

Selection in the Institutional Record

Evidence from Craft Guilds and City Growth in Europe, 1000–1800*

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Abstract

Evaluations of institutions and policies often date a treatment by its first surviving record. The places that adopt an institution are not a random draw. We develop a model of that selection. Two margins govern it, how large a place must be to bear the cost of an institution and how many places the institution can occupy. We test the model in a panel of 1,754 European cities from 1000 to 1800, with craft guilds as the lead case and eight other institutions for comparison. Cities in which a guild is first documented had been twice the size of other cities for four centuries before the record. Capitals and new sees, which had few places, went to large cities while towns granted a market right or a charter, which any town could seek, looked like other towns. For guilds, selection accounts for the gap between cross-city estimates that imply a steady-state population premium near 100 percent and within-city and matched estimates near 14 percent. The matched premium persists for four centuries and the record gives no support to the view that guilds retarded urban growth.

JEL codes: C81, D02, N13, N93, O43, R12.

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1 Introduction

In the year 1000 Ghent had about five thousand people. By 1300 it had sixty-four thousand. Only Paris and London were larger north of the Alps. Craft guilds did not enter the surviving record for Ghent until the thirteenth century, near the peak of the city's ascent. Over the following three centuries the city lost half its population. Read one way the record says that guilds arrived and growth stopped. Read another it says that guilds were first written down in a city that had been rising for three hundred years. Which interpretation is right turns on a question that precedes any question about what guilds did. What does the date at which a city's guilds first appear in the record tell us about the city?

Much of what we know about institutions and growth in cross-city studies comes from designs that date a treatment by an institution's first appearance in the record. Communes, universities, parliaments, printing presses, and market rights have all served as treatments in city-level panels (Bosker et al., 2013; Cantoni and Yuchtman, 2014; Dittmar, 2011; Stasavage, 2014). The literature on Europe's rise points to the bottom-up institutions among them as proximate contributors to growth. Corporations formed by unrelated people, guilds and communes above all, are credited with the continent's later political and economic institutions (Greif, 2006; Mokyr and Tabellini, 2024; Greif et al., 2025). Everyone in this literature agrees that institutions are not assigned at random (Glaeser et al., 2004). The usual remedies are unit fixed effects, which remove a constant difference between treated and control places, and matching on observables at the date of treatment. Neither approach addresses selection on a place's trajectory. How large that selection is and whether it differs by kind of institution has not been measured.

Craft guilds offer one case to measure institutional-record selection. The debate over whether guilds promoted or retarded European economic development has run since Adam Smith, and both sides draw on the same kind of evidence. Classical economists and, in the fullest modern statement, Ogilvie (2019) describe guilds as rent-seeking monopolies that raised barriers to entry and manipulated output markets. The efficiency tradition describes them as institutions that trained new apprentices, transmitted technical knowledge, and signaled product quality (Epstein, 2005; de la Croix et al., 2018). The corporations literature places them among the organizations that gave Europe its later institutions (Greif et al., 2025). A guild appears in the surviving record and the city's

fortunes are measured against that date. The record is built from documents that survived, and cities that grew wrote more and kept more of what they wrote. Before the record can say anything about what guilds did, we need to know which cities it was drawn from and why.

We assemble the largest city-level panel of documented guild activity to date, covering 1,754 European cities from 1000 to 1800, and extend Ogilvie's guild databases with additional sources that raise the number of documented cities from 432 to 750. We then ask how the cities in which guilds are first documented compared with other cities in the centuries before the record using two measures. First, population from the Bairoch and Buringh city estimates compares guild cities with every other city in countries of the same guild strength. Second, the birth of notable people from a database of two million biographies compares guild cities with cities in the same size band to measure their prominence given their size. Population measures how large a city was, and among cities matched on size it carries no further information. Notable births come from a source independent of the institutional record and show whether a city was more prominent than other cities of its size. To learn about the magnitude and direction of selection, we put eight other institutions through the same comparisons. Two of them, the first printing press and the commune, grew from below as guilds did. Five were conferred from above. Three were seats that an authority placed for its own use (a capital, a bishopric, and an archbishopric) and two were rights that a ruler granted to a town (the market right and the town charter). The eighth, the university, was founded by masters in some cities and by rulers in others and we do not assign it a category. Notable births are the measure on which the commune and the seats part from the guild.

Cities in which a craft guild is first documented were on average twice the size of other cities of the same guild strength for four centuries before the first record. They also had twice the notable births of cities in the same size band, about a third more per inhabitant. The lead (defined in Section 2) is of long standing on both measures. Comparisons to other institutions indicate what kind of selection this is and is not. It is not a property of being written down, because towns that received a market right or charter were level with their neighbors before the grant and little changed after it. It is not only a matter of size, because seats also went to large cities while guild cities were already leading among cities in the same size band. It is the selection of an institution that forms where there are enough people to form it. The first printing press, which a printer set up in places where there were buyers, shows the same lead. The comparison is sharpest inside Germany and

Austria, where guild documentation, market rights, and town charters come from shared urban histories. In that subsample, guild towns were 1.5–2.1 times the size of other towns before their guilds appear while market and charter towns were similar in size to their comparables.

A simple model organizes these comparisons. An institution first arrives in a city when whoever decides deems it worth the cost. How much of the benefit the city's own scale supplies differs by institution. Craftsmen gain from organizing only where there are many of them and there is a market for their trade. A ruler selling a market right collects a fee that covers his cost in any town. The model for selection has two dials, the threshold a city must clear and the number of places the institution can occupy. The lead of the cities that acquire an institution over the average city rises with the first and falls with the second. Guilds clear a high threshold. Seats are scarce. Granted rights have no threshold and no limit. Across the nine institutions we consider, the lead of cities that acquired them rises roughly in step with how exclusive the institution was.

Once selection is accounted for, the guild evidence looks different. Naive cross-city growth regressions in our data imply that a century of guild presence is associated with a steady-state city twice as large. No urban institution plausibly delivers that magnitude. Within-city regressions and a matched comparison of guild cities with never-documented cities of the same size and guild strength both put the premium near 14 percent, and the gap between the cross-city and within-city estimates is the level selection that cross-city variation carries. What remains runs against the view that guilds retarded urban growth. The apparent decline of guild cities after their guilds appear is mean reversion, which never-documented cities of the same size share. Population pre-trends in the matched comparison are flat in the three centuries before documentation, with a small negative deviation in the fourth, and the premium holds for four centuries. We do not interpret the premium as a causal effect because the century is the resolution of the data and a city can take off and acquire documented guilds in the same century. We do take it as evidence against the cross-city pattern that favored the rent-seeking view and as consistent with the view that guild formation accompanied commercial vitality.

The paper makes three contributions. The first is a measurement of how selected the institutional record is. Fixed effects remove a lead that is constant and matching removes a lead in levels. The guild case shows that the lead itself, and the path it follows before the record first appears, can be measured. Institutional selection ranges from no lead for a routine grant to a twofold lead of four

centuries' standing for a guild. A two-parameter model we introduce predicts where a given institution falls. The second is the panel, which links documented guild activity to population, notable people, and the dates of eight other institutions for every European city of consequence over eight centuries. The third is a reinterpretation of the guild record. Guilds were first recorded in cities that had led for centuries, and those same cities continued to grow at least as fast as their peers. That is what the cross-city record shows and, in its current form, is all it can show.

Section 2 sets out the model. Section 3 describes the panel and the sources that date each institution. Section 4 sets out the comparisons and reports which cities enter the guild record along with other institutions in the comparison set. Section 5 returns to guilds and city growth. Section 6 draws out what the results mean for work that dates institutions by their records, and Section 7 concludes.

2 A Model of Institutional Selection

2.1 Setup

A population of M towns is indexed by i . Each has a scale $S_i > 0$ that stands for its population and the density of its commercial life, with $\log S_i$ normally distributed $N(\mu_t, \sigma^2)$ across towns at the date t at which an institution is decided. An institution comes into being in a town when the deciding party deems it worthwhile to establish. The relevant decision maker differs by kind of institution. For a craft guild it is the craftsmen of the town. For a printing press it is a printer choosing where to set up. For a bishopric or a capital it is a church or a prince choosing where to put a seat. For a market right or a town charter it is a ruler who decides whether to grant a privilege that a town requested.

The decision maker weighs a benefit against a cost. The net payoff from having the institution in town i is

$$\pi_i = a + b S_i - F, \tag{1}$$

where $a \geq 0$ is the part of the benefit that any town supplies, $b \geq 0$, the rate at which the benefit rises with the town's scale, and $F > 0$, the cost of bringing the institution into being. The institution

is worth having when $\pi_i \geq 0$, that is, when

$$S_i \geq S^* \equiv (F - a)/b. \quad (2)$$

The threshold S^* is the first of two dials. It is high when the scale-free part of the benefit falls well short of the cost, so that only the town's own scale can make up the difference. Craftsmen gain from organizing only where there are enough of them to organize (and a demand for their trade). Nothing about a small town supplies that gain. For a guild, a is near zero. The cost of organizing is real, and S^* is high. A printer needs buyers for books. A bishop needs a town that can support a cathedral and a household. A ruler selling a market right collects a fee that covers his cost whatever the size of the town. For a grant, $a \geq F$, the condition binds nowhere, and there is no threshold at all.

The second dial is how many towns can have the institution. A kingdom has one capital and a diocese one see. Call the number of places available for a given institution K . When more than K towns clear the threshold the deciding authority chooses among them and it chooses the towns it values most, which by Eq. (1) are the largest. A granted right has no such limit. A ruler can sell market rights to every town that asks. Panel A of Figure 1 shows the two dials on the distribution of town scale, with the threshold as a cut from below and the capacity as a cut from above.

2.2 Selection

The two dials together set how far the towns that acquire an institution stand above the average town. That superior relative size, or “lead”, is defined as $r \equiv \mathbb{E}[S \mid \text{acquired}]/\mathbb{E}[S]$. With no limit on places the institution appears in every town with $S_i \geq S^*$. For the lognormal with $q = \log S^*$ and Φ the standard normal distribution function, the lead is

$$r(q) = \frac{1 - \Phi((q - \mu_t - \sigma^2)/\sigma)}{1 - \Phi((q - \mu_t)/\sigma)}, \quad (3)$$

which equals one when no threshold binds and rises without bound as q rises (corresponding to the solid line in Panel B of Figure 1). With K binding the institution appears in the K largest towns, which are those above the $(1 - K/M)$ quantile of the scale distribution, and Eq. (3) applies with

q at that quantile, so r rises as K/M falls, which corresponds to the dashed line in the same panel. With no threshold and no limit the institution appears in any town that asks. The towns that have it are a random draw, their average size equals the average town's, and r is one. Appendix A derives Eq. (3) and relates r to the lead over the towns that did not acquire the institution (as reported in Table 2 and Appendix E).

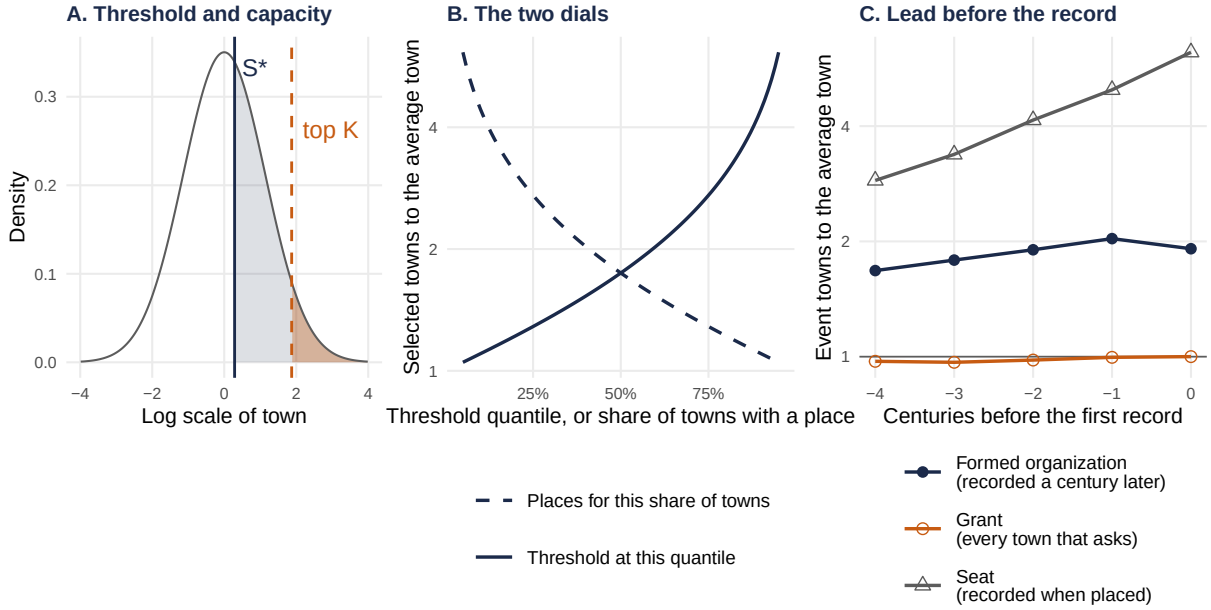


Figure 1: The model. Panel A: the distribution of town scale, with the threshold S^* and the cut that a capacity of K places implies. Panel B: the lead of the towns that acquire an institution over the average town as the threshold rises (solid) and as the number of places falls (dashed), from Eq. (3). Panel B expresses the threshold as the share of towns below it, $\Phi((q - \mu_t)/\sigma)$, so that the curve depends only on σ . Panel C: the same lead by century before the first record for three kinds of institution, from the simulation in Appendix A; the simulated leads are over the average town and so sit below the leads over non-event cities reported in Section 4.

Prediction 1. *The lead of towns that acquire an institution over the average town, measured before the institution appears, rises with the threshold S^* and falls with the number of places K .*

The prediction concerns selection on levels. It says nothing about what the institution subsequently does. A comparison of towns with and without an institution reveals the lead of the towns the institution is drawn from before it can pick up any effect the institution has. The two dials set the size of that lead.

2.3 Scale Persistence and Record Selection

Town scale persists across centuries, so the towns that were large enough to acquire an institution at the date of decision were already larger than other towns in the centuries before it. Let $\log S_{it}$ evolve across centuries as

$$\log S_{i,t+1} - \mu_{t+1} = \rho (\log S_{it} - \mu_t) + \varepsilon_{i,t+1}, \quad \varepsilon_{it} \sim N(0, s^2), \quad (4)$$

with $0 < \rho < 1$ so that the cross-sectional distribution is stationary with $\sigma^2 = s^2/(1 - \rho^2)$. The institution is decided at t_0 by the rule above and recorded at $t_0 + \tau$, where $\tau \geq 0$ is the lag between the institution's existence and its first surviving document. Record selection at t_0 is on the level of $\log S_{it_0}$, and under stationarity the expected deviation of a selected town at any other date is $\rho^{|t-t_0|}$ times its deviation at t_0 . The lead measured h centuries before the record is governed by $\rho^{h-\tau}$ for $h \geq \tau$. It is largest at the decision date and declines geometrically in both directions at the rate at which scale mean-reverts. A lead visible four centuries before the record requires scale to be highly persistent. The population data bear that out. The convergence rate estimated in Appendix H.4 implies a half-life of five to seven centuries.

The lag τ differs by kind of institution. An organization formed by its members exists before anyone writes it down. Guilds enforced their rules, collected dues, and engaged in commercial activity for years before a town council confirmed their statutes or a court recorded a dispute (Ogilvie, 2019, pp. 29–30). For a formed organization $\tau > 0$ and the decision date lies before the first record. Its lead peaks before the record and is flatter over the centuries preceding it. A founding document that creates an institution is the institution's beginning. A charter of market rights brings the right into being on the day it is sealed. A placement puts the seat (like a capital or the erection of a see) in the designated city. For a seat and a grant, $\tau = 0$. Any lead peaks at the record's date. The printing press is the exception that checks this interpretation. A press is a firm rather than a corporate body, which makes it an organization in North's sense but not an institution in the sense of a rule. The first record of a press is a surviving book with a publication date. The press exists and is recorded in the same year. A long lead among press cities therefore cannot be an artifact of late recognition.

Prediction 2. *Towns that acquire organizations formed by their members lead for the whole period before the first record, with the lead flattest during the lag between formation and record. Towns*

that receive placed seats lead at the date of placement. Towns that receive granted rights do not lead.

