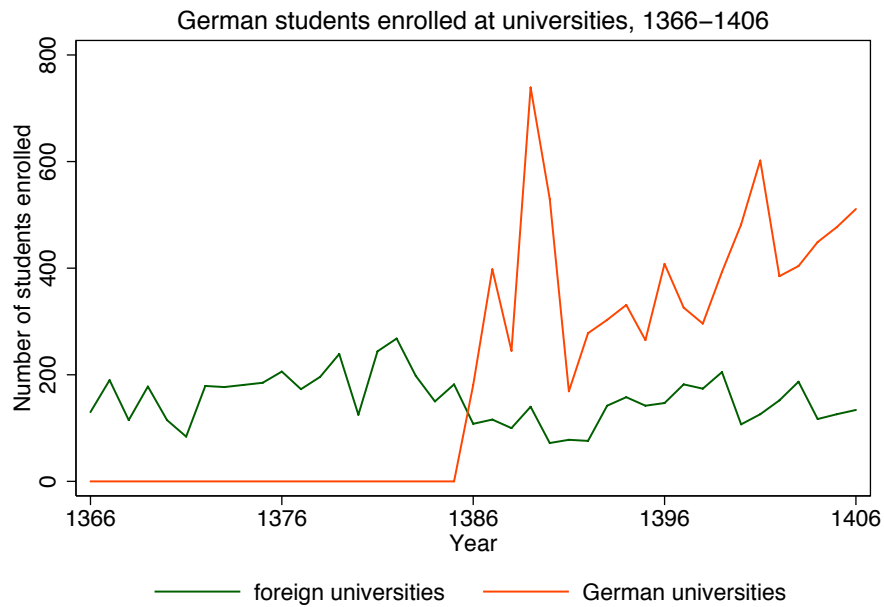


Figure 4: Number of German university students, 1366–1406, by location of study. “Foreign” universities are Bologna, Padua, Paris, Orléans, and Prague. “German” universities are Heidelberg, Cologne, and Erfurt. See Appendix A for a discussion of sources and the assumptions underlying these estimates.

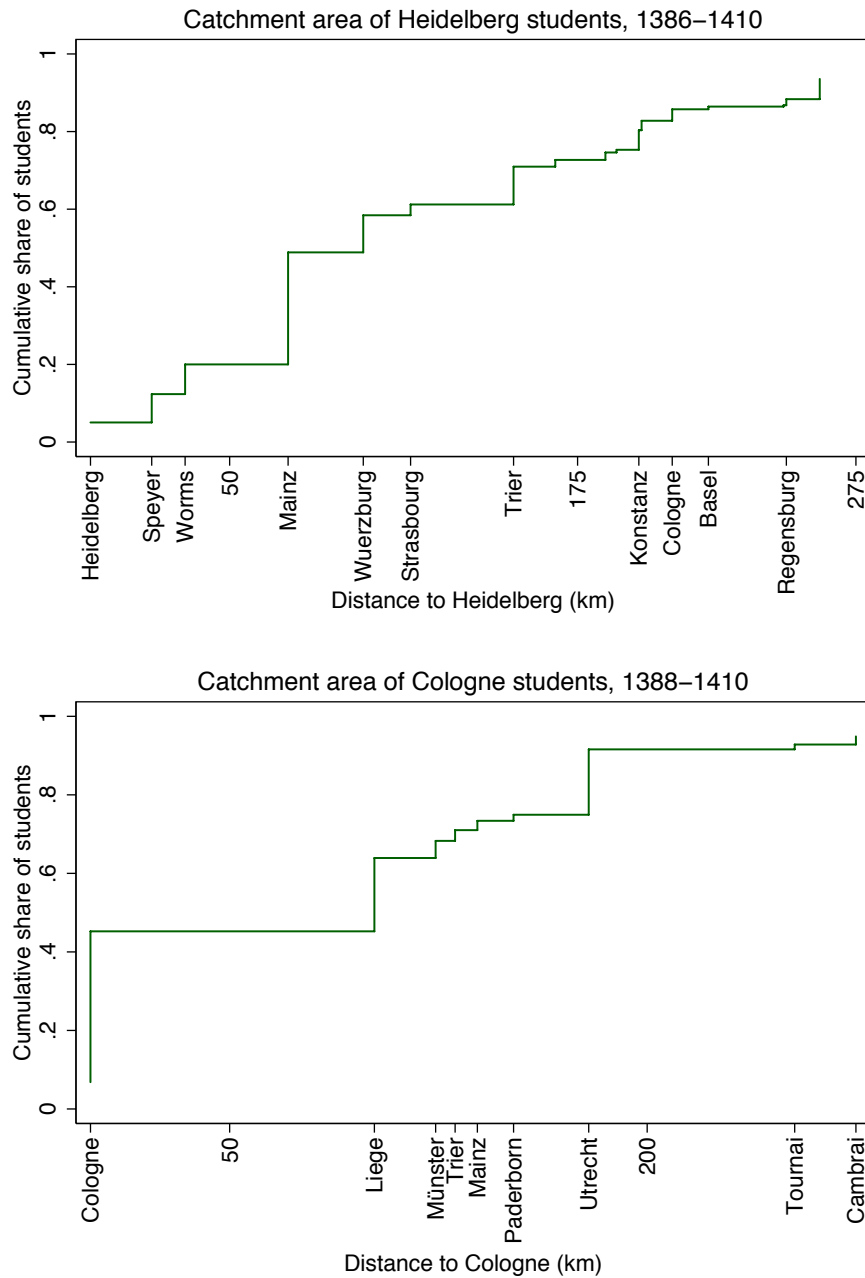


Figure 5: Cumulative distributions of students at the Universities of Heidelberg and Cologne, by the distance from a student’s home diocese to the university attended (based on Fuchs, 1995, and Keussen, 1892).

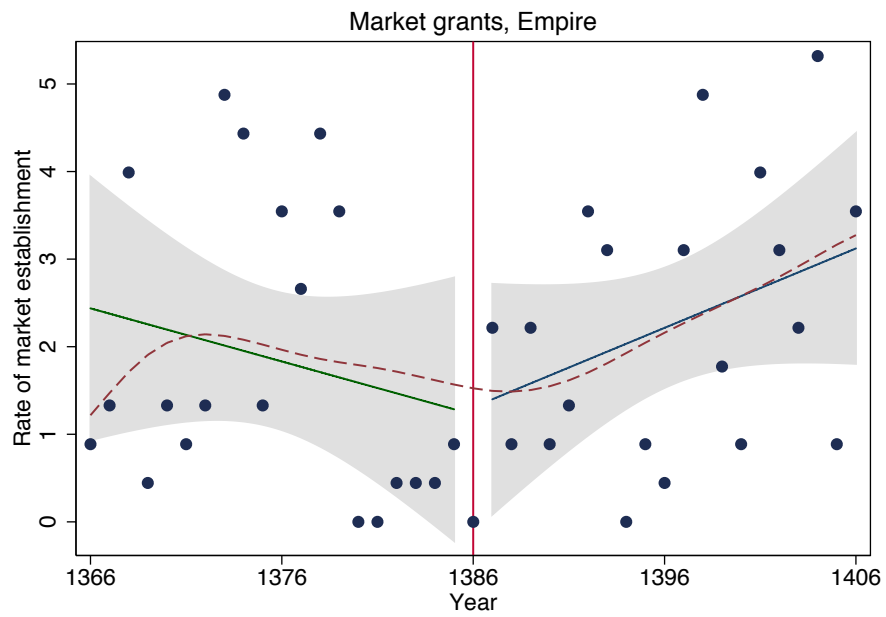


Figure 6: Change in the linear trend rate of market establishment, whole sample (corresponding to the regression in Table 3, column 1); and, non-parametric (LOWESS) graph of market establishment rates.

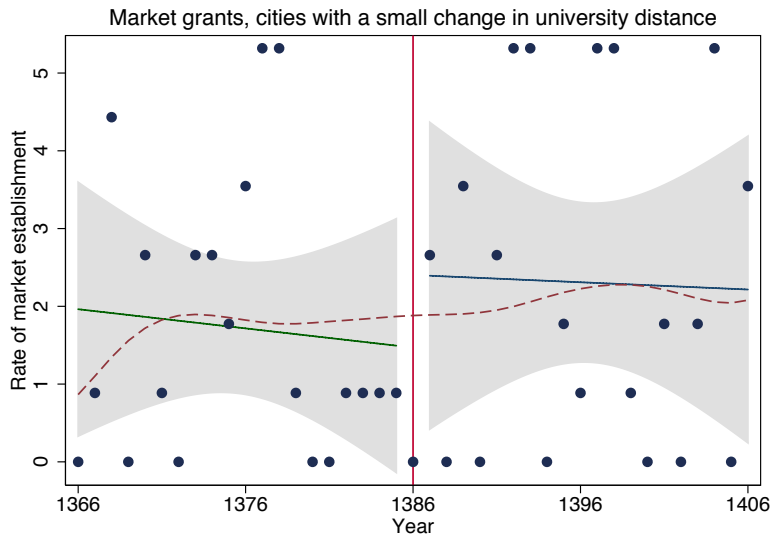


Figure 7: Change in the linear trend rate of market establishment, cities with a small (below median) change in distance to the closest university (corresponding to the regression in Table 3, column 2); and, non-parametric (LOWESS) graph of market establishment rates.

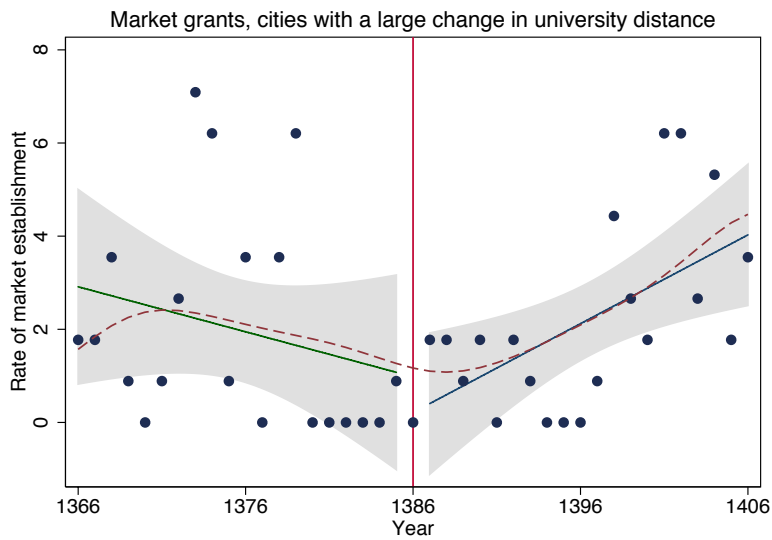


Figure 8: Change in the linear trend rate of market establishment, cities with a large (above median) change in distance to the closest university (corresponding to the regression in Table 3, column 3); and, non-parametric (LOWESS) graph of market establishment rates.

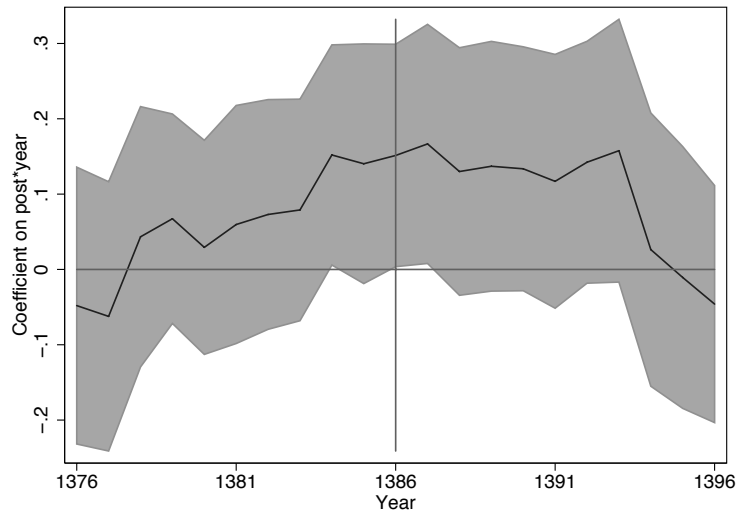


Figure 9: Changes in the trend rate of market establishment (coefficient on $Year_t \cdot Post_t$) under varying pivot years, 1376–1396; for each year between 1376 and 1396, we test for a trend break in that specific year, examining the 20 years before and after that year, as in the specification estimated in Table 3, column 1.

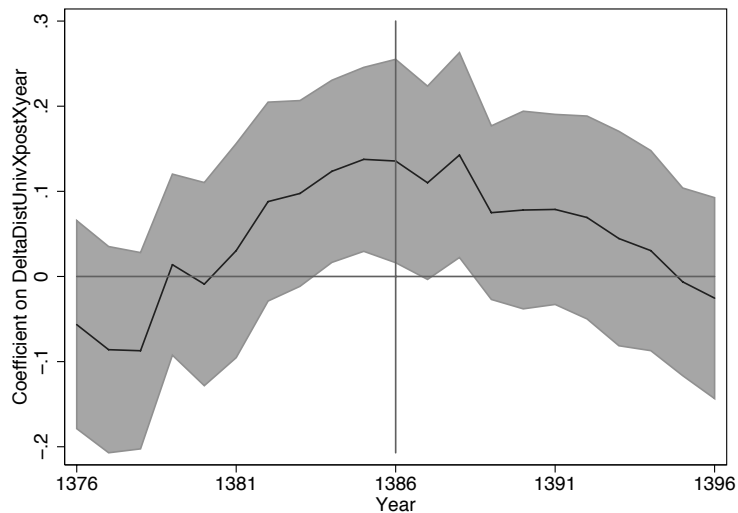


Figure 10: Changes in the trend rate of market establishment (coefficient on $\Delta DistUniv_i \cdot Year_t \cdot Post_t$) under varying pivot years, 1376–1396; for each year between 1376 and 1396, we test for a trend break in that specific year associated with $\Delta DistUniv_i$, examining the 20 years before and after that year, as in the specification estimated in Table 3, column 4.

Table 1: 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 (opens in 1383)
<i>Erfurt</i>	<i>1379 (opens 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>

Source: Verger (1992), pages 62–65. Universities in the territory considered “Germany” in our dataset 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.

Table 2: 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, ed (2000), *inter al.*

Table 3: Baseline estimates

Dependent variable:	Rate of market establishment					
	Sample:	Time series			Panel	
		< median $\Delta\text{DistUniv}$	\geq median $\Delta\text{DistUniv}$	city level	territory level	cell level
	(1)	(2)	(3)	(4)	(5)	(6)
Year	-0.061 [0.053]	-0.025 [0.059]	-0.097 [0.061]	-0.004 [0.075]	0.087 [0.126]	0.018 [0.051]
Post1386	0.084 [0.807]	0.933 [1.152]	-0.765 [0.973]	1.726 [1.553]	-1.101 [2.219]	0.396 [1.418]
Year \times Post1386	0.151** [0.073]	0.015 [0.097]	0.287*** [0.084]	-0.086 [0.138]	-0.129 [0.205]	-0.068 [0.094]
$\Delta\text{DistUniv}$				-0.173 [0.413]	-0.808 [1.030]	-0.364 [0.250]
$\Delta\text{DistUniv} \times \text{Year}$				-0.032 [0.035]	-0.058 [0.060]	-0.030 [0.022]
$\Delta\text{DistUniv} \times \text{Post1386}$				-0.937 [0.630]	0.017 [1.069]	-0.232 [0.593]
$\Delta\text{DistUniv} \times \text{Year} \times \text{Post1386}$				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	90240	20880	3200
Number of cities	2256	1128	1128	.	.	.
Number of cross sectional units	.	.	.	2256	522	80

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of markets established per 1,000 cities (see footnote 42 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 one-degree latitude one-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 one-degree by one-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 one-degree by one-degree cells (column 6).

Table 4: Spatial endogeneity 1: local shocks

Dependent variable:	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
	(1)	(2)	(3)	(4)	(5)	(6)
Year	-0.061 [0.053]	-0.002 [0.075]	-0.048 [0.050]	-0.008 [0.077]	-0.040 [0.055]	0.012 [0.076]
Post1386	0.135 [0.810]	1.729 [1.565]	0.463 [0.765]	1.400 [1.601]	-0.155 [0.853]	1.141 [1.527]
Year \times Post1386	0.148** [0.072]	-0.088 [0.139]	0.117 [0.071]	-0.058 [0.141]	0.127* [0.075]	-0.080 [0.140]
Δ DistUniv		-0.167 [0.430]		-0.374 [0.467]		-0.122 [0.471]
Δ DistUniv \times Year		-0.035 [0.037]		-0.025 [0.039]		-0.031 [0.038]
Δ DistUniv \times Post1386		-0.926 [0.650]		-0.594 [0.703]		-0.781 [0.680]
Δ DistUniv \times Year \times Post1386		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 \pm 20					
Observations	40	88800	40	81440	40	84000
Number of cities/cross sectional units	2220	2220	2036	2036	2100	2100

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see footnote 42 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 \times year. Regions examined in the table are: all of Germany excluding areas within 20km/50km 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.

Table 5: Spatial endogeneity 2: regional differences

Dependent variable:	Rate of market establishment							
	≥ 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	Panel, city level	
Sample:	(1)	(2)	(3)	(4)	(5)	(6)	(6)	
Year	-0.050 [0.053]	-0.014 [0.078]	-0.079 [0.066]	-0.021 [0.131]	-0.141 [0.293]	.	.	
Post1386	0.444 [0.837]	1.704 [1.624]	0.245 [0.978]	3.608 [2.788]	16.933** [8.154]	.	.	
Year \times Post1386	0.108 [0.079]	-0.086 [0.143]	0.197** [0.089]	-0.119 [0.244]	-0.673 [0.707]	.	.	
Δ DistUniv		-0.300 [0.474]		-0.333 [0.589]	-0.173 [0.413]	-0.231 [0.827]		
Δ DistUniv \times Year		-0.023 [0.039]		-0.027 [0.052]	-0.015 [0.056]	-0.065 [0.071]		
Δ DistUniv \times Post1386		-0.788 [0.715]		-1.589 [1.014]	-2.896** [1.362]	-2.325* [1.231]		
Δ DistUniv \times Year \times Post1386		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	81000	40	70360	90240	90240	90240	
Number of cities/cross sectional units	2025	2025	1759	1759	2256	2256	2256	

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see footnote 42 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 20km 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 3, 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.

Table 6: Accounting for political shocks

Dependent variable:	Rate of market establishment					
	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
	(1)	(2)	(3)	(4)	(5)	(6)
Year	-0.061 [0.053]	-0.004 [0.075]	-0.061 [0.051]	-0.011 [0.077]	-0.061 [0.053]	-0.004 [0.075]
Post1386	-0.073 [0.843]	1.659 [1.553]	0.242 [0.832]	1.879 [1.596]	0.084 [0.811]	1.729 [1.553]
Year × Post1386	0.150** [0.073]	-0.089 [0.138]	0.132* [0.075]	-0.090 [0.140]	0.152** [0.073]	-0.087 [0.138]
ΔDistUniv		-0.173 [0.414]		-0.097 [0.433]		-0.170 [0.415]
ΔDistUniv × Year		-0.033 [0.035]		-0.027 [0.036]		-0.033 [0.035]
ΔDistUniv × Post1386		-0.989 [0.628]		-0.975 [0.655]		-0.942 [0.633]
ΔDistUniv × Year × Post1386		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	89960	40	85160	40	89840
Number of cities/cross sectional units	2249	2249	2084	2129	2246	2246

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see footnote 42 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 VC). Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level.

Table 7: Placebo analyses

Dependent variable:	Rate of market establishment	
	Italy	England and Wales
Sample:	(1)	(2)
Year	0.115 [0.097]	0.110 [0.075]
Post1386	0.305 [2.581]	-2.034* [1.177]
Year × Post1386	-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	2254

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see footnote 42 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.

Online Appendix (not for publication)

OA.1 Market grants and economic activity

To validate the market right as an indicator of economic activity, rather than merely a change in the formality of economic institutions that had already existed, we begin by examining the association between city size in 1500 (and, in other specifications, 1400) and market rights granted up to the year 1500 (or 1400). This analysis requires some background discussion. Typically, *urbanization*, rather than city size, has been used to study economic development prior to the era of modern economic growth. However, urbanization rates are unavailable for units smaller than countries prior to 1700. Because we study market establishment at much more disaggregated levels of analysis—indeed, at the city level—we will use the size of a city as a measure of a city’s economic development. As noted in the main text of the paper, the data on city size are very limited in their coverage for the medieval period, but they are still able to provide suggestive evidence on the relationship between market establishment and economic development, with city size acting as a proxy for the latter.