Panel C of Figure 1 simulates the three profiles. The formed organization, recorded a century after it forms, leads throughout the four centuries before the record with its peak a century before. The seat leads at placement and less at every earlier date. The grant shows no lead at any date. The height of a lead is set by the two dials and its shape by τ and ρ . The model is one of selection on levels at one date. It produces a lead that rises into the decision, which is the capital's path before placement. The capital's continued rise afterward lies outside a model of selection. It does not produce a lead that is highest four centuries before placement and declines into it, as the new bishopric's path does. Section 4 reports that path.

2.4 Degrees

The three kinds of institutions in the predictions are points on a continuum and real institutions sit between them. A town charter that founded a new settlement on empty ground created the town along with the right. In that case the charter is closer to a placement than a grant. The earliest universities grew from gatherings of masters and students (Cantoni and Yuchtman, 2014). They were corporations in the same sense as a guild, while later universities were founded by princes and popes by a dated act. Across the nine institutions considered in this paper, universities evolved the most across the selection categories we lay out. A capital was often never placed at all. The court settled where the ruler lived, and the city became a capital after the fact. Communes had both features. In one town a commune may have been a sworn association of burghers that extracted recognition from its lord. In another a commune conferred a set of liberties by the lord.

The model places each institution by the two dials, which vary continuously. An institution with a high threshold and few places is drawn from leading towns and an institution with no threshold and no placement cap is not. The empirical sections report every institution we observe on the same scale, the lead of the towns that acquired it over the towns that did not.

The distinction between institutions that grow from below versus institutions conferred from above has a long tradition. Menger (1883) separated 'organic' from 'pragmatic' institutions, Hayek (1973) delineated 'grown' from 'made' orders, and North (1990) distinguished 'organizations' from

‘rules of the game.’ Guilds, communes, and universities are organizations in North’s sense. Market rights and charters are rules. The literature on Europe’s corporations treats the organizations formed by unrelated people as the source of the continent’s later institutions (Greif, 2006; Lucassen et al., 2008; Mokyr and Tabellini, 2024; Greif et al., 2025), and the literature on self-governance treats their formation as a response to the problems a community faces (Ostrom, 1990). Both literatures hold that such organizations form where they are needed. This corresponds to the threshold in Eq. (2). Mokyr and Tabellini (2024) place them in time the same way. Self-governing cities and communes emerged “with the urbanization that accompanied the slow but unmistakable recovery” of the European economy, and guilds emerged within those cities (p. 350). Our contribution is to measure the lead that this sequence implies and to show how it varies across institutions.

2.5 The Nine Institutions

Table 1 places each of the nine institutions on the two dials and gives the category under which Sections 4 and 5 report it. Each assignment rests on who brought the institution into being as the historical literature and the sources that date the institution describe that party.

Table 1: The nine institutions by deciding party, threshold, and number of places

Institution	Who decides	Threshold S^*	Places K	Category
Craft guild	The craftsmen of the town	High	Open	Grew from below
First printing press	A printer	High	Open	Grew from below
Commune	Burghers, recognized by a lord	High	Open	Grew from below
Capital	The ruler	Positive	One per state	Seat
Bishopric	The Church	Positive	One per diocese	Seat
Archbishopric	The Church	Positive	One per province	Seat
Market right	The territorial ruler	None	Open	Granted right
Town charter	The territorial ruler	None	Open	Granted right
University	Masters, or a prince or pope	Varies by foundation		Not classified

Three institutions we consider grew from below. A craft guild is an association of the practitioners of a trade in one town and it forms only where there is a trade to organize. Gross (1890, vol. 1, p. 4) made the point about the English merchant guild, whose existence “presupposes a greater mercantile and industrial development” than tenth-century England had reached. The earliest English guild documents show associations already in being. Between 1093 and 1109 the Chapman

Gild of Canterbury appears in the record conveying eight houses to Christ Church in exchange for nine others (Gross, 1890, vol. 1, p. 5). Guilds are the canonical case of corporate collective action from below (Lucassen et al., 2008). Accounts that stress how much guilds owed to bargains with political authorities have the association form first and seek its privileges second (Ogilvie, 2019). The printing press is a firm and a printer set up where there were buyers for books (Dittmar, 2011). The commune is dated from a source that codes “the presence of a local urban participative organization that decides on local urban affairs” (Bosker et al., 2013, pp. 1422–1423), which is an organization of townspeople whatever a lord later confirmed. The commune is the mixed case of the previous subsection, and its estimates should be interpreted with that in mind.

Three institutions are seats. The capital, the bishopric, and the archbishopric record a city’s “status in the political and ecclesiastical hierarchy” (Bosker et al., 2013, p. 1422). A prince or the Church put each one in a town, and the hierarchy fixed how many there could be.

Two institutions are granted rights. The compilers of the German data state that “fairs and markets did not develop spontaneously. Territorial rulers established them with previous permission of the king” (Cantoni et al., 2020, markets codebook, p. 2), and they define a town charter as “a bundle of privileges granted to a settlement by a superordinate ruler” (Cantoni et al., 2020, town-charters codebook, p. 2). Most recipients were small. Roughly 95 percent of medieval German cities held fewer than 2,000 inhabitants (Cantoni et al., 2020, town-charters codebook, p. 3).

The university is not classified. Universities had a mixture of bottom-up and top-down attributes that evolved over time. The earliest universities were corporations of masters and students. Later ones were founded by rulers. The first universities in Germany were founded by its rulers after the papal schism of 1378 (Cantoni and Yuchtman, 2014). A single series of first dates therefore mixes foundations of both kinds. Universities also “gravitated mainly toward cities of more substantial size” (Bairoch, quoted in Bosker et al., 2013, p. 1427). The university enters the comparison by exclusivity in Section 4, since Prediction 1 orders institutions by the share of cities that acquired them and the lead of those cities, and both are measured. It stays out of Prediction 2, which depends on who decided and so on the record lag τ . For universities that party changed over time.

2.6 Implications for Empirical Work

Studies that date a treatment by an institution’s first record face a selection problem whose size and direction the two dials predict. Designs built on guilds, presses, communes, universities, and seats of power compare towns that were already ahead to towns that were not. Designs built on granted rights compare towns that were alike. A difference-in-differences design with town fixed effects removes a constant lead. It does not remove a lead that was still growing when the record begins, which violates parallel trends. Matching on size at the date of record removes the level and leaves whatever path remains. The sections that follow find a lead for guild cities that was growing slowly in population. The matched premium is net of the level and continues along a small residual path.

The predictions also fix what a positive association between an institution and later growth can mean. For an institution with a high threshold or few placements, that relationship contains the lead of towns observed in the pool from which they were drawn. A granted right does not have this lead. The “guilds and growth” debate is a case of the former relationship. Section 5 returns to guilds with the selection measured.

3 Data

The panel covers 1,780 European cities with population estimates from 900 to 1800 and documented guild activity in each preceding century. Twenty-six of these cities have no non-zero population estimate before 1800, so the analysis sample comprises 1,754 cities. Each city and century observation carries a population estimate at the end of the century and the share of the preceding century in which guild activity was documented. We add the dates and locations of eight other institutions to this panel, seven that we classify and the university, as well as one outcome that does not run through the guild record, the birth of notable people. Table C1 in Appendix C reports descriptive statistics.

3.1 City Populations

Estimates of European city populations come from [Buringh \(2021, pp. 1–18\)](#), which updated the figures of [Bairoch et al. \(1988\)](#). The source records population at a centennial frequency up to 1500

and at a semi-centennial frequency from 1550. For consistent interpretation of our estimates, we use the century years. Positive estimates begin at 1,000 inhabitants and are rounded to thousands. A zero in the source means that the city has no estimate for that century. Of the 17,800 city-century cells, 2,707 are set to zero, falling from 661 in 1000 to 12 in 1800. The analysis panel used for the guild event study drops those cells. The unmatched population comparisons of Section 4 keep them and count them as zero so that a city too small to be recorded is treated as small rather than as missing.

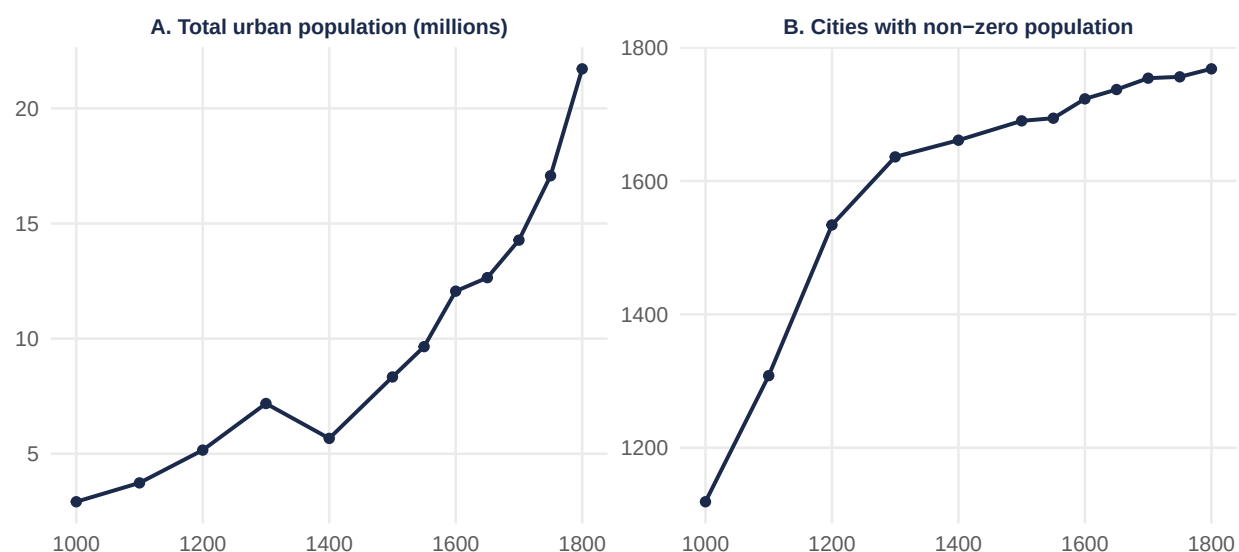


Figure 2: Urban population and city count, 1000–1800. Panel A: total urban population (millions) across all panel cities with non-zero population estimates, including half-century observations. Panel B: number of cities with a non-zero population estimate. Source: [Buringh \(2021\)](#).

Figure 2 plots total urban population and the count of cities with estimates. Population and city counts rise together over 1000–1300; urban population falls by about 21 percent between 1300 and 1400, a span that includes the Black Death, its recurrences, and the migration that refilled cities after it ([Jedwab et al., 2024](#), pp. 10–12), while the number of cities holds—and from 1400 onward, the city count is nearly constant as urban population climbs. Across all cities centennial growth rates over 1000–1800 ranged from –25 percent to 90 percent with a mean of 22 percent.

3.2 Guild Presence

Associations of people linked to trades and crafts appeared in Europe in late antiquity and the early medieval era, and guilds in their commercial capacity began appearing in European cities from 1000 (Ogilvie, 2011, pp. 19–22), reached near-universal coverage by the fourteenth century (Ehmer, 2015, p. 48), and ended with their abolition by the end of the nineteenth century (Ogilvie, 2019, p. 15). Their forms and interests varied, even within the same region. Florentine wool and finishing guilds consisted of master drapers who enforced regulations on clothworkers outside any guild, while in Verona guild members spanned the occupations of the textile industry and master drapers only coordinated production (Hunt and Murray, 1999, p. 39). Ogilvie’s classification distinguishes merchant guilds that engaged in long-distance wholesale trade from craft guilds (Ogilvie, 2019, pp. 9–10), and her classification of countries by guild strength encodes variation in municipal and national policy, from Elizabeth I’s *Statute of Artificers* of 1563, which regulated apprenticeship through the guilds but stopped short of making membership compulsory, to the French edicts of 1581 and 1597 that strengthened guild authority over labor mobility and trade (Heckscher, 1994, pp. 233–235). We refer to this classification as guild strength. It places each country in one of three classes, with relatively weak, intermediate, or strong guilds, and we add a residual class for the remaining countries. The classes are sets of countries, so cities of the same guild strength need not be near one another. Spain and Germany, for example, are both strong (Appendix Figure B1). The matched comparisons of Sections 4 and 5 and the heterogeneity analysis in Appendix I use it.

Documentation of guild activity at the city level builds on the databases behind Sheilagh Ogilvie’s *The European Guilds: An Economic Analysis* (2019), the most comprehensive collection of historical sources on European guilds. Her databases record qualitative examples of guild behavior, guild demographics, and quantitative measures of guild activity such as ordinances, membership fees, and lobbying expenditures. For our purposes their essential content is narrower. They identify how long a guild was active in a particular city during a particular period. We adopt her definition of craft guilds as “non-wholesale, occupational” organizations (Ogilvie, 2019, p. 10), which includes manufacturing, victualing, and service trades and excludes merchant-wholesalers. We add documented guild activity from additional secondary sources, which raise the number of cities with documented guild activity from 432 to 750. Each additional source carries a reliability rating, and

Appendix B describes the sources, the ratings, and a resampling exercise showing that the conventional estimates do not depend on the lower-rated ones. The combined record covers 724 of the 1,754 analysis-sample cities.

Our measure of guild presence is the share of the preceding century with any recorded guild activity in the city, $G_{it} \in [0, 1]$. The date of first documentation is the first century in which that share is positive. The record establishes when guilds were active and does not establish founding dates since a guild’s first surviving document is typically a confirmation of statutes, a dispute, or a conveyance of property by a body already in being. As Ogilvie cautions, the databases are not an exhaustive account of guild activity (Ogilvie, 2019, p. 30), and the caution extends to our panel. Cities coded as never documented are a mixture of cities without guilds and cities whose guilds left no surviving record. Country and century fixed effects, or matching on guild strength, only absorb the part of this that reflects the historiographical preference of some societies to document guilds more than others (Ogilvie, 2019, p. 28).

Figure 3 shows the distribution of guilds over time and space. Guild documentation begins in the Mediterranean commercial core and northern France, spreads through the Holy Roman Empire and the Low Countries in the thirteenth and fourteenth centuries, and reaches the periphery late. Documented and never-documented cities are interleaved throughout, which is what permits matching guild cities to comparable cities of the same guild strength. Table B3 in Appendix B gives the distribution of cities across first-documentation cohorts, and Figure 4 plots average population by cohort. Cities whose guilds are documented by 1300 are the largest throughout the nine centuries, cohorts first documented in 1400–1500 are next, cohorts documented from 1600 are smaller still, and never-documented cities are the smallest. The ordering holds at every date as we show in Section 4.

3.3 Other Institutions

Eight further institutions are dated from three sources, each matched to the panel by coordinates. Table 1 gives the category of each and Section 2.5 the grounds for it.