We use data collected by Bairoch et al. (1988), containing city size data for 279 German cities across the period 800–1850. To be included in the dataset, cities needed to have populations of size 5,000 or greater by the year 1800. Of these, 128 were large enough in 1500 to have available city size data; 75 were large enough in 1400 to have city size data. We do not know with certainty that cities without data were small; however, the ability to find city size information for a given century is a strong indicator that the city was, indeed, relatively large.

We begin our analysis by studying the relationship between market grants and a dummy variable indicating whether a city has city size data available in the Bairoch dataset in 1500 (or 1400). This will tell us whether cities that were granted more market rights in the 1100–1500 period were, in fact, “big” cities in 1500 (and whether cities granted more market rights in the 1100–1400 period were “big” in 1400). Of course, cities that did not exist were more likely to have no population data and no market grants; however, only 6 of the 279 cities in the Bairoch dataset had not been mentioned in historical documents prior to 1500, and only 7 had not been mentioned prior to 1400.¹ In addition, we have conducted all of our analyses including only cities that had been *incorporated* prior to 1500 (or 1400), and this does not significantly change our findings.

We thus regress the “city size data available” dummy variable on the number of market rights granted, for cities that had previously been mentioned in documents prior to 1500 (or 1400). As can be seen in Table OA.1, column 1, there is a very strong, positive correlation between market grants and being a big enough city to have population data in 1500. The same holds for the year 1400 (see Table OA.1, column 5). We next run the same regressions, but using an indicator of at least one market right granted as the explanatory variable. This is a useful robustness check given the noisiness of the market grant data, and to ensure that our results were not driven by many grants in a particular city. We again find a statistically significant, positive association between receiving a market grant and being a city large enough to have population data in 1500 (see Table OA.1, column 2) or in 1400 (see Table OA.1, column 6). We have estimated all of these specifications controlling for cities’ latitude and longitude, and we continue to find a strong, positive association between market grants and the city having population data. Finally, we have estimated the same relationships using probit and logit specifications, and our results are robust to these alternative models as well.

Next, we condition on a city having population data in 1500 (or 1400), and examine the relation-

¹Information on the date a city was first mentioned comes from the *Deutsches Städtebuch*.

ship between market grants and city size among the 128 cities in Germany with population data in 1500 (or the 75 cities in Germany with population data in 1400). We regress log city size in 1500 on the number of market grants a city received between 1100 and 1500, and we again find a statistically significant, positive association (see Table OA.1, column 3); when we examine city size in 1400 and market establishment between 1100–1400, the relationship is positive, though it is no longer significant (see Table OA.1, column 7). We then regress city size in 1500 (or 1400) on an indicator that a city received at least one market right between 1100 and 1500 (or 1100 and 1400), and find again a strong, positive relationship between market rights and city size (see Table OA.1, column 4 for the year 1500 results and Table OA.1, column 8 for the year 1400 results). As was the case in our study of cities with and without population data, our results are robust to including latitude and longitude controls.

While the analysis above can only be suggestive, it does indicate a robust association between market rights granted and economic development at the city level in medieval Germany.

Table OA.1: City sizes and market grants

Dependent variable:	City size in 1500				City size in 1400			
	Any size reported		log(size)		Any size reported		log(size)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total markets granted	0.200*** [0.0449]		0.176* [0.106]		0.251*** [0.0514]		0.106 [0.132]	
Any markets granted		0.601*** [0.0400]		0.610*** [0.156]		0.514*** [0.0822]		0.468** [0.212]
Observations	273	273	128	128	272	272	75	75
R ²	0.103	0.185	0.045	0.104	0.120	0.141	0.014	0.058

*: Significant at 10%; **: 5%; ***: 1%. Each column shows estimates from a cross-sectional regression of a measure of city population on that city's level of market establishment in the Middle Ages; all regressions include a constant term (not reported). Measures of city size are either a dummy variable indicating whether a city had population data in 1500 (or 1400) available in the Bairoch dataset (columns 1, 2, 5, and 6) or, conditional on having city size data in 1500 (or 1400), the log of the city's population (columns 3, 4, 7, and 8). City size data come from Bairoch et al. (1988) and market grants data were collected by the authors from the *Deutsches Städtebuch*. All cities included in these regressions had populations of size 5,000 or greater by the year 1800, and thus are included in Bairoch dataset. Regression estimates in columns 1–2 and 5–6 are based on the sample of cities that had been mentioned in documents prior to 1500, or 1400, respectively (to ensure that the absence of city size data) is not a mechanical result of no city existing). Regression estimates in columns 3–4, and columns 7–8, are based on the sample of cities with city size data available in the Bairoch dataset in 1500, and in 1400, respectively. Robust standard errors in brackets.

In addition to examining the relationship between market grants and city size, 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 (we discuss this in the main text as well). We identified several useful sources; first, the *Deutsches Städtebuch* and the *Handbuch der historischen Stätten Deutschlands* (Klose, ed, 1958–) provide descriptions of notable new construction in each German city. Some of these are plausibly directly linked to the establishment of a functioning market: for example, construction or fortification of city walls, construction of customs houses, and merchants' halls. Other construction might have been supported by increased trade, and increased tax revenues derived from that trade: for example, the construction of a church, or a city hall.

We examined historical construction records for the cities receiving the 80 market grants and/or

city incorporations between 1386 and 1406, and find that 38 of them experienced some notable construction within 20 years of the year of the market grant or city incorporation (in Table OA.2, we list the cities; column 4 indicates with an “X” which of these experienced notable construction). As we discuss in the main text, 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. The city of Kulmbach received a market grant in 1397; that same year was the first time a moat around the city was mentioned, and in 1398, a city hall and a merchant hall were mentioned for the first time. Petershagen received a market grant in 1399; 20 years later, the nearby bridge over the Weser River needed to be expanded. Overall, it appears that a great deal of new construction activity followed the granting of a medieval market right, suggesting real effects of 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 twenty-year window and control cities within a forty-year window is statistically significant at the 5% level.² This suggests that the construction activity occurring in the cities receiving market grants truly was linked to the market establishments themselves.

We also consulted a report on the markets existing in Germany in 1936, *Verzeichnis der Märkte und Messen im Deutschen Reich im Jahre 1936* (Statistisches Reichsamt, ed, 1935) and matched the markets in the report to the 63 market establishments in our dataset between 1386 and 1406. We find that 60 of the cities receiving market grants from 1386–1406 had functioning markets in 1936 (see 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 14th (or early 15th) century market grant in *both* the frequency and type of market (see Table OA.2). These findings indicate that market grants to small towns were not formalities, but rather produced functioning markets. The small towns receiving these grants continued to have functioning markets over 500 years later, and frequently their medieval markets persisted into the 20th century.

Thus, based on a range of historical evidence, we are confident that the granting of a market right generally indicates increased commercial activity.³

²When limiting the window of analysis for the comparison cities to the 20 year period 1386–1406, one finds 19 instances of construction activity; the difference between this level of activity and that for the treatment cities is statistically significant at 1%.

³As we also note in the main text, 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.

Table OA.2: Cities incorporated and/or granted markets, 1386–1406

City	State	Year	Incorporation	Market grant	Market in 1936	Markets matched?	Construction
<i>Panel A: Cities incorporated, 1386–1406</i>							
Abensberg	Bayern	1401	X	-	-	-	
Altdorf	Bayern	1387	X	-	-	-	X
Bad Liebenzell	Württemberg	1388	X	-	-	-	
Boxberg	Baden	1388	X	-	-	-	
Breckerfeld	Westfalen	1396	X	-	-	-	X
Hammerstein	Pommern	1395	X	-	-	-	X
Hattingen	Westfalen	1396	X	-	-	-	X
Hirschberg	Thüringen	1397	X	-	-	-	
Hirschhorn	Hessen	1391	X	-	-	-	
Kölleda	Sachsen-Anhalt	1392	X	-	-	-	X
Otterndorf	Niedersachsen	1400	X	-	-	-	
Plettenberg	Westfalen	1397	X	-	-	-	X
Scheinfeld	Bayern	1405	X	-	-	-	X
Treuen i. V.	Sachsen	1390	X	-	-	-	
Ummerstadt	Thüringen	1394	X	-	-	-	
Veringenstadt	Württemberg	1393	X	-	-	-	
Wächtersbach	Hessen	1404	X	-	-	-	X
<i>Panel B: Cities incorporated and granted markets, 1386–1406</i>							
Alzenau	Bayern	1401	X	X		no	
Aub	Bayern	1404	X	X	X	yes	
Gaildorf	Württemberg	1404	X	X	X	yes	X
Groß-Gerau	Hessen	1398	X	X	X	likely	
Hadmersleben	Sachsen-Anhalt	1390	X	X	X	.	
Thiersheim	Bayern	1398	X	X	X	no	X
<i>Panel C: Cities granted markets, 1386–1406</i>							
Aalen	Württemberg	1398		X	X	yes	X
Auerbach i.d.Opf.	Bayern	1397		X	X	yes	X
Bühl	Baden	1403		X	X	likely	
Bacharach	Rheinland-Pfalz	1403		X	X	no	X
Besigheim	Württemberg	1405		X	X	likely	X
Bischofswerda	Sachsen	1406		X	X	likely	
Bogen	Bayern	1389		X	X	yes	
Burgsteinfurt	Westfalen	1406		X	X	likely	X
Esslingen/Neckar	Württemberg	1388		X	X	.	X
Fraustadt	Schlesien	1404		X	X	likely	
Freystadt	Bayern	1393		X	X	yes	
Friedberg	Bayern	1404		X	X	yes	X

Continued on next page

Table OA.2: (continued)

City	State	Year	Incorporation	Market grant	Market in 1936	Markets matched?	Construction
Gerbstedt	Sachsen-Anhalt	1404	X	X	X	yes	X
Gunzenhausen	Bayern	1401	X	X	X	likely	
Hirschhorn	Hessen	1404	X	X	X	no	X
Ichenhausen	Bayern	1406	X	X	X	.	
Ingolstadt	Bayern	1395	X	X	X	yes	
Külsheim	Baden	1405	X	X	X	likely	
Kelheim	Bayern	1399	X	X	X	likely	
Kulmbach	Bayern	1398	X	X	X	likely	X
Lüchow	Niedersachsen	1398	X	X	X	.	
Lauchheim	Württemberg	1402	X	X	X	likely	
Liebenau	Hessen	1393	X	X	X	no	X
Limburg	Hessen	1403	X	X	X	likely	
Lörrach	Baden	1403	X	X	X	no	X
Mainburg	Bayern	1397	X	X	X	likely	
Meppen	Westfalen	1387	X	X	X	no	
Merkendorf	Bayern	1398	X	X	X	yes	X
Meschede	Niedersachsen	1399	X	X	X	no	
Moringen	Niedersachsen	1390	X	X	X	likely	
Neumarkt	Schlesien	1387	X	X	X	.	X
Neustadt	Rheinland-Pfalz	1404	X	X	X	no	
Neustadt a.d. Waldnaab	Bayern	1387	X			no	
Petershagen	Westfalen	1400	X	X	X	.	X
Philippsburg	Baden	1402	X	X	X	no	
Pirna	Sachsen	1392	X	X	X	likely	X
Pleystein	Bayern	1391	X	X	X	yes	
Pressath	Bayern	1398	X	X	X	likely	
Radevormwald	Rheinland	1400	X	X	X	likely	
Rain	Bayern	1397	X	X	X	no	X
Rastatt	Baden	1404	X	X	X	.	
Regensburg-Stadtamhof	Bayern	1389	X	X	X	yes	
Rinteln	Westfalen	1392	X	X	X	likely	X
Roth b. Nürnberg	Bayern	1392	X	X	X	likely	X
Rothenburg o.d. Tauber	Bayern	1406	X	X	X	yes	X
Rottenburg a.d. Laaber	Bayern	1393	X	X	X	likely	X
Rottweil	Württemberg	1397	X	X	X	likely	X
Sömmerda	Sachsen-Anhalt	1389	X	X	X	.	X
Scheßlitz	Bayern	1395	X	X	X	.	X
Schweinfurt	Bayern	1397	X	X	X	likely	X
Solingen-Gräfrath	Rheinland	1402	X			no	
Soltau	Niedersachsen	1388	X	X	X	.	
Thum	Sachsen	1407	X	X	X	no	
Vilsbiburg	Bayern	1401	X	X	X	likely	X

Continued on next page

Table OA.2: (continued)

City	State	Year	Incorporation	Market grant	Market in 1936	Markets matched?	Construction
Vilseck	Bayern	1396	X	X	X	likely	X
Volkach	Bayern	1406	X	X	X	likely	X
Weißenhorn	Bayern	1387	X	X	X	yes	

Table includes cities incorporated and/or granted market rights between 1386 and 1406 (incorporations and market grants taken from the *Deutsches Städtebuch*). For each city, it is first indicated whether incorporation or the granting of a market right (or both) occurred between 1386 and 1406, along with the date when this event (or these events) occurred. Next, for cities that received a market grant between 1386 and 1406, we indicate whether *Verzeichnis der Märkte und Messen im Deutschen Reich im Jahre 1936* identifies a market in that city in 1936. If information on the timing of the medieval market or the goods traded at the market (or both) is available in the *Deutsches Städtebuch*, the table next shows whether the medieval market and the 1936 market match: “yes” indicates a match on both timing and goods traded; “likely” indicates a match on one characteristic and no mismatch on timing or goods traded; “no” indicates a discrepancy between the medieval market and the 1936 market in timing or goods traded (or the non-existence of a market in 1936); a dot indicates that no information on timing or goods traded is available for the medieval market. Finally, the table indicates whether the city experienced a significant construction event within 20 years of its incorporation or receiving a market grant (information on construction activity comes from the *Deutsches Städtebuch* and the *Handbuch der historischen Stätten Deutschlands*).

OA.2 Universities and urbanization across Europe

We argue in the main text of the paper that our analysis of the impact of German universities on market establishment can speak to the larger question of the causal effect of universities on the Commercial Revolution across Europe. Although the establishment of Europe's universities was generally endogenous with respect to economic activity (as we discuss in the main text), it remains of interest to examine the (non-causal) relationship between universities and economic development across countries in medieval Europe.

To study the relationship between universities and economic development, we use data from Burleigh and van Zanden (2009) on the number of universities and the urbanization rate in each European "country", in each century, from 1200–1500.⁴ We first present the scatterplot of urbanization against the number of universities, century by century (see Figure OA.1). In each century, there appears to be a positive association between the number of universities in a country and its urbanization rate. One can see that Belgium stands out as a clear outlier, having a very high urbanization rate, but no universities until the University of Louvain was established in 1425 (the Netherlands are an outlier as well in the later centuries). Without Belgium, the correlation of urbanization and the number of universities is strikingly high, being close to 0.8 in most periods considered. Of course, Belgian (and Dutch) students could – and did – attend universities in nearby France and Germany. Even with these outliers, the general association between universities and economic development during the Commercial Revolution is quite clear.

We then estimate cross-sectional regressions of urbanization on the number of universities, century-by-century, for the 1200–1500 period. In Table OA.3, Panel A, one can see that the relationship is positive in 3 of 4 regressions, and statistically significantly so in 2 of them. When we remove Belgium from the regression, all 4 regressions show positive relationships between universities and urbanization, 3 of them statistically significant (see Table OA.3, Panel B).⁵

It is important to emphasize that these associations should *not* be interpreted as causal – they merely indicate that the European countries that had the most universities were also the most urbanized throughout the Middle Ages. Our goal in studying Germany in the late 14th century is to exploit a case of plausibly exogenous variation in the existence of universities to identify the causal role that universities played in economic development in medieval Europe.

⁴Note that as in the main text, the urbanization rate is calculated as the fraction of the population in the country living in cities with populations 10,000 or larger.

⁵Examining the relationship between universities and urbanization in 1100 (with or without Belgium) yields a highly significant, positive relationship. The only country with a university, Italy, has the highest urbanization rate in the sample.

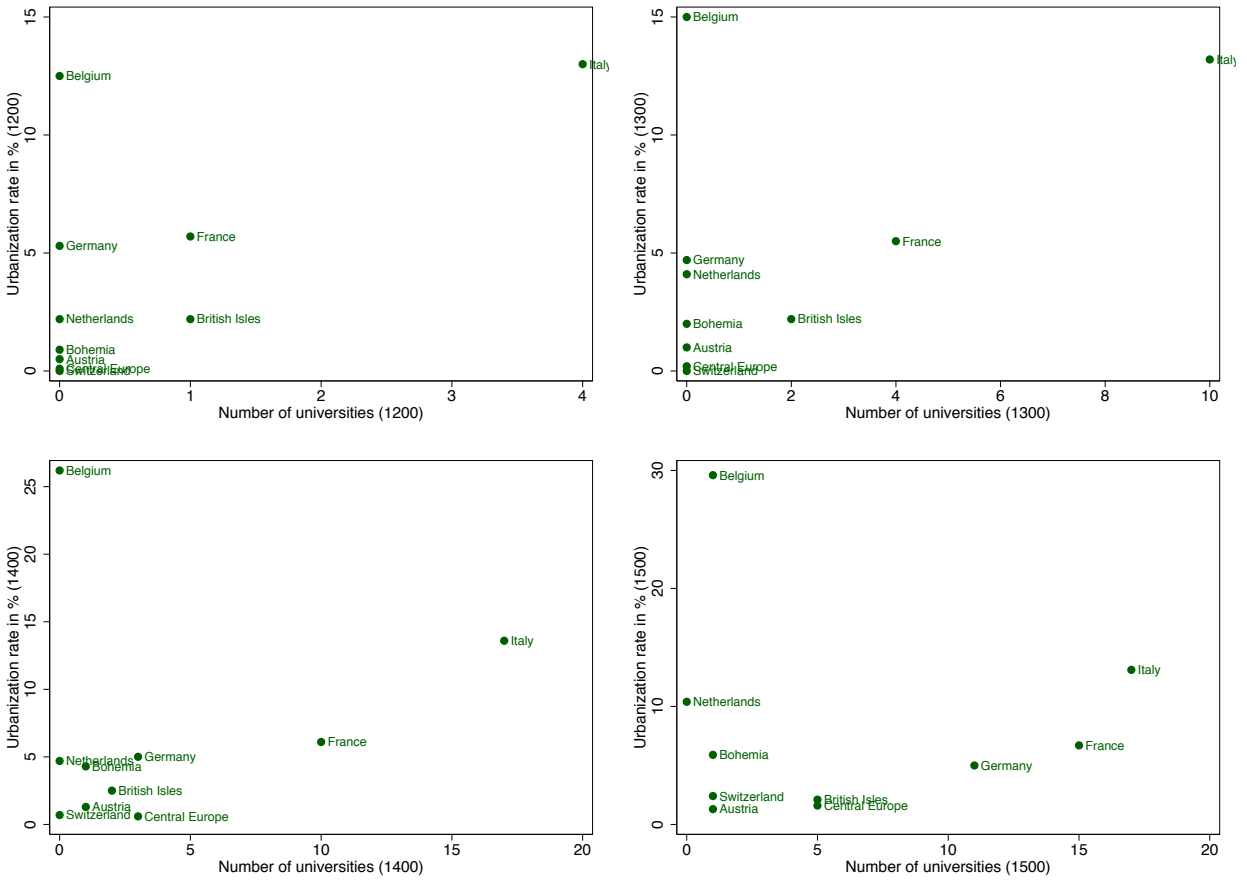


Figure OA.1: Urbanization rates and number of universities, 1200–1500.

Table OA.3: Urbanization rates and number of universities, 1200–1500

Dependent variable:	Urbanization rate (%)			
	1200	1300	1400	1500
	(1)	(2)	(3)	(4)
<i>Panel A: Full sample</i>				
Num. of universities	2.393*** [0.554]	0.866** [0.272]	0.286 [0.374]	-0.0255 [0.395]
Observations	10	10	10	10
R^2	0.380	0.285	0.040	0.000
<i>Panel B: Excluding Belgium</i>				
Num. of universities	2.855*** [0.258]	1.091*** [0.116]	0.614*** [0.111]	0.308 [0.229]
Observations	9	9	9	9
R^2	0.809	0.820	0.760	0.234

*: Significant at 10%; **: 5%; ***: 1%. Each column shows estimates from a cross-sectional regression of the “country”-level urbanization rate on the number of universities. All regressions include a constant term (not reported). Data on the number of universities and the urbanization rate in each European “country” come from Buringh and van Zanden (2009). Robust standard errors in brackets.