The first printing press is dated from the Universal Short Title Catalogue (USTC, 2022). We aggregate surviving editions by place of printing and half-century over 1450–1649 and link printing

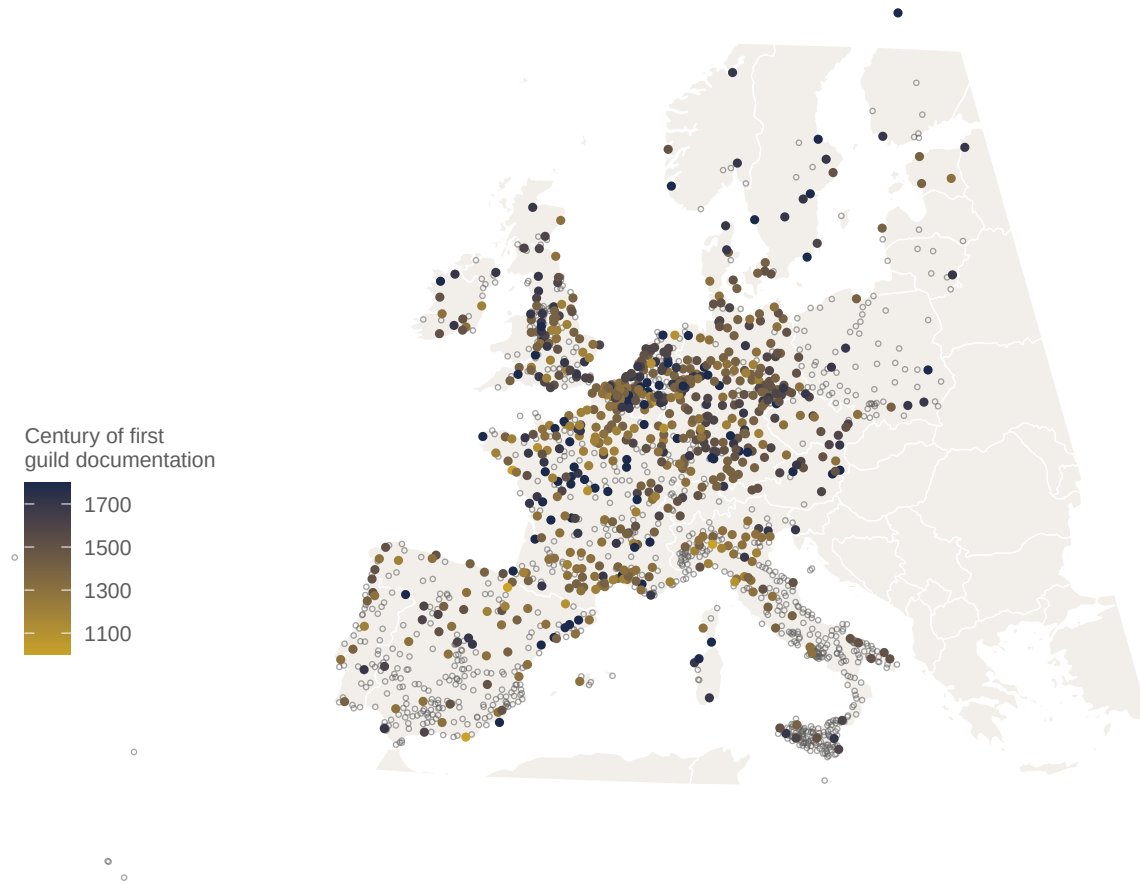


Figure 3: The guild panel. All 1,754 analysis-sample cities. Open gray points are cities with no documented guild activity, and filled points are shaded by the century of first documented guild activity. Europe Equidistant Conic projection.

places to panel cities within 15 km. A city’s first press is the first half-century bin with a surviving edition, assigned to the century that contains it. The match captures 97 percent of editions and 682 panel cities print by 1649.

Communes, universities, capitals, bishoprics, and archbishoprics are dated from the city file of [Bosker et al. \(2013\)](#), which records each status by century for 793 cities in Europe, the Middle East, and North Africa that reached 10,000 inhabitants in some century. We match 600 of its European cities to the panel by name and coordinates. The commune indicator records “the presence of a local urban participative organization that decides on local urban affairs” (pp. 1422–1423), and the capital, bishopric, and archbishopric indicators record the city’s place in the political and ecclesi-

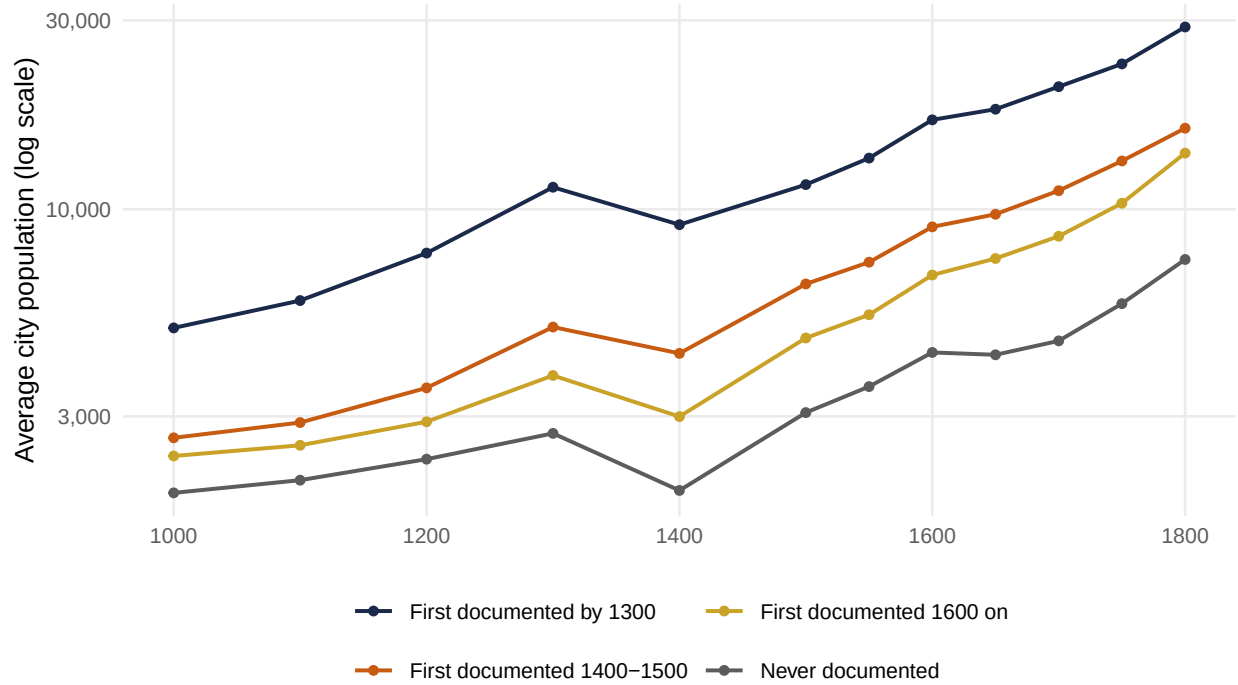


Figure 4: Average city population by century of first documented guild activity, 1000–1800 (log scale). Cities are grouped by the century in which guild activity first enters the record. Never-documented cities are in gray. Sources: [Buringh \(2021\)](#) and the guild panel described in the text.

astical hierarchy. For communes and universities the event is the first century in which the status is recorded. For seats, we reference the first century in which the status appears for a city that did not hold it in any century up to 1000, restricting our count to only newly created seats. Every city in this source became large, so the seat comparisons are among cities that all eventually reached 10,000 inhabitants.

Market rights and town charters are dated from the “Princes and Townspeople” collection of [Cantoni et al. \(2020\)](#), which codes, for the 2,390 cities of the *Deutsches Städtebuch*, the dates of first market establishment and town-charter bestowal. We match 244 of these cities to German and Austrian panel cities within 15 km. Towns whose market right or charter predates 1001 are excluded from that institution’s comparisons, as cities that already held a seat by 1000 are excluded from the seat comparisons, since neither can be an event city in the panel window and both are among the oldest towns. The same urban histories, in their *Die Wirtschaft* sections, are among our principal sources of guild documentation for Germany, so for these cities the guild record and the grant dates come from the same compilation.

3.4 Notable Births

Notable births come from the cross-verified database of [Laouenan et al. \(2022\)](#), which records birth years, birthplaces, and occupations for more than two million individuals. We take the 107,251 individuals born in Europe between 1000 and 1800 with birthplace coordinates and match each birthplace to the nearest panel city within 15 km, retaining 77,160 births. Counts of notable births per city and century measure a city’s prominence independently of any institutional record. The largest city-century counts behave as expected, with Paris and London dominating the eighteenth century and Florence ranking high in the fifteenth.

The matches of notable individuals appear in expected locations. Copernicus is matched to Toruń (born 1473), Dürer to Nuremberg (1471), and Adam Smith to Kirkcaldy (1723). Matched births rise from about four hundred in the century ending 1100 to about forty thousand in the century ending 1800, which likely reflects the density of the sources more than any change in the production of talent. Every comparison that uses this outcome is a ratio between groups of cities in the same century.

4 Measuring Selection Across Institutions

4.1 Comparison Design

We begin by comparing the population of event cities with that of every other city in the same comparison pool, whatever its size. For each institution and each cohort of cities that acquired it in century g , the comparison cities are those in the institution’s comparison pool that never acquired it. For guilds, the press, communes, and universities the comparison cities also have the event cities’ guild strength (Section 3.2). Seats and grants are compared across all levels of guild strength because the events are few. For guilds and the press, the pool is the full panel. For communes, universities, and seats the pool is the cities of [Bosker et al. \(2013\)](#). For market rights and charters the comparison pool is the German and Austrian cities matched to the *Städtebuch* data of [Cantoni et al. \(2020\)](#), with towns whose grant predates 1001 excluded.¹ Within each cohort we take the

¹Appendix D describes each comparison pool in detail, the exclusions, and the rules for comparison cities, and Table D1 gives the number of event and comparison cities for every institution.

mean population of event cities and of comparison cities in each century from four centuries before to four after g . We average across cohorts with weights equal to the number of event cities. The statistic we report is the ratio of those two means. It tells us whether the cities that acquired an institution were larger than other cities, and when.

Next we compare the notable births of event cities with those of cities of the same size. The comparison cities are those from the same pool whose log population one century before g lies within 1.0 log point of the event cities' mean. The statistic we report is, again, the ratio of the means of event cities to comparison cities. This tells us whether the cities that acquired an institution were more prominent than cities of their own size. Because we match on population at $g - 100$ years, the ratio in that century reflects their size up to the width of the band. The ratios in earlier centuries show how long that prominence had been in place. Both comparisons report 95 percent confidence intervals from a bootstrap that resamples event and comparison cities separately 500 times.

We report pooled statistics summarizing three sequential time windows. The early window is the fourth and third centuries before the event; the late window covers the second and first; and the after window spans the event century and three centuries that follow. The population panel begins in 900 and, as a result, the 1100 cohort contributes nothing to the early window, and the 1200 cohort only accommodates the third century prior. This means the early and late windows do not line up with the same cohorts.²

Three presentation choices are applied throughout. We use ratios rather than differences because the sources grow denser over time and a ratio between groups in the same century is unaffected by growth common across cities. We use levels rather than transformed counts because the level of a city's population or notable persons prominence is the very development-related fact we are concerned with at the start of a window and at its end. Finally, we use the same windows and the same aggregation for every institution so the reader can place each one along a single scale.

4.2 Institutions That Grew from Below

Figure 5 plots the population comparison century by century and Figure 6 the comparison of notable births among cities of the same size. Table 2 pools both into early, late, and after windows. Cities in which a craft guild is first documented were on average about twice the size of other cities of

²Appendix E reports the windows on the cohorts from 1300 onward, which all have complete time windows.

Table 2: Event cities relative to comparison cities before and after the first record, by institution

	Population, all comparison cities			Notable births, cities of the same size		
	Early	Late	After	Early	Late	After
<i>Grew from below</i>						
Guild documentation	1.96 [1.60, 2.38]	2.25 [1.95, 2.56]	2.71 [2.36, 3.08]	2.07 [1.51, 2.77]	2.55 [2.02, 3.19]	4.81 [3.92, 5.90]
First printing press	2.27 [2.00, 2.58]	2.49 [2.19, 2.82]	3.38 [2.73, 4.09]	2.67 [2.08, 3.36]	3.33 [2.75, 4.01]	6.97 [5.06, 9.26]
Commune	1.11 [0.62, 2.23]	1.53 [1.07, 2.29]	2.24 [1.82, 2.74]	3.51 [1.42, 8.14]	2.50 [1.66, 3.97]	4.75 [3.45, 6.53]
<i>Conferred from above: granted rights</i>						
Market right	1.12 [0.70, 1.88]	1.03 [0.71, 1.62]	1.13 [0.84, 1.57]	1.22 [0.34, 4.64]	0.83 [0.52, 1.40]	1.23 [0.84, 1.82]
Town charter	0.92 [0.63, 1.44]	1.06 [0.76, 1.54]	1.31 [0.97, 1.79]	1.06 [0.12, 5.26]	0.82 [0.49, 1.49]	1.02 [0.73, 1.44]
<i>Conferred from above: seats</i>						
Becomes a capital	1.57 [0.97, 2.61]	3.52 [2.19, 5.82]	5.72 [4.33, 7.76]	1.07 [0.00, 2.39]	2.00 [1.37, 2.81]	6.38 [4.71, 8.05]
New bishopric	2.56 [1.09, 5.32]	2.09 [1.36, 3.09]	1.72 [1.26, 2.33]	0.99 [0.48, 1.81]	1.94 [0.88, 3.29]	1.96 [0.84, 3.57]
New archbishopric	2.36 [1.50, 3.70]	3.50 [2.40, 5.21]	3.51 [2.39, 5.12]	1.32 [0.59, 2.34]	2.03 [1.34, 3.16]	1.56 [0.98, 2.24]
<i>Same-sample benchmarks</i>						
Guild, German and Austrian cities	1.55 [1.22, 2.00]	2.05 [1.62, 2.59]	2.25 [1.79, 2.83]	1.69 [0.79, 4.50]	1.72 [1.20, 2.62]	1.82 [1.32, 2.57]
Guild, cities in Bosker et al.	1.92 [1.50, 2.46]	2.19 [1.86, 2.59]	2.70 [2.30, 3.14]	2.06 [1.36, 3.06]	2.36 [1.73, 3.13]	5.44 [4.07, 7.06]
<i>Not classified</i>						
University	1.92 [1.34, 2.71]	2.48 [1.90, 3.14]	2.59 [1.91, 3.38]	1.91 [0.77, 3.64]	2.14 [1.33, 3.26]	2.30 [1.65, 3.18]

Each entry is the ratio of the mean for cities that acquired the institution to the mean for comparison cities, with a 95 percent bootstrap interval beneath it. Population compares event cities with every city in the comparison pool, with cities lacking an estimate counted as zero. Notable births compare event cities with cities whose population one century before the event lies within 1.0 log point of the event cities' mean. The early window is the fourth and third centuries before the event, the late window the second and first, and the after window the event century and the three that follow. Comparison pools, sources, and the century-by-century ratios are in Appendix E.

the same guild strength four centuries before the record. The ratio of mean population is 1.9 in the fourth century before documentation, 2.3 in the century before, and 2.7 over the four centuries after. Four centuries before their guilds appear, the average guild city held about 2,600 inhabitants and the average comparison city about 1,400.³ Four and three centuries before the press, press cities

³The sources also record guild cities more often. In the early window 83 percent of guild cities have a population estimate against 71 percent of comparison cities, while market and charter towns are recorded no more often than their comparisons. A city that is written down at all is already a selected city, and the guild record selects on that

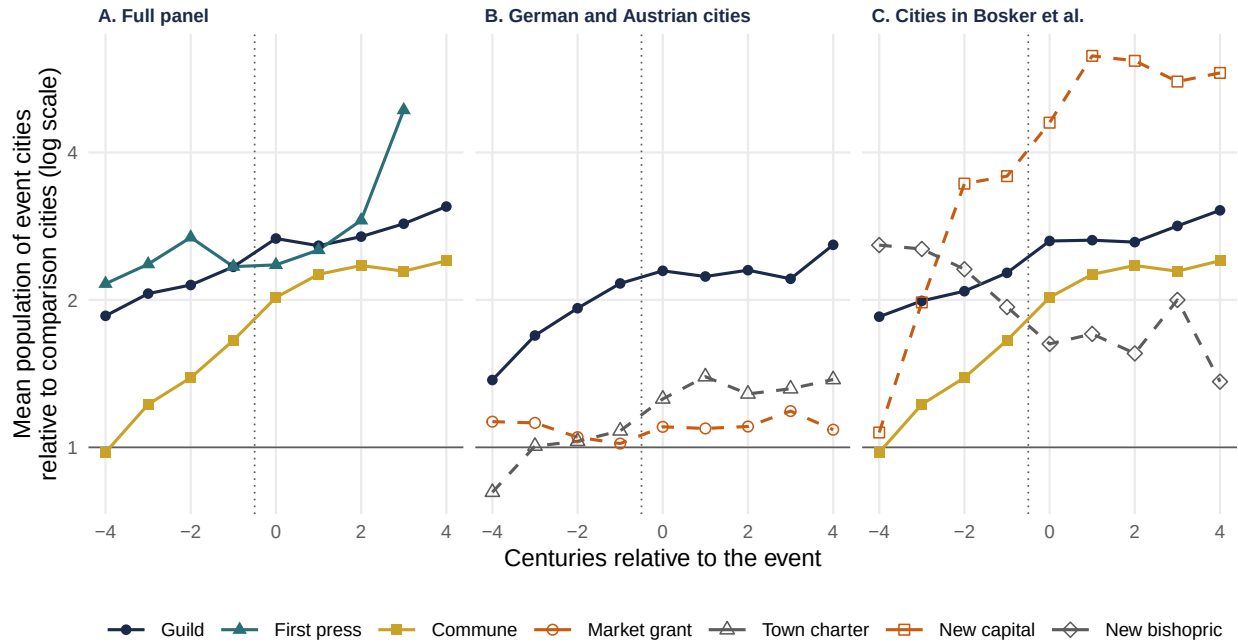


Figure 5: Population of event cities relative to comparison cities, by century from the event. The ratio of mean population, event cities to comparison cities, with cities lacking an estimate counted as zero. Panel A: the full panel, with communes on the cities of [Bosker et al. \(2013\)](#). Panel B: German and Austrian cities matched to the *Deutsches Städtebuch*. Panel C: the cities of [Bosker et al. \(2013\)](#). Solid lines are institutions that grew from below and dashed lines institutions conferred from above. Table 2 gives the pooled values with intervals, and Appendix E the century-by-century values.

were 2.3 times the size of cities that never printed and 2.5 times in the two centuries before.