OA.3 German University Graduates Before and After 1386: Evidence from the *Repertorium Academicum Germanicum*

As noted in the main text, we believe that the number university students, rather than graduates, is a better measure of the human capital being produced in the medieval universities. Still, available data on university graduates provide an alternative measure of university training that can complement the matriculation record data that we focus on in the main text. The *Repertorium Academicum Germanicum* (RAG) database includes a great deal of information on German university graduates in the Middle Ages, though the database's search functionality is still being developed.⁶ We searched the RAG database for all German university graduates between 1366 and 1385 (all from foreign universities), and find 877 graduates; the same search for graduates between 1387 and 1406 yields 1,623 graduates.⁷ The data on German graduates from the RAG database corroborates the evidence on university students from matriculation records.

To provide additional evidence on the change in the number of Germans trained in law following the establishment of Germany's first universities, we can again turn to the RAG database to estimate how many German law *graduates* there were before and after 1386. These individuals were very much the elite—Wieacker (1995, p. 119) notes that, "Imperial law placed the legal doctor on a par with the knight." We searched the RAG database for all German university law graduates between 1366 and 1385 (all of whom attended foreign universities), and find 72 graduates; the same search for graduates between 1387 and 1406 yields 233 graduates.⁸ The RAG data show that while the number of German university graduates nearly doubled after 1386, the number of graduates in law more than *tripled*.

⁶The RAG database is online at <http://www.rag-online.org/>, and contains the biographies of scholars from the Holy Roman Empire from 1250 until 1550.

⁷To be precise, to conduct this search, we specified the range of years in which degrees were granted, and included an asterisk (a "wild card") under the graduate's last name. Other search parameters yield different numbers, but the same pattern of a large increase in graduates after 1386. The search engine is still being perfected and currently does not allow for a sharp distinction of Boolean searches of the "and" and the "or" type (personal correspondence with the administrators of the RAG, 2013/05/14).

⁸To be precise, to conduct this search, we specified the range of years in which degrees were granted, required that degrees be in law ("*jur*") and included an asterisk (a "wild card") under the graduate's last name. Other search parameters yield different numbers, but the same pattern of a large increase in graduates in law after 1386.

OA.4 Units of analysis and clustering city-year level regressions at the territory level

As noted in the text, our choice of city-year as the unit of analysis in our panel regressions raises concerns about the statistical inferences we make (i.e., how many independent observations we have) and general equilibrium effects (i.e., the possibility that units' interdependence biases our coefficients). In this section we replicate our panel regressions of Tables 4 through 6, but using different units of analysis, or clustering our standard errors at different levels.

We first, in Table OA.4, present results from estimating specifications presented in Tables 4 through 6, but using territory-year as the unit of analysis. One can see that our results are very similar to those presented in the main text.

Next, we estimate the same specifications, but using cell-year as the unit of analysis. One can see that our results are again similar to those presented in the main text (see Table OA.5).

Finally, we estimate the specifications presented in Tables 4 through 6 using city-year data as in the text, but clustering our standard errors at the territory level to account for possibly correlated error terms across observations in an entire territory, across space or time. One can see that the magnitudes of the standard errors and our statistical inferences are largely unchanged using this specification (see Table OA.6).

Table OA.4: Panel regressions, territorial lord-year level

Dependent variable:		Rate of market establishment									
		T4, col. 2 (1)	T4, col. 4 (2)	T4, col. 6 (3)	T5, col. 2 (4)	T5, col. 4 (5)	T5, col. 6 (6)	T5, col. 5 (7)	T6, col. 2 (8)	T6, col. 4 (9)	T6, col. 6 (10)
Year		0.090 [0.127]	0.135 [0.126]	0.086 [0.126]	0.131 [0.133]	0.034 [0.175]	0.372 [0.288]		0.087 [0.126]	0.087 [0.130]	0.092 [0.127]
Post1386		-1.077 [2.234]	-1.825 [2.189]	-1.103 [2.222]	-1.347 [2.262]	0.762 [3.281]	0.722 [7.699]		-1.036 [2.210]	-1.046 [2.286]	-1.198 [2.248]
Year × Post1386		-0.140 [0.207]	-0.200 [0.214]	-0.129 [0.206]	-0.298 [0.201]	-0.115 [0.333]	-0.489 [1.291]		-0.136 [0.205]	-0.156 [0.212]	-0.129 [0.208]
ΔDistUniv		-0.811 [1.048]	-1.422 [0.954]	-0.803 [1.035]	-1.535 [0.965]	-0.762 [1.428]	-0.808 [1.030]		-0.807 [1.031]	-0.763 [1.101]	-0.844 [1.069]
ΔDistUniv × Year		-0.061 [0.062]	-0.092 [0.061]	-0.056 [0.061]	-0.094 [0.061]	-0.037 [0.077]	-0.094 [0.065]		-0.058 [0.061]	-0.061 [0.065]	-0.063 [0.063]
ΔDistUniv × Post1386		0.004 [1.091]	0.684 [1.062]	0.006 [1.076]	0.440 [1.035]	-0.711 [1.401]	-0.215 [1.551]		-0.238 [1.030]	-0.265 [1.101]	0.123 [1.120]
ΔDistUniv × Year × Post1386		0.200* [0.111]	0.252** [0.127]	0.191* [0.109]	0.291** [0.119]	0.189 [0.146]	0.237 [0.228]		0.201* [0.106]	0.210* [0.114]	0.188* [0.113]
Constant		3.279 [2.322]	3.950* [2.286]	3.275 [2.310]	4.332* [2.422]	3.287 [3.467]	3.277 [2.307]		3.28 [2.308]	3.341 [2.388]	3.351 [2.337]
Window (years)		1386 ± 20									
Observations		20680	19200	20760	18600	17480	20880	20880	20800	18120	19920
Number of cities		2220	2036	2100	2025	1759	2256	2256	2249	2084	2033

*: Significant at 10%; **: 5%; ***: 1%. Robust standard errors in brackets, clustered at the lord level. Cf. notes to the equivalent tables in the main paper. The dependent variable is computed as market establishments per year per 1,000 cities in the region considered.

Table OA.5: Panel regressions, latitude/longitude cells-year level

Dependent variable:	Rate of market establishment									
	T4, col. 2 (1)	T4, col. 4 (2)	T4, col. 6 (3)	T5, col. 2 (4)	T5, col. 4 (5)	T5, col. 6 (6)	T5, col. 6 (7)	T6, col. 2 (8)	T6, col. 4 (9)	T6, col. 6 (10)
Year	0.020 [0.051]	0.035 [0.057]	0.024 [0.051]	0.026 [0.053]	0.077 [0.136]	-0.063 [0.259]		0.018 [0.051]	0.016 [0.050]	0.027 [0.051]
Post1386	0.391 [1.420]	0.205 [1.427]	0.781 [1.805]	0.259 [1.444]	-0.108 [4.219]	10.627 [9.335]		0.385 [1.417]	0.430 [1.405]	0.198 [1.428]
Year × Post1386	-0.071 [0.094]	-0.095 [0.108]	-0.111 [0.131]	-0.102 [0.099]	-0.040 [0.248]	-0.384 [0.703]		-0.070 [0.094]	-0.067 [0.093]	-0.060 [0.100]
ΔDistUniv	-0.370 [0.257]	-0.612 [0.395]	-0.361 [0.279]	-0.545* [0.292]	-0.954 [0.599]	-0.364 [0.251]	-0.937* [0.547]	-0.364 [0.250]	-0.406 [0.256]	-0.466** [0.224]
ΔDistUniv × Year	-0.033 [0.023]	-0.057 [0.048]	-0.036 [0.027]	-0.035 [0.030]	-0.051 [0.051]	-0.018 [0.048]	-0.094** [0.045]	-0.030 [0.022]	-0.031 [0.022]	-0.045** [0.022]
ΔDistUniv × Post1386	-0.223 [0.599]	0.030 [0.638]	-0.408 [0.759]	-0.119 [0.597]	-0.112 [1.580]	-1.787 [1.691]	-0.916 [1.666]	-0.298 [0.584]	-0.220 [0.591]	-0.132 [0.589]
ΔDistUniv × Year × Post1386	0.099* [0.052]	0.146 [0.102]	0.117* [0.069]	0.110 [0.073]	0.083 [0.099]	0.142 [0.132]	0.376** [0.160]	0.095* [0.049]	0.097* [0.050]	0.110** [0.051]
Constant	1.574*** [0.566]	1.718*** [0.597]	1.595*** [0.588]	1.859*** [0.620]	3.459*** [1.564]	1.572*** [0.564]	0.401* [0.211]	1.574*** [0.564]	1.508*** [0.558]	1.679*** [0.560]
Window (years)	1386 ± 20									
Observations	3200	3200	3200	3200	2080	3200	3200	3200	3200	3160
Number of cities	2220	2036	2100	2025	1759	2256	2256	2249	2084	2033

*: Significant at 10%; **: 5%; ***: 1%. Robust standard errors in brackets, clustered at the level of latitude/longitude cells. Cf. notes to the equivalent tables in the main paper. The dependent variable is computed as market establishments per year per 1,000 cities in the region considered.

Table OA.6: Panel regressions, city-year level, standard errors clustered at territorial lord level

Dependent variable:	Rate of market establishment									
	T4, col. 2 (1)	T4, col. 4 (2)	T4, col. 6 (3)	T5, col. 2 (4)	T5, col. 4 (5)	T5, col. 6 (6)	T5, col. 2 (7)	T6, col. 2 (8)	T6, col. 4 (9)	T6, col. 6 (10)
Year	-0.002 [0.077]	-0.008 [0.078]	0.012 [0.075]	-0.014 [0.080]	-0.021 [0.136]	-0.141 [0.312]		-0.004 [0.076]	-0.002 [0.077]	0.011 [0.077]
Post1386	1.729 [1.274]	1.400 [1.297]	1.141 [1.127]	1.704 [1.333]	3.608 [2.344]	16.933** [6.788]		1.659 [1.246]	1.765 [1.276]	1.498 [1.275]
Year × Post1386	-0.088 [0.139]	-0.058 [0.142]	-0.080 [0.144]	-0.086 [0.143]	-0.119 [0.238]	-0.673 [0.586]		-0.089 [0.137]	-0.098 [0.139]	-0.099 [0.140]
ΔDistUniv	-0.167 [0.422]	-0.374 [0.461]	-0.122 [0.459]	-0.300 [0.466]	-0.333 [0.588]	-0.173 [0.406]	-0.231 [0.827]	-0.173 [0.406]	-0.212 [0.420]	-0.400 [0.367]
ΔDistUniv × Year	-0.035 [0.037]	-0.025 [0.040]	-0.031 [0.038]	-0.023 [0.040]	-0.027 [0.054]	-0.015 [0.058]	-0.065 [0.071]	-0.033 [0.036]	-0.035 [0.038]	-0.052 [0.036]
ΔDistUniv × Post1386	-0.926 [0.585]	-0.594 [0.632]	-0.781 [0.584]	-0.788 [0.643]	-1.589* [0.881]	-2.896** [1.136]	-2.325* [1.231]	-0.989* [0.550]	-0.904 [0.569]	-0.733 [0.569]
ΔDistUniv × Year × Post1386	0.137** [0.066]	0.111 [0.070]	0.124* [0.072]	0.122* [0.071]	0.149 [0.094]	0.211* [0.109]	0.322** [0.153]	0.136** [0.063]	0.137** [0.065]	0.158** [0.066]
Constant	1.513* [0.850]	1.687* [0.868]	1.543* [0.885]	1.678* [0.884]	2.062 [1.453]	1.529* [0.840]	0.269 [0.962]	1.532* [0.841]	1.545* [0.847]	1.797** [0.833]
Window (years)	1386 ± 20									
Observations	88800	81440	84000	81000	70360	90240	90240	89960	83360	81320
Number of cities	2220	2036	2100	2025	1759	2256	2256	2249	2084	2033

*: Significant at 10%; **: 5%; ***: 1%. Robust standard errors in brackets, clustered at the lord level. Cf. notes to the equivalent tables in the main paper. The dependent variable is computed as market establishments per year per 1,000 cities in the region considered.

OA.5 Above/below median split sample results for spatial endogeneity, robustness results, and placebo regressions.

Our baseline results in Table 3 indicated that Germany experienced a break in the trend rate of market establishment in 1386; that this break was concentrated in cities with a change in distance to a university in 1386 greater than the median; and, we saw that in panel regressions, there was generally a significantly greater trend break in places with larger reductions in distance to a university in 1386.

Because our panel regression contained much of the information presented in the split sample results, we omitted many of the latter from the main text. Here, we present the equivalent split sample regressions for the time series specifications in Tables 4 through 6.

One can see that our time series evidence, showing a break in the trend rate of market establishment for all of Germany, is indeed driven by trend breaks specifically in areas with changes in distance to a university in 1386 that were greater than the median (see Table OA.7). This is true across all specifications, providing further evidence in support of our hypothesis that increased access to universities after 1386 significantly affected economic activity.

Moreover, in Figures OA.2 and OA.3 we report the same placebo analysis of Figure 9 (examining the effect of varying the year defining the $Post_t$ dummy from 1376 to 1396) separately for the samples of cities above and below median $\Delta DistUniv_i$. Again, one can see that there is a break in trend concentrated on the years around 1386 for the cities with a large change in distance to a university, but no significant break in trend for any of the years 1376–1396 in the sample of cities below median $\Delta DistUniv_i$.

Table OA.7: Aggregate time series regressions, split sample (above and below median $\Delta DistUniv$)

Dependent variable:	Rate of market establishment							
	T4, col. 1	T4, col. 3	T4, col. 5	T5, col. 1	T5, col. 3	T6, col. 1	T6, col. 3	T6, col. 5
Equivalent to:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Panel A: Below median $\Delta DistUniv$</i>								
Year	-0.025 [0.059]	-0.025 [0.059]	-0.007 [0.061]	-0.026 [0.061]	-0.045 [0.095]	-0.025 [0.059]	-0.027 [0.059]	-0.025 [0.061]
Post1386	0.933 [1.152]	0.937 [1.158]	0.386 [1.119]	1.065 [1.209]	1.938 [1.899]	0.888 [1.152]	1.021 [1.157]	0.962 [1.188]
Year \times Post1386	0.015 [0.097]	0.015 [0.098]	0.017 [0.097]	-0.002 [0.104]	0.034 [0.155]	0.011 [0.097]	0.018 [0.099]	0.016 [0.100]
Constant	1.470** [0.684]	1.476** [0.687]	1.506** [0.702]	1.525** [0.710]	1.922* [1.105]	1.472** [0.685]	1.436** [0.663]	1.515** [0.705]
Window (years)	1386 \pm 20							
Observations	40	40	40	40	40	40	40	40
N. of cities	1128	1123	1104	1087	668	1126	1103	1094
<i>Panel B: Above median $\Delta DistUniv$</i>								
Year	-0.099 [0.062]	-0.076 [0.053]	-0.076 [0.063]	-0.079 [0.053]	-0.100 [0.063]	-0.097 [0.061]	-0.098 [0.058]	-0.131** [0.064]
Post1386	-0.689 [0.988]	-0.121 [0.910]	-0.756 [1.065]	-0.275 [0.891]	-0.791 [1.006]	-1.036 [0.957]	-0.633 [1.003]	-0.476 [0.944]
Year \times Post1386	0.286*** [0.084]	0.241*** [0.077]	0.248*** [0.089]	0.236*** [0.080]	0.297*** [0.087]	0.289*** [0.080]	0.261*** [0.081]	0.327*** [0.095]
Constant	0.974 [0.807]	0.628 [0.658]	1.157 [0.884]	0.819 [0.659]	1.013 [0.811]	0.984 [0.788]	0.907 [0.831]	0.706 [0.631]
Window (years)	1386 \pm 20							
Observations	40	40	40	40	40	40	40	40
N. of cities	1092	913	996	938	1091	1123	981	939

*: Significant at 10%; **: 5%; ***: 1%. Robust standard errors in brackets. Cf. notes to the equivalent tables in the main paper. The dependent variable is computed as market establishments per year per 1,000 cities in the region considered.

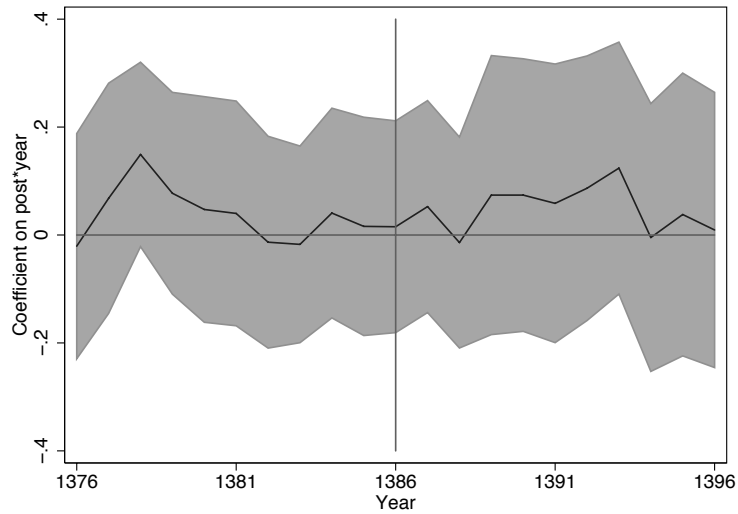


Figure OA.2: Changes in the trend rate of market establishment (coefficient on $Year_t \cdot Post_t$) under varying pivot years, 1376–1396, examining only cities with below-median values of $\Delta DistUniv$; for each year between 1376 and 1396, we test for a trend break in that specific year, examining the 20 years before and after that year, as in the specification estimated in Table 3, column 2.



Figure OA.3: Changes in the trend rate of market establishment (coefficient on $Year_t \cdot Post_t$) under varying pivot years, 1376–1396, examining only cities with above-median values of $\Delta DistUniv$; 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 3, column 3.

OA.6 Robustness of the Empirical Results

We now examine whether our baseline results in Table 3 are robust to alternative specifications. We first consider changing the window of time around 1386 that we examine. In Table OA.8, columns 1 and 2, we replicate our estimates in Table 3, columns 1 and 4, but consider a ± 15 year window, rather than a ± 20 year window. We find even stronger results using this narrower window than in the baseline specification. If a time window of ± 25 years is considered instead, one finds a positive (but statistically insignificant) break in the trend rate of market establishment, and a small, positive (but insignificant) coefficient on $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ (Table OA.8, columns 3 and 4).

These results, especially the strong results for the narrower time window, are reassuring in their qualitative similarity to our findings in Table 3. In interpreting the weaker results in columns 3 and 4, it is worth keeping in mind that we model market establishment across time using *linear* trends (and breaks in trends). As the time window under consideration becomes wider, it is more likely that other economic shocks are captured in the data, and that our linear approximation of trend rates of economic activity (and breaks thereof) is less appropriate.⁹

Still we can estimate a version of our time series model across a longer time period, controlling for smooth changes in underlying economic activity using higher-order polynomials. Our regression equation will be equivalent to the simple time-series setup of equation (4), with the addition of higher-order terms in $Year_t$ and higher-order interaction terms in $Year_t \cdot Post_t$:

$$markets_t = \beta_0 + \sum_{k=1}^K \beta_{1,k} \cdot Year_t^k + \beta_2 \cdot Post_t + \sum_{k=1}^K \beta_{3,k} \cdot Year_t^k \cdot Post_t + \eta_t, \quad (OA.1)$$

where $K = 1$ is equivalent to the linear approximation setup of equation (4), $K = 2$ is equivalent to an approximation of time trends with a quadratic polynomial, $K = 3$ to a cubic polynomial, etc. Additionally, with the variable $Year_t$ normalized to equal 0 in 1386, the (local) trend break in 1386 can be easily represented by the coefficient on the interaction term $Year_t \cdot Post_t$, $\beta_{3,1}$.¹⁰ Our model of the impact of new universities on human capital and market establishment will still predict a sharp, *local* change in the trend rate of market establishment in 1386; thus, we expect a significant, positive coefficient on $Year_t \cdot Post_t$.¹¹

We first estimate the (time series) model in Table OA.8, column 3, which examines a ± 25 year window around 1386, but now we control for economic activity using a quadratic time trend (which may change post-1386). In Table OA.9, column 1, one can see that controlling for a quadratic trend over the longer window, there is a statistically significant, positive (local) trend break in market establishment in 1386. In column 2, we increase the size of the window to ± 50 years, and control for underlying activity using a cubic polynomial (again, allowing the coefficients on the polynomial to change post-1386). Again, we find a significant, positive (local) trend break in market establishment in 1386. Finally, in columns 3 and 4, we increase the size of the window to ± 75 and ± 100 years respectively, and again control for underlying activity using a cubic polynomial; again we find significant,

⁹In fact, the R-squared is decreasing in the size of the window considered: in Table OA.8, column 1 (± 15 year window), it is 0.167; in Table 3, column 1 (the ± 20 year window), it is 0.098; in Table OA.8, column 3 (± 25 year window), it is only 0.034.