Guild cities had twice the notable births of cities in their size band over the four centuries before documentation, 2.1 times in the early window and 2.6 in the late, and 4.8 times over the four centuries after.⁴ Cities with their first documented printing press had 2.7 times the births of cities in their size band in the early window and 3.3 in the late. For both institutions, the lead within the size band is present four centuries before the record and widens toward the first record date.

The commune is the institution that grew from below in which size and notable births given size come apart. In population, commune cities were the same size as other cities in the early window,

too. Counting unrecorded cities as zero, as the figure and table do, treats an unrecorded city as small, which lowers the comparison mean. Restricted to recorded cities only, the guild lead in the early window is 1.7 rather than 2.0. Appendix E reports that version for every institution.

⁴Matched cities are close in size but not equal. Appendix E.1 divides notable births by population within each group to separate the size difference that remains within the band from prominence given size. Per inhabitant the lead before documentation is 1.3–1.4 times for guild cities and 1.6–1.8 times for press cities.

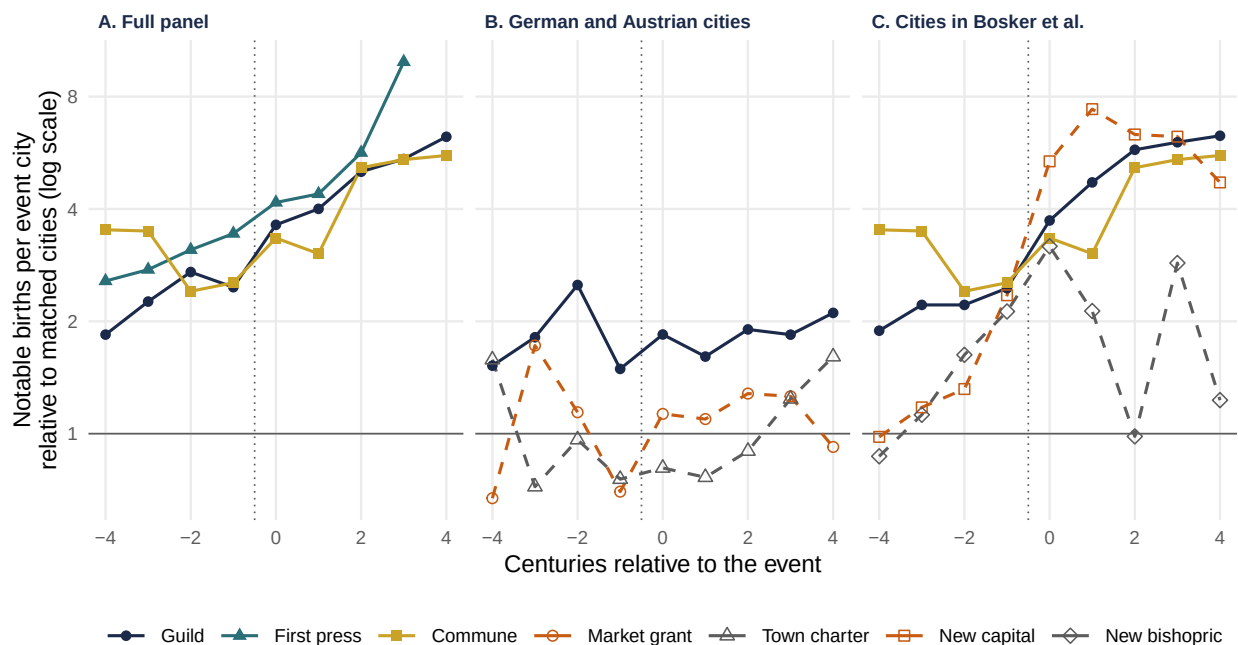


Figure 6: Notable births in event cities relative to matched cities, by century from the event. The ratio of births per event city to births per matched city, where matched cities lie within 1.0 log point of the event cities' mean population one century before the event. Panels and line styles as in Figure 5. The last three columns of Table 2 give the pooled values with intervals, and Appendix E the century-by-century and per-inhabitant values.

with a ratio of 1.1, and reached 1.5 times in the late window and 2.2 afterwards. The population lead shows up only two centuries before the recorded event. In notable births among cities in their size band, they were far ahead throughout, at 3.5 times in the early window and 2.5 in the late, and 3.1 and 1.6 per inhabitant, though the early intervals are wide. Commune cities were ordinary in size and unusually prominent. Two features of the commune data bear on their interpretation. The sample is the 600 panel cities that appear in Bosker et al. (2013), every one of which reached 10,000 inhabitants at some date, so the comparison is among cities that all became large. And the date of a commune is the first century in which that source records a participative government, which may be the date of a charter of liberties rather than of the sworn association that obtained it. Mokyr and Tabellini (2024, p. 373) note that Cambrai, for example, claimed its commune by revolt in the 1070s yet did not receive its charter until after 1122.

4.3 Granted Rights

Towns that received a market right or a charter were not ahead at any point. Market towns were 1.1 times the size of comparison towns in the early window, 1.0 in the late window, and 1.1 afterward. Charter towns were 0.9, 1.1, and 1.3 respectively. Every one of those intervals includes 1. They showed no lead in notable births either. In the late window market and charter towns both had 0.8 times the births of towns in their size band and, per inhabitant, both were about 0.6. Four of the six per-inhabitant confidence intervals include 1. Their ordinariness is what the model implies for a right that a ruler could grant to any town that asked.

The sharpest comparison is the one in which both guild documentation and granted rights come from the same records. For each German and Austrian town the *Deutsches Städtebuch* supplies both its economic history, from which much of our guild documentation for Germany is drawn, and the dates of its market rights and charter coded by [Cantoni et al. \(2020\)](#). Panel B of Figures 5 and 6 places the three institutions on the same towns.

Guild cities in this subsample were 1.5 times the size of other towns in the early window and 2.1 times in the late window. Market and charter towns were 1.1 and 0.9 times the size of theirs in the early window and 1.0 and 1.1 in the late window. During the late window, the guild and grant intervals overlap slightly at their edges. In notable births, guild cities had 1.7 times the births of towns in their size band in the late window. Market and charter towns both had 0.8. Per inhabitant the German guild lead was 1.0. German guild towns were simply large rather than markedly prominent for their size. For the same set of towns, using the same source, guilds enter the record from towns that were already large. Market rights and charters were bestowed on towns that were not.

4.4 Seats

Capitals and sees were conferred from above and, as the model predicts, went to large cities. A kingdom has one capital and a diocese has one see. An authority placing one chooses among the cities that could host it and takes the one it values most. Cities that became capitals were 1.6 times the size of other cities in the early window and 3.5 times in the late window. New bishoprics went to cities 2.6 times the size of other cities in the early window and 2.1 times in the late window. New

archbishoprics went to cities 2.4 and 3.5 times the size of other cities and held that lead afterward.

The two kinds of seats differ in when their leads arose. Cities that became capitals were ordinary in the fourth century before, with a population ratio of 1.1, and rose to 3.6 times the size of other cities in the century before. The court settled in a city that had just become the largest in its realm and the city then grew fastest of all, to 5.8 times the size of other cities in the fourth century after its capital designation. Cities that received a new bishopric had been large for the whole period, with a ratio of 2.6 in the fourth century before and 1.9 in the century before placement. Their relative size declined afterward, to 1.7 over the four centuries after. The Church erected new sees in old cities and the placement did not reverse their decline. Both seats are rare. In the usable cohorts, 28 cities became capitals and 76 received a new bishopric, against 649 cities with documented guilds in cohorts with a comparison pool.⁵

In notable births the early-window intervals for seats are too wide to be informative. In the late window, cities that became capitals, new bishoprics, or new archbishoprics each had about twice the notable births of cities in their size band.⁶

The university, which we report but do not classify because the motives behind its foundation were too mixed to sort, looks most like a seat. Universities went to cities 1.9 times the size of other cities in the early window and 2.5 times in the late. In the late window they had 2.1 times the notable births of cities in their size band.

4.5 All Nine Institutions on One Scale

Figure 7 places the nine institutions onto one scale. The horizontal axis is the share of cities in each comparison pool that ever acquire the institution, which is low for an institution that few cities could have and high for one that most cities eventually had. The vertical axis is the lead of the cities that acquired the institution over the average city in the pool in the late window, which is the statistic predicted by the model. The seats, which few cities received, sit at the left and above one. The university, which about one city in eight acquired, sits among the seats with a lead of

⁵The estimates for seats are imprecise and the capital's early-window interval includes 1.

⁶Per inhabitant the seats' leads roughly halve, to 1.1, 0.9, and 1.2, all with intervals that include 1 (Appendix E.1). Seats went to large cities and within their size band, those cities were no more prominent than their neighbors. Given that these locations are being chosen from the top-down, it is perhaps unsurprising that rulers are bad at picking where local innovation set to develop.

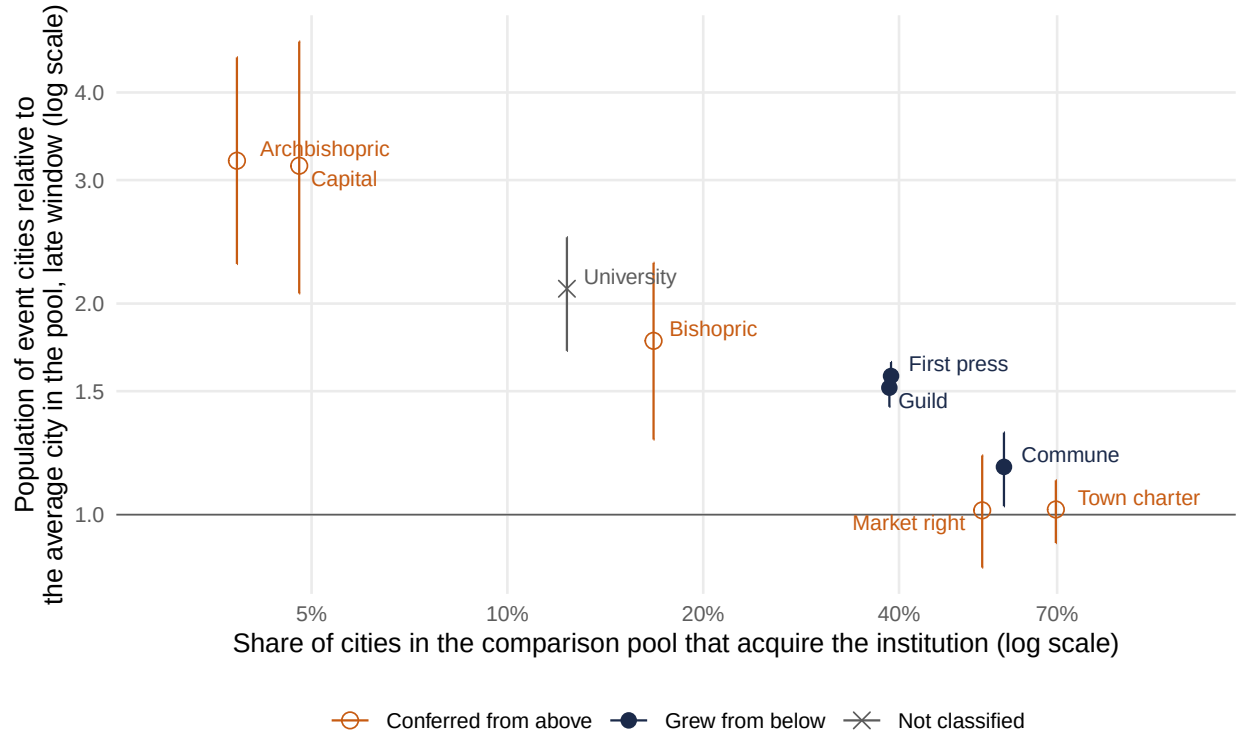


Figure 7: The lead of event cities before the event, against the share of cities in the comparison pool that ever acquire the institution. Vertical axis: the lead of event cities over the average city in the comparison pool in the late window (second and first centuries before the event), computed from the ratio of event to comparison means and the share of event cities as in Appendix A, with 95 percent intervals. Horizontal axis: event cities as a share of event and comparison cities, on a log scale. Filled markers are institutions that grew from below, open markers institutions conferred from above, and the cross the university.

2.1. The guild and the press, which about two in five cities acquired, sit in the middle. The market right and the charter, which most German towns eventually received, sit at the bottom right with an r of 1. The figure is an illustration of the model with nine points. The sharpest contrast in the illustration is the one the model derives between an institution with a threshold and one without. In Germany, guilds and charters were about equally common and guild cities were ahead while charter towns were not. Exclusivity does not separate them. Whether a town was large enough to clear the threshold does.

5 Craft Guilds and City Growth

Section 4 established which cities the guild record is drawn from and why. A city in which a guild is first documented had on average been about twice the size of other cities for four centuries and had twice the notable births of cities in its size band. The question of this section is what the cross-city record can say about guilds and growth once that is known. The empirical design compares each guild city with never-documented cities of the same size and guild strength, which removes the size gap that carries most of the lead and it shows the whole path in event time so that whatever trajectory remains is visible rather than assumed away.

5.1 The Matched Event Study

For each cohort of cities whose guild activity is first documented in century g , from 1100 to 1700, we construct a separate experiment. “Treated” cities are those first documented in g . Control cities have the same guild strength, never enter the guild record, and have a log population at the baseline century $g - 100$ within 1.0 log point of the treated group’s mean. Across seven cohorts, the design comprises 26 experiments, 617 treated cities, and 918 distinct control cities.⁷ Cities, again, are indexed by i , and event time in centuries by k . Stacking the experiments, indexed by s , we estimate

$$y_{ist} = \alpha_{is} + \gamma_{ts} + \sum_{\substack{k=-4 \\ k \neq -1}}^4 \beta_k \mathbf{1}[t - g_s = k] D_{is} + \varepsilon_{ist}, \quad (5)$$

where y_{ist} is log population, g_s is the documentation century of experiment s , and D_{is} indicates a treated city. The specification has experiment-specific city and century fixed effects, the baseline century as reference and standard errors clustered by city. The stacked construction avoids the negative-weighting problems of two-way fixed effects with staggered treatment (Goodman-Bacon, 2021), following Cengiz et al. (2019). Heterogeneity-robust estimators (Sun and Abraham, 2021; Callaway and Sant’Anna, 2021) deliver the same conclusions (Appendix F).

Figure 8 presents the estimates. Panel A contrasts the unconditional event-study path with

⁷The counts of guild cities differ by stage. The combined record documents guilds in 750 cities, 724 of which are in the analysis sample. Of those, 653 have at least one century after first documentation in the panel, 649 fall in cohorts with a comparison pool, and 617 have a population estimate one century before documentation and so enter the matched design.