¹⁰Formally, $\beta_{3,1}$ is the difference in slopes between the polynomial on the left side of 1386 and the polynomial on the right side of 1386, evaluated at $Year_t = 0$ (i.e., 1386).

¹¹Admittedly, this exercise can only be suggestive, as the coefficient on $Year_t \cdot Post_t$ is being estimated using variation that is not just local variation around 1386.

positive trend breaks in 1386.

We next consider the robustness of our baseline results to varying the definition of our outcome variable. In many cases, the incorporation of a city was explicitly linked to the creation of a market; if evidence of both could be found in the *Städtebuch*, this will be reflected both in our city incorporations and our market grants data. But in some cases, no explicit mention of markets is made in the *Städtebuch* when a city incorporation is reported; to the extent that the city charters implicitly included the rights to hold a certain number of markets or fairs, therefore, our market grant data may underestimate the actual number of new markets.

To check whether this ambiguity affects our results, we estimate our baseline specifications (Table 3, columns 1 and 4), but use the sum of the market establishments and city incorporations in a given year (or city-year) as the outcome variable. The results in Table OA.10, columns 1 and 2, again show a significant break in the trend rate of market establishment in 1386, and a greater positive trend break in areas with greater reductions in distance to a university. At the same time, there is now a marginally significant negative pre-1386 trend associated with distance to a university. This could raise concerns to the extent that one would like areas with greater reductions in distance to a university to be identical to areas with less. In practice, the negative trend in city incorporation (recall there was no significant trend in market establishment itself) likely biases results against our hypothesis.¹²

The baseline results might also be biased by a few instances of multiple market grants to a city (perhaps with high values of $\Delta DistUniv$) in a single year. In Table OA.10, columns 3 and 4, we thus estimate our baseline specifications using an indicator of *any* market establishment (computed as a rate per 1,000 cities) as our outcome, rather than the total number of markets established in a city-year. Our estimated coefficients are slightly smaller, but we continue to see a positive, highly statistically significant break in trend that is greatest in areas with large reductions in distance to a university.

¹²If areas with high $\Delta DistUniv$ had fewer cities established just before 1386, this may have meant fewer places where markets would then be granted after 1386.

Table OA.8: Different windows of analysis (linear time trends)

Dependent variable:	Rate of market establishment			
	Time series	Panel, city level	Time series	Panel, city level
	(1)	(2)	(3)	(4)
Year	-0.192*	-0.047	-0.035	-0.025
	[0.095]	[0.092]	[0.035]	[0.055]
Post1386	0.933	2.51	0.368	1.335
	[0.843]	[1.629]	[0.761]	[1.359]
Year × Post1386	0.274**	-0.106	0.064	0.006
	[0.122]	[0.165]	[0.050]	[0.095]
ΔDistUniv		-0.454		0.04
		[0.426]		[0.384]
ΔDistUniv × Year		-0.082		-0.006
		[0.057]		[0.023]
ΔDistUniv × Post1386		-0.9		-0.552
		[0.729]		[0.547]
ΔDistUniv × Year × Post1386		0.216**		0.033
		[0.096]		[0.036]
Constant	0.418	1.214	1.410**	1.339*
	[0.635]	[0.815]	[0.589]	[0.789]
Window (years)	1386 ± 15		1386 ± 25	
Observations	30	67680	50	112800
Number of cities/cross sectional units	2256	2256	2256	2256

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of market establishments per 1,000 cities in the region examined (see footnote 42 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 and 4), the unit of observation is the city × year. Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level.

Table OA.9: Expanded windows of analysis (polynomial time trends)

Dependent variable:	Rate of market establishment			
	Quadratic Polynomial	Cubic Polynomial	Cubic Polynomial	Cubic Polynomial
Time trend approximation:	(1)	(2)	(3)	(4)
Year \times Post1386 (=difference in slopes around 1386)	0.493** [0.214]	0.449*** [0.168]	0.173* [0.089]	0.177*** [0.060]
Window (years)	1386 \pm 25	1386 \pm 50	1386 \pm 75	1386 \pm 100
Observations	50	100	150	200
Number of cities	2256	2256	2256	2256

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of markets established per 1,000 cities in the region examined (see footnote 42 for additional details). The unit of observation in all regressions is the year. Coefficient estimates for the other explanatory variables (cf. equation (OA.1)) omitted. Robust standard errors in brackets.

Table OA.10: Robustness to definition of the outcome variable

Dependent variable:	Rate of market establishment and city incorporation		Rate of market establishment (indicator)	
	Time series	Panel, city level	Time series	Panel, city level
	(1)	(2)	(3)	(4)
Year	-0.117*	0.015	-0.035	0.026
	[0.062]	[0.081]	[0.024]	[0.046]
Post1386	0.084	1.211	-0.061	0.3
	[0.904]	[1.672]	[0.466]	[0.810]
Year \times Post1386	0.201**	-0.11	0.093**	-0.083
	[0.084]	[0.138]	[0.039]	[0.069]
Δ DistUniv		-0.336		-0.412
		[0.479]		[0.262]
Δ DistUniv \times Year		-0.075*		-0.035
		[0.043]		[0.022]
Δ DistUniv \times Post1386		-0.643		-0.206
		[0.700]		[0.355]
Δ DistUniv \times Year \times Post1386		0.177***		0.100***
		[0.064]		[0.033]
Constant	1.808**	2.396***	0.852**	1.574**
	[0.750]	[0.919]	[0.345]	[0.616]
Window (years)	1386 \pm 20			
Observations	40	90240	40	90240
Number of cities/cross sectional units	2256	2256	2256	2256

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of economic “events” per 1,000 cities in the region examined (equivalently to the normalization of the number of markets; see footnote 42 for additional details). “Events” are the sum of market establishments and city incorporations (columns 1–2), or indicators of at least one market being established in a city (so any city receiving multiple market grants in a given year is coded as experiencing a single “event”; columns 3–4). In time series specifications (columns 1 and 3), the unit of observation is the year. In the panel data specifications (columns 2 and 4), the unit of observation is the city \times year. Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level.

OA.7 Full-sample tests of heterogeneous trend breaks across German cities

In the main text, we examine a range of explanations for the positive trend breaks in market establishment that we find, other than the increased human capital following the establishment of universities in 1386. We consider a range of alternatives:

- universities may have been established in cities that were expected to experience greater economic activity
- territorial lords establishing universities may have administered their regions differently, or may have been differentially affected by the Schism
- our results may have been driven by regional differences: areas near the Rhine may have driven our results, and areas east of the Elbe may have done so as well
- changes in city jurisdiction might have produced market grants that were indicative of political changes, rather than economic change
- cross-city conflicts may have produced trade-diverting market establishments
- finally, cities loyal to the Avignon Pope may have received market grants for political reasons

To determine whether these alternative explanations for variation in economic activity were likely drivers of our findings, in the main text we dropped particular subsets of cities from our analysis, and found that no set of potentially “problematic” cities seemed to drive our findings (see Tables 4 through 6).¹³ As a check of those findings, we now test whether allowing these various sub-groups of cities to experience their own trend rates of economic activity (and their own trend breaks in 1386) affects our findings in our standard panel data analysis. Rather than dropping these groups of cities from the analysis all together, we use our entire sample of cities and test whether our findings in the main text are preserved when accounting for these various subgroups of cities’ possibly divergent economic paths.

To be precise, we estimate the model in Table 3, column 4, but include the interaction of $Year_t \cdot Post_t$ with an indicator that a city belongs to a particular subgroup (we examine one subgroup at a time, as in the main text, and we include all lower-order interactions). As in the main text, our model predicts that the coefficient on $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ will be positive and statistically significant. In Table OA.11, columns 1–8, we show the results of estimating our panel model allowing the 8 different groups of cities dropped in the text to have their own trend rates of economic activity. In every case, we continue to find a positive, statistically significant coefficient on $\Delta DistUniv_i \cdot Year_t \cdot Post_t$ (except for the marginally insignificant case of column (2)), providing further evidence that the human capital produced in universities drove the trend breaks we identified, rather than the alternatives proposed.

¹³Note that in addition to merely dropping cities to test among hypotheses, we also examined pre-1386 trend rates of market establishment in cities with different $\Delta DistUniv_i$; we allowed trend breaks in market establishment to vary with longitude, and exploited only within-state variation; and, we examined market establishment in Italy and England around the time of the Papal Schism, to rule out alternative explanations of our findings.

Table OA.11: Full sample analysis of problematic regions

Dependent variable:	Rate of market establishment							
	T4, col. 2	T4, col. 4	T4, col. 6	T5, col. 2	T5, col. 4	T6, col. 2	T6, col. 4	T6, col. 6
Equivalent to:	< 20 km from a univ.	< 50 km from a univ.	university territories	< 20 km from Rhine	east of Elbe	jurisdictional changes	Württemberg	Avignonese obedience
Subgroup:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	-0.000 [0.075]	-0.018 [0.076]	0.011 [0.075]	-0.018 [0.075]	-0.004 [0.076]	-0.005 [0.075]	-0.004 [0.075]	-0.003 [0.075]
Post1386	1.692 [1.562]	1.615 [1.584]	1.495 [1.542]	1.705 [1.582]	1.710 [1.607]	1.684 [1.553]	1.725 [1.553]	1.757 [1.555]
Year × Post1386	-0.089 [0.139]	-0.063 [0.139]	-0.099 [0.141]	-0.064 [0.139]	-0.080 [0.143]	-0.086 [0.138]	-0.086 [0.138]	-0.088 [0.138]
ΔDistUniv	-0.193 [0.426]	-0.210 [0.452]	-0.432 [0.455]	-0.114 [0.433]	-0.578 [0.445]	-0.179 [0.413]	-0.219 [0.422]	-0.118 [0.401]
ΔDistUniv × Year	-0.036 [0.036]	-0.013 [0.038]	-0.052 [0.038]	-0.012 [0.037]	-0.032 [0.035]	-0.033 [0.035]	-0.035 [0.036]	-0.033 [0.038]
ΔDistUniv × Post1386	-0.898 [0.647]	-0.788 [0.695]	-0.630 [0.653]	-0.907 [0.692]	-0.935 [0.636]	-0.984 [0.627]	-0.872 [0.638]	-1.011 [0.639]
ΔDistUniv × Year × Post1386	0.139** [0.061]	0.104 [0.063]	0.152** [0.066]	0.104* [0.063]	0.135** [0.059]	0.136** [0.059]	0.134** [0.060]	0.140** [0.063]
Constant	1.545* [0.836]	1.552* [0.843]	1.613* [0.833]	1.503* [0.832]	2.795*** [0.955]	1.509* [0.830]	1.512* [0.828]	1.526* [0.829]
Window (years)	1386 ± 20							
Observations	90240	90240	90240	90240	90240	90240	90240	90240
Number of cities	2256	2256	2256	2256	2256	2256	2256	2256

*: Significant at 10%; **: 5%; ***: 1%. Robust standard errors in brackets, clustered at the city level. Cf. notes to the equivalent tables in the main paper. The dependent variable is computed as market establishments per year per 1,000 cities in the region considered. The subgroup indicated in the respective header of each column is characterized by an indicator variable in each regression, and this indicator variable is fully interacted with the $Post_t$ and $Year_t$ variables, and their interaction term. Coefficients relating to the subgroup indicators and their corresponding interaction terms not reported.