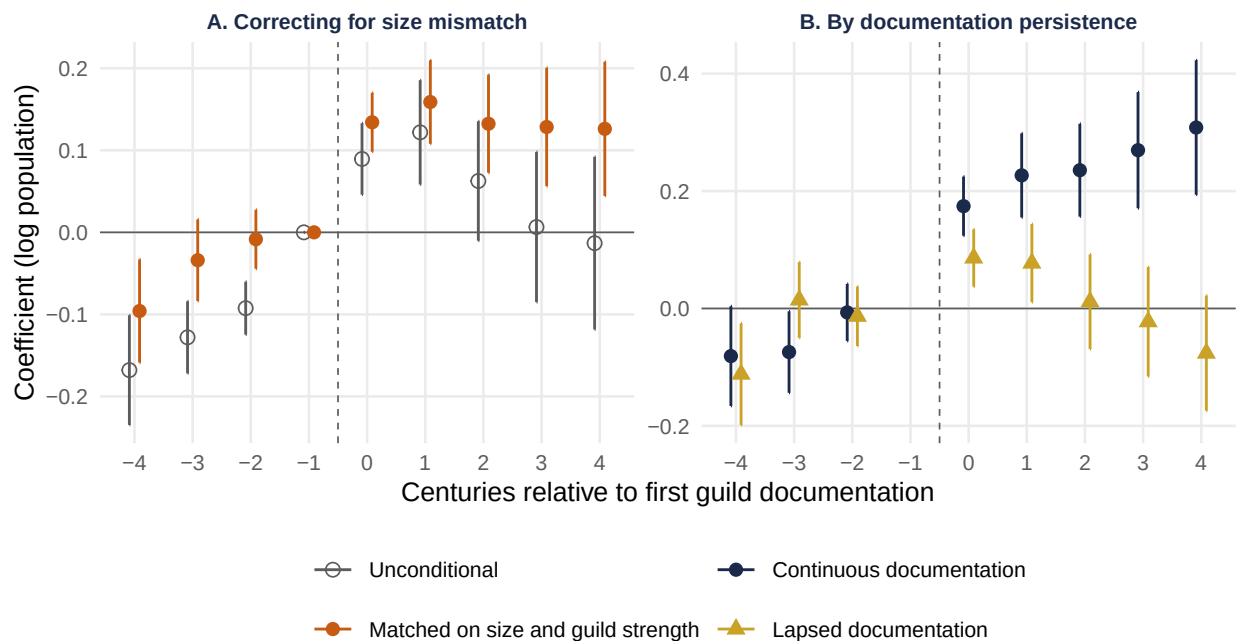


Figure 8: Guild-city size premium relative to comparable never-documented cities. Event time in centuries relative to first documented guild activity. Log population, 95 percent confidence intervals. Matched controls share the guild strength of the guild cities and their baseline (event time -1) log-population band. Panel A contrasts the unconditional path with the path matched on size and guild strength. Panel B splits the matched treated cities by whether guild documentation persists in at least half of the observed post-event centuries.

the matched path. Unconditionally, guild cities boom before first documentation, peak, and then decline steadily relative to never-documented cities in log population. Taken at face value, that path supports the view that guilds retarded urban growth. The matched path shows that the decline is mean reversion. Once guild cities are compared with like-sized cities of the same guild strength, pre-trends are flat in the three centuries before documentation, with a small negative deviation in the fourth. The premium is about 14 percent at documentation. It holds over the following four centuries because the matched control cities revert toward the mean at the same rate as the treated cities. Matching removes the size gap that made the treated cities appear to revert faster and leaves the tendency to revert in place on both sides. The unconditional decline is in log population among recorded cities relative to never-documented cities. The ratio of mean population in Section 4 rises after documentation because it compares guild cities with all other cities and is carried by the largest guild cities.

The premium holds across the variants of the design summarized in Appendix Figure F1. It

risers under tighter matching, from 0.14 log points in the main design to about 0.17 with a 0.5-log caliper and between 0.16 and 0.19 under nearest-neighbor matching. If the premium were residual mean reversion left over from loose matching, tighter matching would shrink it. It is essentially unchanged when not-yet-documented cities are added to the control pool. A joint test of the pre-period coefficients rejects at the 5 percent level ($p = 0.012$), driven entirely by the small deviation four centuries before documentation, and relative-magnitudes bounds (Rambachan and Roth, 2023) show that the on-impact premium survives violations of parallel trends as large as that deviation. Appendix F reports these results.

Panel B splits the matched treated cities by whether guild documentation persists. Of the 653 documented cities with at least one post-event century, counted before the matching step, 357 have guild activity in at least half of their observed post-event centuries and 296 do not. Where documentation is sustained the premium rises to about 0.31 log points by four centuries out. Where it lapses the premium reverts to the comparable-city baseline. Because this split conditions on post-event documentation, we treat this as descriptive. Cities whose documentation lapsed crossed the archival threshold once, yet they retain no persistent premium. The premium tracks sustained documentation and a single appearance in the record does not carry it.

Notable births show the same break. In a count model with city and century effects, births in guild cities are flat relative to matched cities in the two centuries before documentation and about 45 percent higher in the documentation century, and the gap widens afterward (Table F1).

Market access does not explain the premium. Matching controls additionally on their baseline access to the trade network, measured as population-weighted market potential over a historical transport-cost surface, leaves the results unchanged (Appendix G).

The within-city regressions of Appendix H arrive at the same answer as our event studies. A two-way fixed-effects regression of log population on guild presence with a lagged dependent variable implies a long-run association of about 14 percent. What matching adds is a clearly defined control group, a visible pre-period, and freedom from the negative weighting that staggered two-way fixed effects can generate (Goodman-Bacon, 2021). The estimate that differs radically is the cross-city one. Growth-on-levels regressions in the convergence framework of Duranton and Puga (2014, p. 7), which identify from differences across cities within countries, imply a steady-state premium near 100 percent for a full century of guild presence (Appendix H.4). The same regres-

sions run backward show the selection directly. Initial city size predicts the subsequent duration of documented guild activity and a doubling of initial size predicts about four additional years of documented guild activity over the following century (Appendix [H.3](#)).

5.2 What the Record Can and Cannot Say

The cross-city record does not support the claim that guilds retarded urban growth. The one pattern that favored it, the unconditional decline of guild cities after their guilds appear, is mean reversion shared by never-documented cities of the same size and no matched comparison across matching rules, calipers, control groups, and estimators produces evidence of relative decline. Guild cities grew at least as fast as their peers for four centuries after their guilds entered the record and they became more prominent faster.

Whether guilds caused that growth is a question the record cannot definitively settle. The century is the resolution of the data and a city can take off for reasons unrelated to guilds and enter the guild record in the same century. The reverse-causality result shows that size predicts documentation, so part of what happens in the documentation century is the record catching up with the city's size. We therefore report the premium as an association and attach no causal interpretation to it. The heterogeneity of the premium across Ogilvie's levels of guild strength, reported in Appendix [I](#), is consistent with a restriction channel at the margin, since the premium is smallest where guilds were strongest, a country-level classification that we present only as a descriptive gradient.

The view that our evidence does support is that guild formation accompanied commercial vitality rather than suppressing it. That is consistent with the efficiency tradition ([Epstein, 2005](#); [de la Croix et al., 2018](#)) and with the corporations literature ([Mokyr and Tabellini, 2024](#); [Greif et al., 2025](#)). Ogilvie's documentation that guilds extracted rents and restricted entry ([Ogilvie, 2019](#)) describes what guilds did inside cities that were already leading. The two literatures have interpreted the same record as if it measured the institution. What it does measure is the city's relative trajectory at the moment of record selection.

6 Reading Institutional Records

The results we have developed bear on any research design that dates a treatment by an institution's first appearance in the record. Three implications follow.

The first implication identifies which designs raise the most concerns. For institutions that grew from below and for seats conferred from above, the first record is drawn from cities that were already ahead. A difference-in-differences design with city fixed effects removes the part of that lead that is constant. It does not remove the part that was still growing when the record begins and for guilds and capitals, that lead was growing. Matching on size at the date of record removes the level difference and leaves the trajectory. The gap between the cross-city and within-city estimates, or the matched estimates in the guild case, is the level selection. According to our estimates, this gap was about 85 percent of the implied guild premium over never-documented cities. Granted rights, by contrast, select no particular kind of town and a design built on market rights or charters starts from treated and control towns that were alike. In other words, granted rights like charters and market rights had common support in size for both treated and control towns.

The second implication is about direction. The selection we measure is positive for guilds, presses, prominent communes, and every seat. A naive estimate of the effect of such an institution on later growth is biased upward. The bias is larger the higher the institution's threshold and the fewer places it could occupy. Studies of the printing press, of communes, of universities, and of self-governing cities compare places that led with places that did not, and the lead is not small. Studies of granted rights compare like with like. The exclusivity figure of Section 4 is a rough guide to where any given institution falls.

The third implication is about the record itself. A first record is a document that survived to today, and documents survive in cities that keep them. Guild cities were recorded in the population sources more often than other cities, 83 percent against 71 percent in the early window. Market and charter towns, by contrast, were recorded no more often than their neighbors. Surviving documentation selects on the same thing that a forming institution selects. The two sources of selection reinforce each other for formed organizations and both are absent for granted rights, which is one reason the contrast between them is so sharp.

Granted rights are observed for German and Austrian cities only, because our dates for them

come from the coding of the *Deutsches Städtebuch* by [Cantoni et al. \(2020\)](#), which covers the 2,390 towns the *Städtebuch* lists. We exercise caution for that part of the evidence because it is from a single region with a small number of comparison towns and derived from the same documentary source. This is our sharpest finding but also the narrowest. Size and prominence given size do not always agree. Commune cities were relatively ordinary in size and prominent. Cities that received new sees were large and no more prominent than cities their size. We report both measures rather than choose between them.

Within those limitations, the institutional selection we define and observe is general. Across nine institutions, the first record of an institution tells a reader about the city in proportion to how hard the institution was to have, and institutions that grew from below were among the hardest.

7 Conclusion

When an institution first appears in the historical record, the record tells us something about the city before it tells us anything about the institution. In a panel of 1,754 European cities over eight centuries, cities in which a craft guild was first documented had on average been twice the size of other cities for four hundred years and had twice the notable births of cities in their size band. Cities with a first printing press were ahead by somewhat more. Towns that received a market right or a charter were ordinary towns. Capitals and sees went to large cities. Capitals went to cities that had just risen and sees to cities that had long been large. A two-parameter model orders these cases by how high a threshold a city had to clear and how few places the institution could occupy. The data observed in our panel follow that order.

Measured selection also changes what the evidence can say about the guild debate. Most of the cross-city association between guild presence and city size is the lead guild cities already held. What remains is a premium of about 14 percent that holds for four centuries with population pre-trends flat in the three centuries before documentation. In our unconditional event study there is a decline in guild-city size after documentation that turns out to be mean reversion, which never-documented cities of the same size share. The cross-city record gives no support to the claim that guilds slowed urban growth. It does not show that guilds caused the growth that followed either, because at century resolution a city can take off and acquire documented guilds in the same hundred

years.

The two dials developed in our model apply wherever institutions are adopted by the places that hold them. Occupational licensing is the modern counterpart of the guild ([Kleiner and Soltas, 2023](#)) and the enterprise zone and the special economic zone are contemporary counterparts of the town charter ([Neumark and Simpson, 2015](#)). Record survival is less of a concern for twenty-first-century institutions, whose documentation is more complete. In developing countries it could still be first order. An evaluation that compares places with an institution to places without it faces the selection measured here. Its size can be anticipated from who creates the institution and how many places can have it. The lead is highest for institutions that communities form for themselves. The record of such institutions in the places that formed them overstates what conferring the same legal form on other places would deliver. That is the gap between an institution's form and its function that [Andrews et al. \(2017, ch. 2\)](#) describe in modern state-building.

The open question is one the evidence raises and cannot settle. Europe's bottom-up institutions were formed in cities that were already leading. Whether they later sustained that lead, as the corporations literature holds ([Greif et al., 2025](#)), is a question about what happened after the record begins. Such a systematic assessment needs a design that can order events within the century. The assembled panel, linking documented guild activity to population, notable people, and the dates of eight other institutions for every European city of consequence, is offered here as a place to start.

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Appendices

A The Model: Derivations and Simulation

This appendix derives Eq. (3), relates the lead over the average town to the lead over non-event towns that the tables report, and gives the simulation behind Figure 1.

A.1 The Lead over the Average Town

At the decision date t , with $\log S \sim N(\mu_t, \sigma^2)$, $\mathbb{E}[S] = e^{\mu_t + \sigma^2/2}$ and, for a threshold q on $\log S$,

$$\mathbb{E}[S \mathbf{1}\{\log S \geq q\}] = e^{\mu_t + \sigma^2/2} \left[1 - \Phi\left(\frac{q - \mu_t - \sigma^2}{\sigma}\right) \right], \quad (\text{A.1})$$

so that $\mathbb{E}[S \mid \log S \geq q] = e^{\mu_t + \sigma^2/2} [1 - \Phi((q - \mu_t - \sigma^2)/\sigma)] / [1 - \Phi((q - \mu_t)/\sigma)]$ and dividing by $\mathbb{E}[S]$ gives Eq. (3). As $q \rightarrow -\infty$ the ratio of the two normal tails tends to one, and as $q \rightarrow \infty$ it grows without bound, since the ratio behaves as $e^{\sigma z - \sigma^2/2}$ for $z = (q - \mu_t)/\sigma$. When a capacity K binds, the acquiring towns are those above the $(1 - K/M)$ quantile, and the same expression applies with q at that quantile.

A.2 The Lead over Non-Event Towns

The tables report $\mathbb{E}[S \mid \text{acquired}] / \mathbb{E}[S \mid \text{not}]$ rather than r . With a share p of towns acquiring the institution, $\mathbb{E}[S] = p \mathbb{E}[S \mid \text{acquired}] + (1 - p) \mathbb{E}[S \mid \text{not}]$, so

$$\frac{\mathbb{E}[S \mid \text{acquired}]}{\mathbb{E}[S \mid \text{not}]} = \frac{(1 - p) r}{1 - p r}, \quad (\text{A.2})$$

which rises in r for given p . It is not monotone in the threshold alone. A very low threshold leaves only the smallest towns as comparisons and a very high one selects only the largest, so the ratio to the rest is high at both ends. The monotone statement of Prediction 1 is about r , and Figure 7 plots r , computed from the reported ratio and p by inverting Eq. (A.2).

A.3 Persistence

Under Eq. (4) the deviation $\log S_{it} - \mu_t$ is stationary and Gaussian and so time-reversible, which is why the conditional expectation of a selected town's deviation decays at rate ρ backward as well as forward from t_0 . The lead itself is a ratio of means of S rather than of $\log S$, and for a truncated-lognormal selected group it equals $\exp(\rho^h \Delta\mu - \frac{1}{2}\rho^{2h}(\sigma^2 - \text{Var}_{\text{sel}}))$ at horizon h from the decision, where $\Delta\mu$ is the selected group's mean deviation in logs and Var_{sel} its variance. The text's statement that the lead measured h centuries before the record is governed by $\rho^{h-\tau}$ is therefore approximate.

A.4 Simulation

Figure 1 uses $\rho = 0.85$ and $s = 0.6$, so that $\sigma \approx 1.14$, with 20,000 towns and twelve centuries. The institution is decided in the eighth century. The formed organization is decided where $\log S$ exceeds its 60th percentile at t_0 and recorded at $t_0 + 1$. The seat is placed in the top 5 percent at t_0 and recorded at t_0 . The grant goes to a random half of towns. Panel C plots the ratio of mean scale in event towns to that in all towns from four centuries before the record to the record. The formed organization's lead is about 1.7 four centuries before the record and 1.9 at it, having peaked at 2.0 one century before. The seat's lead rises from 2.9 to 6.2 at placement. The grant's lead is one throughout. The simulation uses a slightly faster reversion than the estimate, a half-life of about four centuries, and the heights of the two paths reflect the chosen selection rules as much as the lag. The values depend on the parameters. The script `fig_model.R` regenerates the figure for others.

B Data Construction and Sources

Our panel of European craft guild activity extends Sheilagh Ogilvie's project of assembling documentation that has largely been the product of "detailed micro-histories of specific guilds and histories" (Ogilvie, 2019, p. 25). The panel detailed here was constructed to answer a different question, the cross-city relationship between documented guild presence and urban population over time. A wider representation of European cities in the form of an unbalanced panel is more amenable to econometric testing.

B.1 European Guilds Databases

Sheilagh Ogilvie has assembled the most expansive set of documentation on European craft guilds in her *Qualitative Guilds* and *Quantitative Guilds* databases, referenced in her book *The European Guilds: An Economic Analysis* (“*Guilds*”) (Ogilvie, 2019). These databases served as the baseline for constructing the panel of guild presence for 750 cities, including some without Buringh population estimates. The two databases record detailed measures and qualitative descriptions of guild activities by city, time period, and occupation. Records that mentioned guild activities for the same city, time period, and occupation were dropped as duplicates.

The combined *Guilds* databases were then collapsed into city-year observations and supplemented with additional historical sources for cities mentioned in neither database. Ogilvie’s records make up less than 60 percent of all cities with recorded guild activity (Table B1) and a little more than half of the city-century observations with recorded guild activity (Table B5) across the entire panel.

B.2 Additional Sources of Craft Guild Activity

The goal of the data collection process was to construct a panel of guild activity across European towns and cities from 1000 to 1800. The bar for inclusion was deliberately low. A source had to establish where and for how long a craft guild was active. The reliability ratings described below and the resampling exercise of the Robustness Checks subsection guard against the false attributions this invites. Ogilvie’s research questions directed her to collect quantifiable measures and qualitative descriptions of guild activities (Ogilvie, 2019). Our question was whether any guild was present and active in an urban economy during a particular period. Additional documentation came from secondary sources including academic journals in urban history, medieval archaeology, and industrial history and from primary sources of city government records.

We assigned each additional source a subjective rating for the quality, reliability, and quantity of its documentation. Table B1 summarizes the number of cities with documented guild activity by region and rating. Cities with guild activity documented by Ogilvie are summarized separately from cities documented only by the additional sources (labeled as having a “High”, “Medium”, or “Low” rating).

Table B1: Number of Cities with Guilds by Region & Rating

Region	Ogilvie	Medium & Low	High	Total
Austria	5	5	4	14
British Isles	47	19	18	84
France	77	89	32	198
Germany	107	19	67	193
Iberia	52	3	17	72
Italy	40	14	2	56
N. Netherlands	33	0	0	33
S. Netherlands	27	7	5	39
Switzerland	7	2	1	10
Other*	37	2	12	51
Total	432	160	158	750

* Scandinavia, the Baltics, the Czech Republic, and Poland.

The additional documentation substantially increased the coverage of cities on the continent, particularly in France and Germany. Table B2 shows the regional shares of cities in the expanded panel compared to the sources referenced by Ogilvie. Representation by unique city count is similar to Ogilvie's databases for most regions and the combined panel raises the representation of French towns. The examples below group the documentation for small and medium-sized cities by reliability rating and assess each in turn.

Table B2: Share of Cities with Guilds by Region & Rating

Region	Ogilvie	Medium & Low	High	Total
Austria	1%	3%	3%	2%
British Isles	11%	12%	11%	11%
France	18%	56%	20%	26%
Germany	25%	12%	42%	26%
Iberia	12%	2%	11%	10%
Italy	9%	9%	1%	7%
N. Netherlands	8%	0%	0%	4%
S. Netherlands	6%	4%	3%	5%
Switzerland	2%	1%	1%	1%
Other*	9%	1%	8%	7%

* Scandinavia, the Baltics, the Czech Republic, and Poland.

B.2.1 Examples of Additional Historical Source Assessments

Clear documentation that gave dates, places, and mentions of guild activity was rated “High” in reliability. Documentation from multiple sources and citations also improved an observation’s rating. Ratings of “Medium” or “Low” indicated sources lacking one or more of those criteria, whether specific dates, a link to a city center, or the explicit keyword “guild” (across languages and alternative spellings). Representative examples for each rating follow. Facsimiles of the source documents are collected in an online appendix available from the authors.

High-reliability examples include *The English Craft Gilds*, which documented craft guilds operating in medium-sized and smaller cities across England, such as the sanctioned joiners, coopers, blacksmiths, and wiremakers of Scarborough (Kramer, 1927, pp. 13–16), and records of guild meetings and proceedings such as those for Berwick, which identify when and where meetings were held and who was involved, including merchants (“Feryngmen”) and other craft guilds (Scott, 1888). Urban histories from the *Deutsches Städtebuch* provided the most consistently documented references to guild activity for cities across Germany (Keyser and Stoob, 1939). Each city has a separate economic history recounted in its *Die Wirtschaft* section, in which keywords related to guilds (*Zünfte*, *Zunftordnungen*) or craft workers (*Handwerker*) helped identify when and where craft guilds were operating, as in the entries for Ingolstadt and Kaiserslautern.

Medium-reliability examples include references to guild activities in smaller towns like Veurne, Belgium, where tailors’ and second-hand-dealers’ guilds were characterized as an “exception” compared to larger cities in Brabant and Flanders (Deceulaer, 2008, p. 22) and where entrance fees for commercial guilds in the eighteenth century are documented (Deceulaer and Jacobs, 1998, Table 1). Documentation found in multiple sources, as for Veurne, raised the reliability rating from “Low” to “Medium”. References to guild activities in footnotes, as for the smaller city of Coutances, France, or under alternative spellings like “Coutance”, were also rated “Medium” (Coffin, 1994, p. 778).

Low-reliability examples are secondary sources that mention “craftsmen” or occupations adjacent to guilds without the keyword “guild”. Documentation for Dole, France, mentions “craftsmen”, specific occupations often identified with a guild (e.g., “butcher”), and urban elites involved in guild-like activities (e.g., “social arbiters”), but none of it mentions the keyword “guild” (or French equivalents like “*la gilde*” or “*la confrérie*”) for that town (Edwards, 2002, pp. 310–

346). Other secondary sources reference regional rural guilds like “*La Mesta*”, a pastoral guild that regulated transhumant sheep across Castile and León and whose itinerant royal magistrates (“*entregadores*”) were contested by cities like Badajoz (Klein, 1964, pp. 86, 106–107), or mention guilds within the city only in a non-productive capacity, such as sponsoring and commissioning religious plays (Andrews, 2020, pp. 21–23). These general references were rated “Low”.

B.3 Panel Construction

Historical documentation on the length of time a guild was active in each city varied in form. Some references mentioned a guild being active for one year only. Others gave ranges of years. The assembled documentation of guild presence was first split out into single-year observations.⁸ References to guild activity across a range of years were split into separate observations for each year in the range. Many cities had different guilds and occupations with overlapping periods of activity and the same assembly process was followed for each. Overlapping periods across different guilds and occupations did not alter the time-extensive measure of guild presence, which identifies periods when any guild was active and not how many.

The single-year observations were then aggregated by city and half-century. If guild activity in City A was documented for one year only during a half-century, say 1582, the aggregated observation received a 1 for the variable “years present” in the half-century ending 1600. City B with documented guild activity over 1551–1600 had a “years present” measure of 50 for the half-century period ending 1600. The count of single-year observations for any type of craft guild activity was aggregated for each city and half-century period.

The guild-presence dataset, aggregated by city and half-century, was then merged with the Buringh dataset of population estimates for European cities for 1000–1800 (Buringh, 2021).⁹ European urban populations in Buringh are available at a 50-year frequency for the half-century periods ending 1550–1800. A subpanel of half-century population estimates and guild-presence indicators is

⁸These data-intensive manipulation tasks were executed in the statistical software SAS and those programs and logs are available on request. Everything downstream of the assembled panel, including every figure and table in this paper, is produced in R (Appendix B.7).

⁹SAS workpapers and logs document each of these merge steps. Six cities in the Buringh file carry a neighboring city’s coordinates, which makes a nearest-city match exactly tied for them. The most consequential is Frankenthal, which carries Frankfurt am Main’s coordinates. We correct all six against standard gazetteer values. The corrections are listed with their sources in a tracked file and applied when the panel is loaded, so the source file itself is left unaltered.

therefore available only for 1500–1800. For a consistent interpretation of centennial population growth the statistical analysis uses only centennially aggregated measures of guild presence and their end-of-century population estimates. The guild-presence measure used in the regressions of Appendix H is the share of the preceding century t with recorded guild activity in city i , that is $G_{it} = \text{Years Present}_{it}/100$. Table B6 lists the variables in the assembled panel.

Table B3 reports how the documented cities are distributed across centuries of first documentation and how many of each cohort enter the matched event study of Section 5.1. Cities drop out of the design when they lack a baseline population observation or when too few never-documented cities of the same guild strength fall inside the matching band, and the 1000 and 1800 cohorts have no usable event window at all.

Table B3: Cities by Century of First Documented Guild Activity

Century of first documentation	Cities	In the matched design
1000	4	—
1100	8	5
1200	61	56
1300	139	129
1400	158	152
1500	108	108
1600	84	79
1700	91	88
1800	71	—
Documented, any century	724	617
Never documented	1,030	—

The first column counts every city whose guild activity is first documented in that century. The second counts those entering the stacked event study of Section 5.1, which requires a baseline population observation in the preceding century and at least two never-documented cities of the same guild strength within the 1.0-log band. The 1000 and 1800 cohorts have no usable window and are excluded by construction, marked “—”.

B.4 Robustness Checks

The panel includes observations from every reliability rating. To account for Type I errors in the additional historical sources we ran a resampling exercise. Each of 100 draws sets the guild-presence measure to zero for a random 50 percent of the observations rated “Medium” and 75 percent of those rated “Low”, treats documentation referenced by Ogilvie or rated “High” as free of Type I

error, rebuilds every city’s first-documentation century, and recomputes the guild lead in population and notable births of Section 4 and the matched premium of Section 5. In a typical draw about 59 of the 724 documented cities become never documented and about 33 move to a later cohort.

Table B4 reports the results. Every quantity changes by a few percent at most. The leads in population and in notable births and the matched premium are slightly larger under resampling than in the full record, since the documentation that drops out belongs mostly to small towns, as the next paragraph shows. The matched premium averages 0.148 log points across draws against 0.136 in the full record, and the pre-event mean stays near zero.

Table B4: Main results under source-reliability resampling

	Full record	Resampling mean	2.5th–97.5th percentile
Population, early window	1.963	1.989	[1.941, 2.027]
Population, late window	2.251	2.311	[2.267, 2.344]
Population, after	2.715	2.796	[2.756, 2.847]
Notable births, early window	2.073	2.169	[2.036, 2.340]
Notable births, late window	2.546	2.586	[2.502, 2.693]
Notable births, after	4.814	4.833	[4.735, 4.934]
Notable births per inhabitant, early	1.276	1.351	[1.259, 1.469]
Notable births per inhabitant, late	1.354	1.391	[1.346, 1.441]
Matched premium, event times 0 to 4	0.136	0.148	[0.135, 0.158]
Matched pre-event mean, –4 to –2	–0.046	–0.039	[–0.049, –0.030]

Each of 100 draws sets the guild-presence measure to zero for a random half of the observations whose source is rated Medium and three quarters of those rated Low, rebuilds each city’s first-documentation century, and recomputes the quantity. A city whose only documentation is dropped becomes never documented and a city whose early documentation is dropped moves to a later cohort; on average 59 of the 724 documented cities become never documented and 33 change cohort per draw. Population and notable-birth rows are ratios as in Table 2; the matched rows are mean event-study coefficients in log points as in Section 5.1. Seed 20260903.

The additional sources with lower reliability ratings are concentrated in cities and periods with lower population levels, as Table B5 shows. That pattern is consistent with the survivorship bias of historical records, which are more plentiful for larger cities than for smaller ones.

Table B5 compares urban population, city count, and average guild presence for the cities documented by Ogilvie and for the additional cities grouped by reliability rating. The average population of cities with guild activity documented by Ogilvie is consistently larger than that of cities documented only by outside sources, and among the latter it is higher for “High” ratings than for “Medium” or “Low” before 1600. The average length of guild presence by century follows a differ-

ent pattern. The additional sources record longer periods of guild presence than Ogilvie's sources.

Table B5: Panel Summary by Century & Rating

Century	Ogilvie				Medium & Low				High			
	Pop.	Cities	Avg. pop.	Presence	Pop.	Cities	Avg. pop.	Presence	Pop.	Cities	Avg. pop.	Presence
1000	35	3	11.67	1	—	—	—	—	3	1	3.00	1
1100	20	5	4.00	1	3	2	1.50	1	28	5	5.60	60
1200	335	32	10.47	22	48	23	2.09	24	78	17	4.59	41
1300	1,942	96	20.23	29	155	53	2.92	61	255	57	4.47	47
1400	1,788	127	14.08	45	205	88	2.33	51	303	102	2.97	71
1500	2,554	154	16.58	42	248	72	3.44	68	465	119	3.91	82
1600	4,025	177	22.74	40	226	49	4.61	80	477	108	4.42	86
1700	5,604	210	26.69	39	182	36	5.06	69	354	80	4.42	78
1800	8,140	233	34.94	36	461	33	13.97	57	552	50	11.04	66

Pop. is the total population of the guild cities in the group, in thousands, and Avg. pop. is its mean. Cities is the number of guild cities, and — marks a group with none. Presence is the average number of years in the century with recorded guild activity. After 1500 the source is half-centennial, and a century's presence sums its two half-centuries, as in the analysis panel.

Table B6: Panel Data Dictionary

Variable	Description	Source
country_ehw	Normalized uniform modern-day country description across historical datasets	Buringh
city	City	Ogilvie & Wilhelm
city_buringh	City name reported in Buringh	Buringh
synonyms historical names	Other historical names	Buringh
country_buringh	Country name	Buringh
latitude_in_degrees	Latitude reported in degrees with commas	Buringh
longitude_in_degrees	Longitude reported in degrees with commas	Buringh
year	Century for periods (ending in year) up until 1500. Half-century for periods (ending in year) beginning in 1550.	Buringh
inhabitants_in_000s	Population in 1000s	Buringh
source	Primary and secondary source referencing guild	Ogilvie & Wilhelm
nature_of_estimate	How population estimate was derived	Buringh
Match_rating	Subjective assessment and confidence of quality and quantity of sources related to guild presence	Wilhelm
guild	At least one guild present in period ending in year	Wilhelm
years_present	Number of years of recorded guild activity during year period	Wilhelm
years_present_cr, _vi, _ma	Years of recorded activity for craft, victualer, and manufacturer guilds separately	Wilhelm
craft, victualer, manufacturer, merchant, service	Indicators for the occupational category of the documented guild	Wilhelm

B.5 Panel Summary by Century

Table B7: Population Summary by Century

Century	All cities			Cities with guild			Cities with no guild			Relative pop. factor
	Cities	Pop.	Avg. pop.	Cities	Pop.	Avg. pop.	Cities	Pop.	Avg. pop.	
1000	1,119	2,916	2.61	4	38	9.50	1,115	2,878	2.58	3.68
1100	1,308	3,735	2.86	12	51	4.25	1,296	3,684	2.84	1.50
1200	1,534	5,159	3.36	72	461	6.40	1,462	4,698	3.21	1.99
1300	1,636	7,182	4.39	206	2,352	11.42	1,430	4,830	3.38	3.38
1400	1,661	5,667	3.41	317	2,296	7.24	1,344	3,371	2.51	2.88
1500	1,690	8,336	4.93	345	3,267	9.47	1,345	5,069	3.77	2.51
1600	1,723	12,061	7.00	334	4,728	14.16	1,389	7,333	5.28	2.68
1700	1,754	14,278	8.14	326	6,140	18.83	1,428	8,138	5.70	3.30
1800	1,768	21,716	12.28	316	9,153	28.97	1,452	12,563	8.65	3.35

Population in thousands. City counts are the number of cities with nonzero population estimates in that century. Average population divides total population by that same city count. The relative population factor is the average population of cities with a guild divided by that of cities with no guild.

Table B8: Guild Presence Shares by Century

Century	Cities	Cities with guild	Cities with no guild	Avg. guild presence	
				All cities	Cities with guild
1000	1,119	4	1,115	0.00	0.01
1100	1,308	12	1,296	0.00	0.26
1200	1,534	72	1,462	0.01	0.27
1300	1,636	206	1,430	0.05	0.42
1400	1,661	317	1,344	0.10	0.55
1500	1,690	345	1,345	0.12	0.61
1600	1,723	334	1,389	0.11	0.61
1700	1,754	326	1,428	0.09	0.52
1800	1,768	316	1,452	0.08	0.43

B.6 Guild Strength and the Notables Match

The matched design of Section 5.1 and the heterogeneity analysis of Appendix I partition the panel by guild strength following the country-level classification of Ogilvie (2019, ch. 9). Figure B1 maps it. Guilds were relatively weak in the British Isles and the Low Countries and intermediate in France, Italy, Switzerland, and Luxembourg.¹⁰ They were strong in Austria, Germany, Spain, and Portugal. Scandinavia, the Baltics, the Czech Republic, and Poland form a residual class. Cities of the same guild strength therefore need not be near one another. Because the classification is country-level, the map fills modern country polygons and the matching step uses no geography finer than this partition.