OA.8 Using within-state variation

In the main text, we consider a specification that adds to our baseline specification state-specific time trends, as well as state-specific breaks of the trend in 1386 (results are presented in Table 5, column 6). We adopt the division of Germany into 18 states, as in the volumes of the *Deutsches Städtebuch*: these states 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). Here, we provide a map showing these 18 states, and the locations of cities within them, see Figure OA.4.

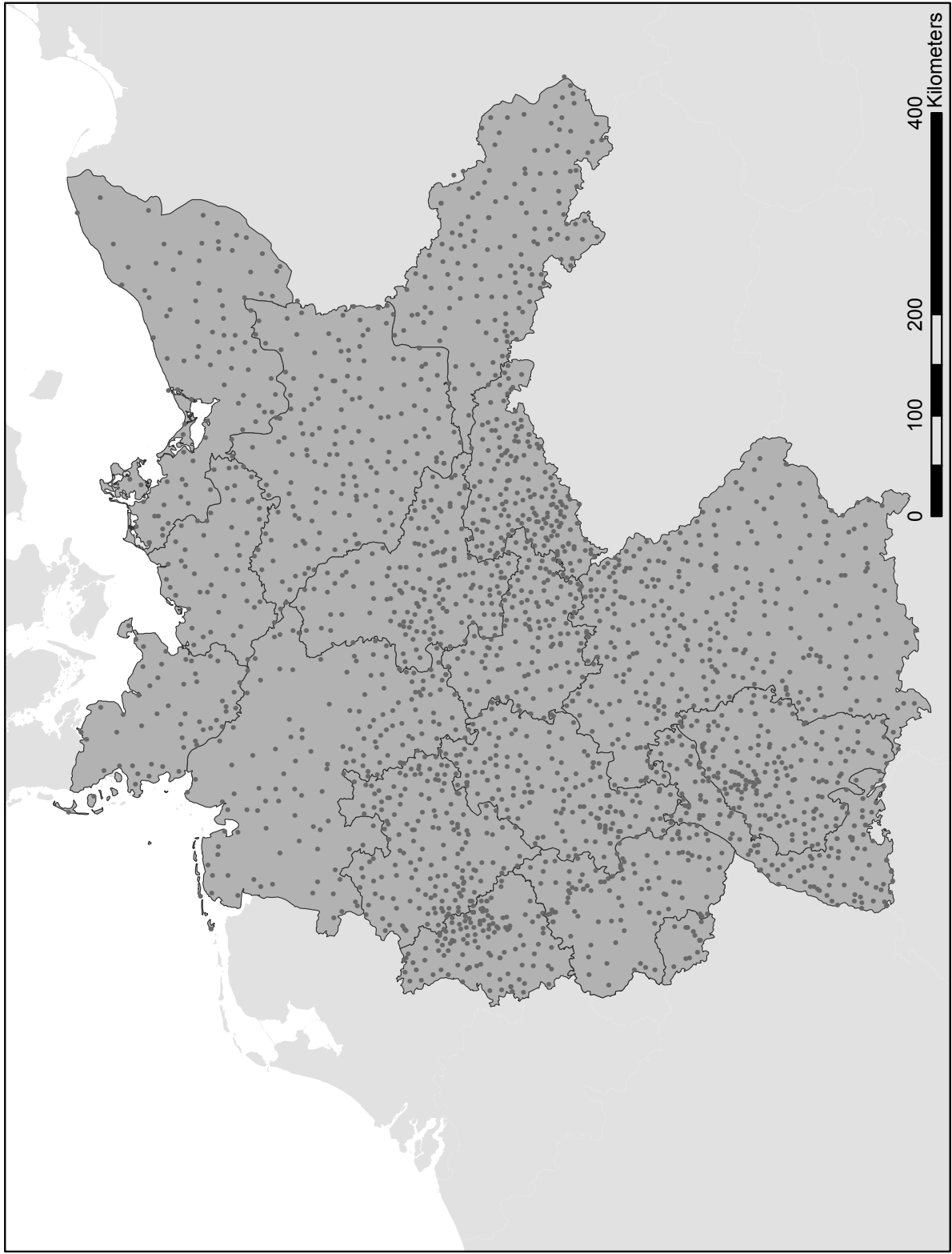


Figure OA.4: This map divides the German territory analyzed in the paper into 18 states, as in the volumes of the *Deutsches Städtebuch*. Each dot indicates a city included in the dataset.

OA.9 The impact of political shocks outside of Germany

In the main text, we discuss the impact of political changes within Germany (the impact of the Papal Schism, of jurisdictional changes, and of inter-city conflict) on patterns of market establishment. Of course, political shocks *outside* of Germany may have had spillover effects, affecting patterns of German trade, and thus market establishment. One important event overlapping with the Papal Schism was the political rise of Burgundy following the establishment of Philip II as Duke in 1363. One might worry that political change in Burgundy could have affected the German lands we study: perhaps trade increased in German cities near Burgundy around this time; because the cities in the western part of Germany had larger values of $\Delta DistUniv_i$, this could have generated the trend break we find.

To determine whether this was likely to have driven our results, we estimate our specifications from Table 3, columns 1 and 4, but drop all cities in the state of Baden, which was the German territory closest to Burgundy, and the most likely to have been affected by political shifts there. We find that excluding the cities in Baden has very little effect on the coefficients of interest; we continue to observe a positive trend break in 1386, concentrated in cities experiencing a large reduction in distance to a university (see Table OA.12, columns 1 and 2).

Another important political event of the late 14th century was the revolt of Flanders (see, for example, Cohn (2006, pp. 225-227)). One might wonder if conflict in Flanders redirected trade toward the adjacent, western parts of Germany, thus generating the pattern of market establishment we observe. To address this concern, we estimate the specifications in Table 3, columns 1 and 4, but drop all cities west of Düsseldorf (6 degrees, 47 minutes, east longitude). We find that our main results are practically unaffected (see Table OA.12, columns 3 and 4).

The reign of Jogaila (Wladyslaw II Jagiello of Poland), beginning in the late 14th century and marking the beginning of Poland's "Golden Age," roughly coincided with the Papal Schism, and might have affected economic activity in Germany. However, we do not believe it drives our results: when we dropped the regions of Germany east of the Elbe (in Table 5, columns 3 and 4), which were most likely to have been affected by political change in Poland, we find that our results are unchanged.

Finally, the Hundred Years' War, waged between France and England throughout the period we study, was also unlikely to have generated our results: by the 1380s, the War was focused on Calais, quite far from the territories we study. To the extent that the War affected German trade, it was most likely to do so in the western part of Germany; yet, as noted above, dropping cities west of Düsseldorf does not affect our results. Moreover, as also noted above, the most important political changes in France at the time occurred in Burgundy, and dropping German cities closest to Burgundy does not change our results.

Table OA.12: Accounting for external political shocks

Dependent variable:	Rate of market establishment			
	Sample:	excluding Baden	excluding "close" to Flanders	
		Panel, city level	Panel, city level	
	(1)	(2)	(3)	(4)
Year	-0.058 [0.059]	-0.011 [0.077]	-0.060 [0.054]	-0.004 [0.075]
Post1386	0.205 [0.873]	1.879 [1.596]	0.084 [0.832]	1.752 [1.561]
Year × Post1386	0.125 [0.082]	-0.090 [0.140]	0.154** [0.075]	-0.090 [0.138]
ΔDistUniv		-0.097 [0.433]		-0.147 [0.431]
ΔDistUniv × Year		-0.027 [0.036]		-0.033 [0.037]
ΔDistUniv × Post1386		-0.975 [0.655]		-0.977 [0.650]
ΔDistUniv × Year × Post1386		0.125** [0.061]		0.143** [0.061]
Constant	1.345* [0.670]	1.511* [0.853]	1.266* [0.633]	1.517* [0.836]
Window (years)	1386 ± 20			
Observations	40	85160	40	87440
Number of cities/cross sectional units	2129	2129	2186	2186

*: Significant at 10%; **: 5%; ***: 1%. The outcome variable in all regressions is the number of market establishments per 1,000 cities in the region examined (see footnote 42 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 and 4), the unit of observation is the city×year. Robust standard errors in brackets. Standard errors in the panel data specifications are clustered at the city level.

OA.10 England and Italy falsification exercises, using 1378 as the pivot year

Our test for a break in the trend rate of market establishment in Italy or England and Wales in 1386 was intended to check whether places experiencing the Schism, but not experiencing university foundations as a result, also experienced changed rates of market establishment.

Of course, the pivot year we used was chosen to fit specifically German circumstances (the slight delay between the year of the Schism and the foundation of Germany's first universities). If the Papal Schism affected market establishment in England and Wales or in Italy, it might have done so immediately. We thus estimate the specifications in Table 7, but use 1378 as the pivot year used to define $Post_t$. We again find no effect of the Papal Schism on market establishment in England and Wales or in Italy, providing further evidence that without university establishment as a consequence, the Papal Schism did not significantly affect economic activity (see Table OA.13).

Table OA.13: Robustness of placebo analyses

Dependent variable:	Rate of market establishment	
	Sample:	England and Wales
	Italy	
	(1)	(2)
Year	-0.087 [0.064]	-0.020 [0.034]
Post1378	2.161 [1.373]	1.742* [0.954]
Year \times Post1378	0.119 [0.145]	-0.079 [0.072]
Window (years)	1378 \pm 20	
Observations	40	40
Number of cities	190	2254

*: Significant at 10%; **: 5%; ***: 1%. Both regressions estimate the baseline time series specification (Table 3, column 1), except that 1378 is used as the "pivot year" defining the $Post_t$ dummy variable. The outcome variable in the regressions is the number of markets established per 1,000 cities (see footnote 42 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.