Figure B2 plots the 77,160 notable births matched to a panel city within 15 km (Section 3.4), binned to the panel century in which each birth falls. The steep rise toward 1800 reflects the compilation gradient of the underlying biographical data as much as any change in upper-tail human capital, which is why the comparisons take ratios between groups of cities within the same century and Appendix F reports a count model with century fixed effects.

B.7 Replication

Every figure and every generated table in this paper is produced from the raw data by a single script, `run_all.R`, which executes the pipeline in dependency order. The analysis is written in R. The package roster is given in `scripts/00_packages.R`, and the exact versions used to produce the results reported here, 304 packages under R 4.5.1, are pinned in a lockfile (`renv.lock`) from which the environment can be restored. The resampling exercise reported above is seeded, so its tables regenerate exactly.

The repository contains the assembled guild panel, the documented coordinate corrections applied to it when it is loaded, the extract of printed output used to date the first press, the city files that date communes, seats, market rights, and charters, and every crosswalk that links these sources to one another. Two public datasets are not redistributed and are downloaded once by documented commands, the cross-verified database of notable people (Laouenan et al., 2022) and the “Princes and Townspeople” collection (Cantoni et al., 2020). Steps that require a dataset the user has not

¹⁰The population tables of Appendix C group Luxembourg, a single panel city, with the Southern Netherlands for geographic presentation. The matching and heterogeneity analyses use the classification mapped here.

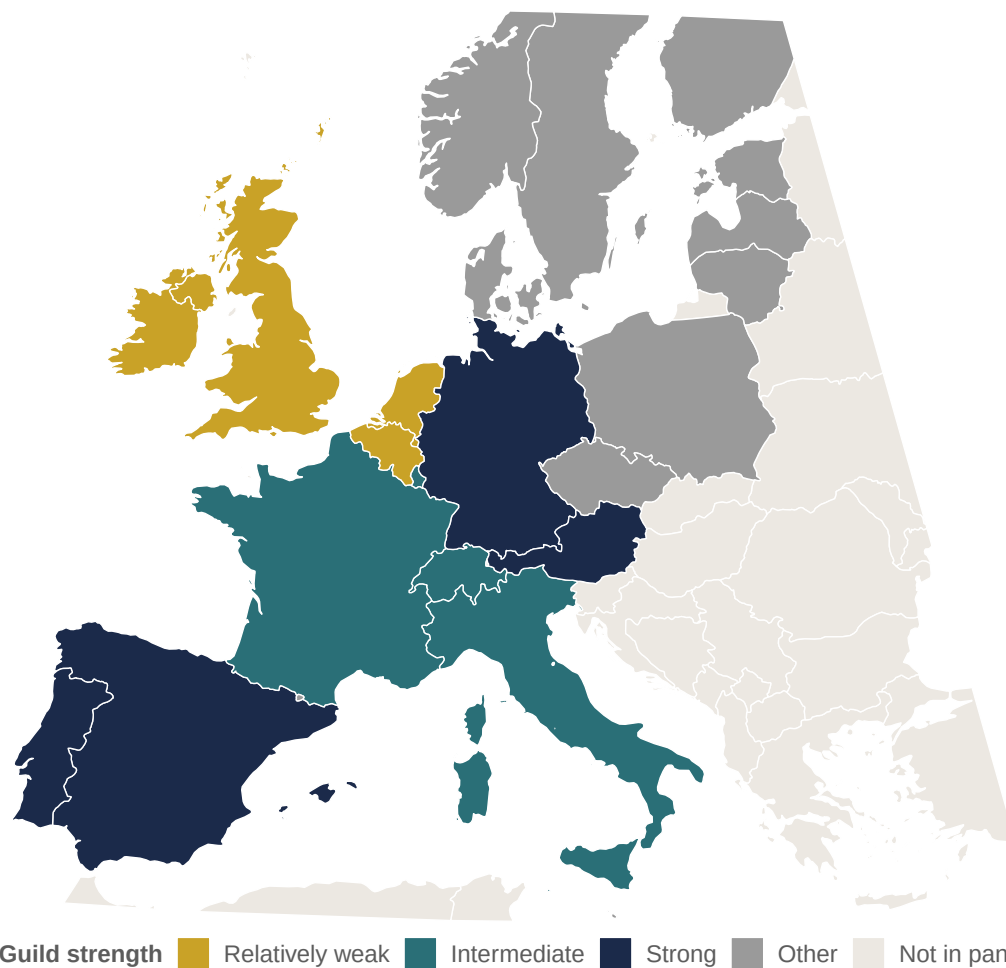


Figure B1: Guild strength in the analysis. Countries are shaded by the guild-strength classification of [Ogilvie \(2019, ch. 9\)](#). The classification is country-level, so modern country polygons are filled. Countries outside the panel are unshaded.

downloaded are skipped with a message, so the remainder of the pipeline still runs.

The construction of the guild panel itself from the primary and secondary sources described earlier in this appendix predates the analysis pipeline and was carried out in SAS. The panel it produces is included in the repository, so nothing in the paper depends on re-running those programs.

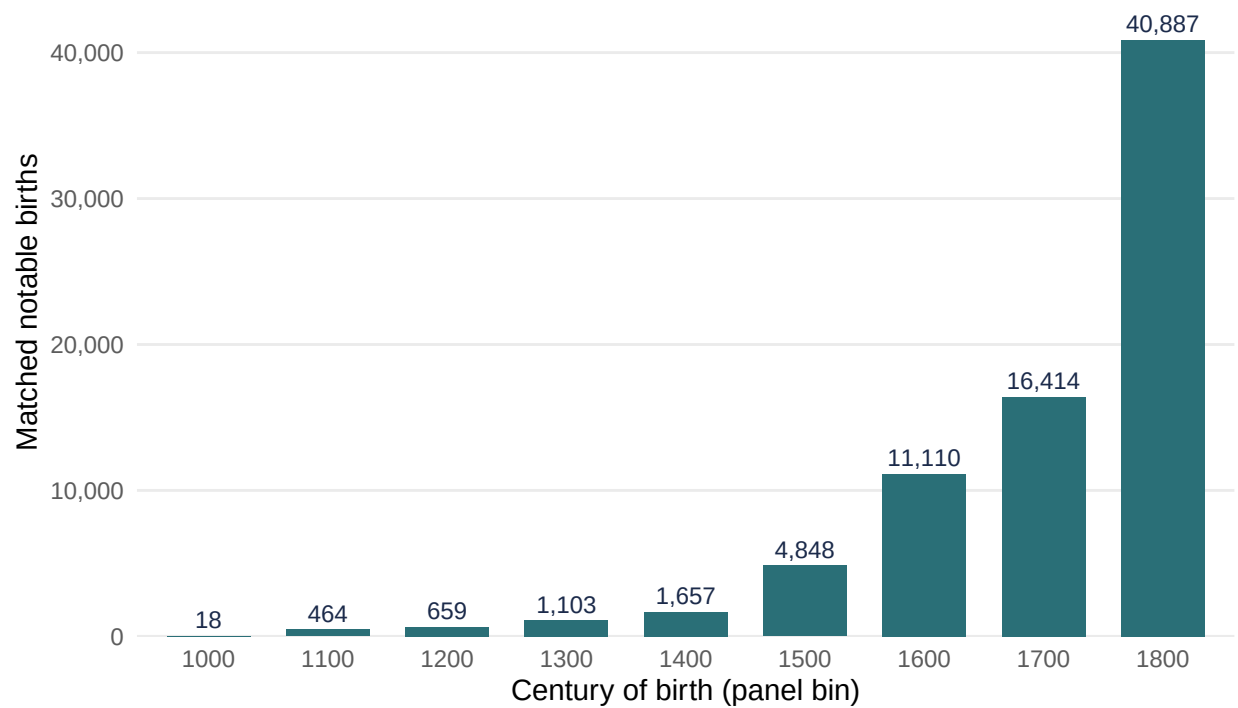


Figure B2: Notable births matched to panel cities by century, 1000–1800. Births are binned to the panel century in which they fall, so a birth in 1201–1300 is assigned to 1300. The steep rise reflects the compilation gradient of the source, which ratios between groups in the same century remove. Source: [Laouenan et al. \(2022\)](#).

C Descriptive Statistics and Additional Population Tables

Table C1 reports descriptive statistics for the analysis panel, including the notable-births outcome described in Section 3.

Table C1: Descriptive Statistics: Analysis Panel, 1000–1800

	N	Mean	SD	p25	Median	p75
Population (thousands)	13,324	6.01	16.64	2.00	3.00	6.00
Log population	13,324	8.12	0.92	7.60	8.01	8.70
Centennial growth (Δ log)	13,324	0.23	0.46	0.00	0.22	0.51
Guild presence (share of century)	13,324	0.07	0.24	0.00	0.00	0.00
Any documented guild activity (0/1)	13,324	0.14	0.35	0.00	0.00	0.00
Notable births (count)	13,324	5.76	35.94	0.00	0.00	3.00
Any notable birth (0/1)	13,324	0.47	0.50	0.00	0.00	1.00

The unit of observation is the city-century (13,324 observations; 1,754 cities; half-century observations excluded as in the estimation sample). 724 cities have documented guild activity in at least one century. Notable births are matched to cities within 15 km from the cross-verified database of notable people.

C.1 Population by Region and Guild Strength

Tables C2 through C4 report regional urban populations for 1300–1800 grouped by Ogilvie’s guild-strength classification. Table C2 covers all panel cities, Table C3 the city-centuries with documented guild activity, and Table C4 the share of urban population those cities represent. Urban populations in the regions Ogilvie classifies as having relatively weak guilds grew fastest over 1400–1800 in both the total and guild-active panels.

Table C2: Total Population (1300–1800)

	Population in Thousands						Centennial Growth			
	1300	1400	1500	1600	1700	1800	1400–1800	1400–1600	1600–1800	
Relatively Weak Guilds										
British Isles	464	344	459	757	1,415	3,473	78%	48%	114%	
N. Netherlands	139	160	305	540	758	796	49%	84%	21%	
S. Netherlands	351	356	435	446	604	720	19%	12%	27%	
Intermediate Guilds										
France	1,364	968	1,473	2,204	3,031	3,995	43%	51%	35%	
Italy	2,119	1,560	2,358	3,441	3,655	4,941	33%	49%	20%	
Switzerland	58	56	75	94	117	150	28%	30%	26%	
Strong Guilds										
Austria	59	54	77	118	203	379	63%	48%	79%	
Germany	856	701	1,046	1,297	1,422	2,375	36%	36%	35%	
Iberia	1,491	1,178	1,634	2,403	2,233	3,675	33%	43%	24%	
Other	280	289	473	760	839	1,211	43%	62%	26%	
Averages										
Relatively Weak Guilds	318	287	400	581	926	1,663	55%	42%	69%	
Intermediate Guilds	1,180	861	1,302	1,913	2,268	3,029	37%	49%	26%	
Strong Guilds	802	644	919	1,273	1,286	2,143	35%	41%	30%	

Guild-strength groupings follow [Ogilvie \(2019, ch. 9\)](#). Malta is grouped with Italy and Luxembourg with the Southern Netherlands. Other comprises Scandinavia, the Baltics, the Czech Republic, and Poland. Growth is the midpoint centennial rate.

Table C3: Urban Population with Guilds (1300–1800)

	Population in Thousands						Centennial Growth			
	1300	1400	1500	1600	1700	1800	1400–1800	1400–1600	1600–1800	
Relatively Weak Guilds										
British Isles	123	145	161	361	879	1,414	77%	58%	98%	
N. Netherlands	10	42	131	350	550	532	89%	189%	23%	
S. Netherlands	201	220	292	163	292	420	18%	-14%	61%	
Intermediate Guilds										
France	567	425	540	651	1,061	1,623	40%	24%	58%	
Italy	661	494	764	1,138	876	1,288	27%	52%	6%	
Switzerland	7	23	30	43	41	44	18%	37%	1%	
Strong Guilds										
Austria	20	20	53	99	178	278	93%	122%	68%	
Germany	234	396	685	714	560	739	17%	34%	2%	
Iberia	495	460	482	573	666	564	5%	12%	-1%	
Other	33	70	128	85	200	247	37%	10%	70%	
Averages										
Relatively Weak Guilds	111	136	195	291	574	789	55%	47%	65%	
Intermediate Guilds	412	314	445	611	659	985	33%	39%	27%	
Strong Guilds	250	292	407	462	468	527	16%	26%	7%	

Guild-strength groupings follow [Ogilvie \(2019, ch. 9\)](#). Malta is grouped with Italy and Luxembourg with the Southern Netherlands.

Other comprises Scandinavia, the Baltics, the Czech Republic, and Poland. Growth is the midpoint centennial rate.

Table C4: Share of Population with Guild Presence (1300–1800)

	1300	1400	1500	1600	1700	1800
Relatively Weak Guilds						
British Isles	27%	42%	35%	48%	62%	41%
N. Netherlands	7%	26%	43%	65%	73%	67%
S. Netherlands	57%	62%	67%	37%	48%	58%
Intermediate Guilds						
France	42%	44%	37%	30%	35%	41%
Italy	31%	32%	32%	33%	24%	26%
Switzerland	12%	41%	40%	46%	35%	29%
Strong Guilds						
Austria	34%	37%	69%	84%	88%	73%
Germany	27%	56%	65%	55%	39%	31%
Iberia	33%	39%	29%	24%	30%	15%
Other	12%	24%	27%	11%	24%	20%
Share of Populations						
Relatively Weak Guilds	35%	47%	49%	50%	62%	47%
Intermediate Guilds	35%	36%	34%	32%	29%	33%
Strong Guilds	31%	45%	44%	36%	36%	25%

Guild-active population divided by total population. Groupings follow [Ogilvie \(2019, ch. 9\)](#).

Tables C2 through C4 summarize the urban populations of all 1,780 European cities in our panel by region. Regional populations in Table C2 include all cities in our panel with and without guild activity. The regions are further grouped by Ogilvie’s three categories of guild strength, “relatively weak guilds”, “intermediate guilds”, and “strong guilds” (Ogilvie, 2019, ch. 9). Her criteria for guild strength include guild frequency on an absolute and per-capita basis, the strength of craft guilds relative to other economic actors such as merchants and rural producers, measures of intra-guild cohesion, and the relative strength of urban, rural, and state institutions (Ogilvie, 2019, Table 9.1). Centennial midpoint growth rates are reported in the last three columns.

Table C3 summarizes city populations for observations where and when guild activity was recorded. The table should be interpreted with caution because cities enter and exit over time depending on their record of guild activity. A city with documented guild activity in the century ending 1300 but none after 1300 appears under the 1300 column and in no later column. The growth rates in Table C3 are therefore changes in population for city-centuries that had guild activity. At the bottom of the table urban populations with guild activity in regions that Ogilvie classifies as “relatively weak” grew much faster than those in “intermediate” or “strong” guild regions. Recall that the indicators of guild presence do not capture the types of activities guilds were engaged in within each city or region.

Table C4 shows the share of urban population with guild activity in each region and time period, dividing the guild-active population in Table C3 by the total population in Table C2. On this cross-city extensive measure the share of population with guild activity remained highest in regions with “relatively weak guilds”. Although the share was similar across the three levels of guild strength in 1300, there was substantial variation within each category. The Northern Netherlands and Switzerland had low coverage of guild presence, 7–12 percent, whereas France (mostly northern France) and Flanders had much higher coverage, 42 percent and 57 percent of their respective populations in 1300. The weak-guild share rose through 1700 while the intermediate and strong shares peaked by the fifteenth century and declined thereafter. One regional contrast echoes the policy differences described in Section 3. In 1600 the share of urban population with guilds was higher in the British Isles, where England accounted for the predominant share, than in France (Table C4), and total urban population in the British Isles grew 87 percent from 1600 to 1700, more than double France’s 38 percent (Table C2). The same contrast appears in the guild-active populations of Table C3.

D Comparison Pools

This appendix sets out how the level comparisons of Section 4 choose their comparison cities. Section 3 describes the sources that date each institution, and Table D1 lists the pool, the rules, and the number of cities for every row of Table 2.

Table D1: Comparison pools of the level comparisons, by institution

		Cities	Same guild	Comparison	Event / comparison cities	
Institution	Pool	in pool	strength	cities	Population	Births
<i>Grew from below</i>						
Guild documentation	Full panel	1,754	Yes	Never	649 / 1,030	617 / 918
First printing press	Full panel	1,754	Yes	Never	682 / 1,072	672 / 900
Commune	Bosker et al.	600	Yes	Never or later	352 / 255	315 / 186
<i>Conferred from above: granted rights</i>						
Market right	<i>Städtebuch</i> , grant by 1000 excluded	220	No	Never or later	131 / 113	110 / 85
Town charter	<i>Städtebuch</i> , grant by 1000 excluded	242	No	Never or later	177 / 77	143 / 54
<i>Conferred from above: seats</i>						
Becomes a capital	Bosker et al., capital by 1000 excluded	582	No	Never or later	28 / 557	25 / 419
New bishopric	Bosker et al., bishopric by 1000 excluded	439	No	Never or later	76 / 377	63 / 248
New archbishopric	Bosker et al., archbishopric by 1000 excluded	571	No	Never or later	22 / 551	22 / 388
<i>Same-sample benchmarks</i>						
Guild, German and Austrian cities	<i>Städtebuch</i>	244	No	Never or later	176 / 85	168 / 58
Guild, cities in Bosker et al.	Bosker et al.	600	No	Never or later	315 / 357	302 / 265
<i>Not classified</i>						
University	Bosker et al.	600	Yes	Never or later	70 / 497	70 / 357

Full panel: the 1,754 analysis cities. Bosker et al.: the 600 panel cities in [Bosker et al. \(2013\)](#), every one of which reached 10,000 inhabitants in some century. *Städtebuch*: the 244 German and Austrian panel cities matched to [Cantoni et al. \(2020\)](#). Same guild strength: comparison cities have the event cities' guild strength in the country-level classification of [Ogilvie \(2019\)](#). Comparison cities: "Never" admits cities that never acquired the institution, and "Never or later" also admits cities that acquired it more than four centuries after the event cohort. The last two columns count distinct cities across cohorts in the population comparison, which has no size requirement, and in the notable-birth comparison, which keeps comparison cities within 1.0 log point of the event cities' mean log population one century before the event.

Each institution has a comparison pool, the set of cities from which both its event cities and its comparison cities are drawn. For guilds and the press the pool is the full panel of 1,754 analysis cities. For communes, universities, and the three seats it is the 600 panel cities that appear in

Bosker et al. (2013), the source that dates those institutions. Every one of those cities reached 10,000 inhabitants in some century, so these comparisons are among cities that all became large. For market rights and charters the pool is the 244 German and Austrian panel cities matched to the *Deutsches Städtebuch* data of Cantoni et al. (2020). The two benchmark rows of Table 2 repeat the guild comparison on the *Städtebuch* and Bosker et al. pools, so that guilds can be compared with the grants and the seats on the same cities.

Two exclusions remove cities that cannot be event cities in the panel window. Cities that already held a seat by 1000 are dropped from that seat's pool, 18 for capitals, 161 for bishoprics, and 29 for archbishoprics. Towns whose market right or charter predates 1001 are dropped from that grant's pool, 24 for market rights and two for charters. These cities are among the oldest and largest, and keeping them as comparison cities would raise the comparison mean for reasons unrelated to the event.

Event cities are grouped into cohorts by the century g in which they acquired the institution, from 1100 to 1700. The press has three cohorts, 1500, 1600, and 1700, because the first editions in the Universal Short Title Catalogue date from 1450 to 1649. For guilds, the press, communes, and universities each cohort is split by guild strength (Figure B1), and comparison cities have the event cities' guild strength. Seats and grants have too few events for that split, and their cohorts span all levels of guild strength.

The comparison cities of a cohort are the cities in the pool that had not acquired the institution within the window, which runs from four centuries before g to four centuries after. For the main guild comparison and the press these are cities that never acquired it. For the other institutions, and for the two guild benchmark rows, they also include cities that acquired it more than four centuries after g , which are untreated throughout the window. Most cities in the commune, grant, and Bosker et al. guild pools eventually acquired the institution, and without that rule some cohorts would have almost no comparison cities. Under the same rule a city can be an event city in one cohort and a comparison city in an earlier one, so the counts of event and comparison cities in Table D1 can sum to more than the pool.

A cohort enters a comparison only if it has at least three event cities and three comparison cities. The guild comparison, which has many more events, requires one event city and two comparison cities in each cohort and level of guild strength.

The two measures then draw on the pool differently. The population comparison keeps every event and comparison city in the cohort with no requirement on size, and counts a city without a population estimate in a century as zero. The notable-birth comparison keeps event cities with a population estimate one century before g and comparison cities whose log population in that century lies within 1.0 log point of the event cities' mean.

Because the pools differ, the share of cities that acquired an institution in Figure 7 is a share within its own pool. It is the number of event cities divided by the number of event and comparison cities in the population comparison. A share among the Bosker et al. cities is a share among cities that all became large.

E The Level Comparisons in Detail

This appendix reports the level comparisons of Section 4 century by century and in two further forms. Tables E1 and E2 give the ratios plotted in Figures 5 and 6. Table E3 pools the population ratios with cities lacking an estimate counted as zero, as in the main text, and among recorded cities only, with the share of each group that is recorded. Table E4 pools the notable-birth ratios per city and per inhabitant, where the per-inhabitant ratio divides births by population within each group and so removes the residual size difference inside the matching band.

Because the population file begins in 900, the 1100 cohort contributes nothing to the early window and the 1200 cohort only its third century, so the early and late windows in the main text do not rest on exactly the same cohorts. Table E5 restricts every event to cohorts first recorded in 1300 or later, which contribute to both windows. The guild, press, grant, and seat ratios are within a few hundredths of the full-sample values, and the commune's population lead in the early window is 1.0 on either set.

Table E6 re-estimates the notable-birth ratios with matched cities within 0.5 log points of the event cities' mean baseline population instead of 1.0. The pooled ratios move little. The tighter band leaves the mean population of event cities above that of matched cities because the band matches the mean of log population and a few large event cities hold up the event mean, which is why Table E4 reports per-inhabitant ratios as well.

Table E1: Population of event cities relative to comparison cities, by century from the event

	−4	−3	−2	−1	0	1	2	3	4
<i>Grew from below</i>									
Guild documentation	1.86	2.06	2.14	2.34	2.67	2.58	2.69	2.86	3.10
First printing press	2.16	2.37	2.68	2.34	2.36	2.53	2.91	4.88	–
Commune	0.98	1.22	1.39	1.65	2.02	2.26	2.35	2.29	2.40
<i>Conferred from above: granted rights</i>									
Market right	1.13	1.12	1.05	1.02	1.10	1.09	1.10	1.19	1.09
Town charter	0.81	1.01	1.03	1.08	1.26	1.39	1.29	1.32	1.38
<i>Conferred from above: seats</i>									
Becomes a capital	1.07	1.98	3.45	3.58	4.60	6.30	6.15	5.58	5.81
New bishopric	2.59	2.54	2.31	1.93	1.63	1.70	1.56	2.00	1.36
New archbishopric	2.42	2.32	3.16	3.80	3.88	3.45	3.62	3.27	3.16
<i>Same-sample benchmarks</i>									
Guild, German and Austrian cities	1.37	1.69	1.92	2.16	2.29	2.23	2.30	2.21	2.59
Guild, cities in Bosker et al.	1.85	1.99	2.08	2.27	2.64	2.65	2.62	2.83	3.05
<i>Not classified</i>									
University	1.85	1.98	2.25	2.69	2.78	2.49	2.42	2.69	3.55

Ratio of mean population, with cities lacking an estimate counted as zero, in event cities to that in comparison cities, by century from the event, aggregated across cohorts with weights equal to the number of event cities. Guild documentation and the first printing press use the full panel, with comparison cities never treated and of the same guild strength. Communes, universities, capitals, bishoprics, and archbishoprics use the cities in [Bosker et al. \(2013\)](#). Communes and universities are compared among cities of the same guild strength and the seats regardless of it, with cities already holding the status by 1000 excluded. Market rights, town charters, and the German benchmark use German and Austrian cities matched to the *Deutsches Städtebuch*, with towns whose grant predates 1001 excluded from that institution. Outside the full panel comparison cities have no event or an event more than 400 years later. Counts of event and comparison cities in the pooled tables are city entries across cohorts, since a city can serve in more than one cohort.

E.1 Notable Births per Inhabitant

Matched cities are close in size but not equal. Table [E7](#) divides births by population within each group to separate the size that remains within the band from prominence given size. Per inhabitant the guild lead before documentation is 1.3–1.4 times. About two-thirds of the lead in births reflects the remaining difference in size within the band, and about one-third reflects prominence given their size. The per-inhabitant lead is estimated with an interval of 1.1–1.7 in the late window and an interval of 0.9–1.8 (which includes 1) in the early window. Cities with their first documented printing press had 1.6–1.8 times the births per inhabitant of cities in their size band. In the late window market and charter towns were both at about 0.6 per inhabitant, and the leads of capitals,

Table E2: Notable births in event cities relative to matched cities, by century from the event

	-4	-3	-2	-1	0	1	2	3	4
<i>Grew from below</i>									
Guild documentation	1.84	2.26	2.71	2.47	3.63	4.00	5.03	5.44	6.24
First printing press	2.56	2.75	3.11	3.44	4.16	4.39	5.66	9.91	–
Commune	3.52	3.49	2.41	2.54	3.34	3.04	5.16	5.42	5.56
<i>Conferred from above: granted rights</i>									
Market right	0.67	1.72	1.14	0.70	1.13	1.09	1.28	1.26	0.92
Town charter	1.58	0.72	0.96	0.76	0.81	0.76	0.90	1.24	1.61
<i>Conferred from above: seats</i>									
Becomes a capital	0.98	1.18	1.32	2.35	5.37	7.41	6.33	6.25	4.71
New bishopric	0.87	1.12	1.63	2.13	3.18	2.13	0.98	2.87	1.23
New archbishopric	0.90	1.53	1.71	2.18	2.57	1.83	1.37	1.30	2.05
<i>Same-sample benchmarks</i>									
Guild, German and Austrian cities	1.52	1.81	2.50	1.49	1.84	1.61	1.90	1.84	2.11
Guild, cities in Bosker et al.	1.89	2.21	2.21	2.45	3.73	4.71	5.76	6.04	6.28
<i>Not classified</i>									
University	2.65	1.44	1.79	2.26	2.53	2.30	2.69	2.05	2.92

Ratio of notable births per city, among cities within 1.0 log point of the event cities' mean population one century before the event, in event cities to that in comparison cities, by century from the event, aggregated across cohorts with weights equal to the number of event cities. Guild documentation and the first printing press use the full panel, with comparison cities never treated and of the same guild strength. Communes, universities, capitals, bishoprics, and archbishoprics use the cities in [Bosker et al. \(2013\)](#). Communes and universities are compared among cities of the same guild strength and the seats regardless of it, with cities already holding the status by 1000 excluded. Market rights, town charters, and the German benchmark use German and Austrian cities matched to the *Deutsches Städtebuch*, with towns whose grant predates 1001 excluded from that institution. Outside the full panel comparison cities have no event or an event more than 400 years later. Counts of event and comparison cities in the pooled tables are city entries across cohorts, since a city can serve in more than one cohort.

new bishoprics, and new archbishoprics fall to 1.1, 0.9, and 1.2, all with intervals that include 1.

Table E3: Pooled population ratios, event cities to comparison cities

Institution (event / comparison cities)	No estimate counted as zero			Cities with an estimate only			Share with an estimate, early
	Early	Late	After	Early	Late	After	
<i>Grew from below</i>							
Guild documentation (649 / 1,030)	1.96 [1.60, 2.38]	2.25 [1.95, 2.56]	2.71 [2.36, 3.08]	1.74 [1.43, 2.11]	2.02 [1.75, 2.30]	2.65 [2.30, 3.00]	0.83 / 0.71
First printing press (682 / 1,072)	2.27 [2.00, 2.58]	2.49 [2.19, 2.82]	3.38 [2.73, 4.09]	2.03 [1.81, 2.28]	2.38 [2.08, 2.69]	3.37 [2.72, 4.08]	0.96 / 0.85
Commune (352 / 255)	1.11 [0.62, 2.23]	1.53 [1.07, 2.29]	2.24 [1.82, 2.74]	0.85 [0.47, 1.67]	1.29 [0.90, 1.90]	2.17 [1.78, 2.65]	0.81 / 0.58
<i>Conferred from above: granted rights</i>							
Market right (131 / 113)	1.12 [0.70, 1.88]	1.03 [0.71, 1.62]	1.13 [0.84, 1.57]	1.05 [0.71, 1.59]	0.91 [0.65, 1.34]	1.06 [0.79, 1.47]	0.66 / 0.60
Town charter (177 / 77)	0.92 [0.63, 1.44]	1.06 [0.76, 1.54]	1.31 [0.97, 1.79]	0.97 [0.74, 1.28]	0.94 [0.70, 1.28]	1.20 [0.90, 1.60]	0.54 / 0.52
<i>Conferred from above: seats</i>							
Becomes a capital (28 / 557)	1.57 [0.97, 2.61]	3.52 [2.19, 5.82]	5.72 [4.33, 7.76]	1.57 [1.03, 2.33]	3.38 [2.15, 5.33]	5.57 [4.21, 7.56]	0.83 / 0.78
New bishopric (76 / 377)	2.56 [1.09, 5.32]	2.09 [1.36, 3.09]	1.72 [1.26, 2.33]	2.36 [1.06, 4.80]	1.81 [1.21, 2.63]	1.66 [1.21, 2.24]	0.83 / 0.73
New archbishopric (22 / 551)	2.36 [1.50, 3.70]	3.50 [2.40, 5.21]	3.51 [2.39, 5.12]	2.09 [1.36, 3.05]	3.12 [2.14, 4.57]	3.44 [2.33, 5.00]	0.96 / 0.81
<i>Same-sample benchmarks</i>							
Guild, German and Austrian cities (176 / 85)	1.55 [1.22, 2.00]	2.05 [1.62, 2.59]	2.25 [1.79, 2.83]	1.34 [1.10, 1.63]	1.71 [1.39, 2.11]	2.11 [1.69, 2.66]	0.78 / 0.65
Guild, cities in Bosker et al. (315 / 357)	1.92 [1.50, 2.46]	2.19 [1.86, 2.59]	2.70 [2.30, 3.14]	1.68 [1.32, 2.13]	1.99 [1.71, 2.32]	2.64 [2.25, 3.06]	0.88 / 0.76
<i>Not classified</i>							
University (70 / 497)	1.92 [1.34, 2.71]	2.48 [1.90, 3.14]	2.59 [1.91, 3.38]	1.68 [1.22, 2.34]	2.37 [1.80, 3.01]	2.57 [1.90, 3.36]	0.98 / 0.85

Ratios of mean population as in Table E1, pooled over the early window (fourth and third centuries before the event), the late window (second and first), and the after window (event century and the three that follow). A zero in the population source means the city has no estimate. Positive estimates start at 1,000 inhabitants. The last column is the share of event and comparison cities with a positive estimate in the early window. Intervals are percentile intervals from 500 bootstrap draws that resample cities.

Table E4: Pooled notable-birth ratios, event cities to matched cities

Institution (event / matched cities)	Per city			Per inhabitant			Share of births, event / matched
	Early	Late	After	Early	Late	After	
<i>Grew from below</i>							
Guild documentation (617 / 918)	2.07 [1.51, 2.77]	2.55 [2.02, 3.19]	4.81 [3.92, 5.90]	1.28 [0.92, 1.78]	1.35 [1.10, 1.67]	2.03 [1.74, 2.45]	1.08 / 0.30
First printing press (672 / 900)	2.67 [2.08, 3.36]	3.33 [2.75, 4.01]	6.97 [5.06, 9.26]	1.55 [1.23, 1.96]	1.77 [1.48, 2.12]	2.62 [2.11, 3.23]	1.14 / 0.31
Commune (315 / 186)	3.51 [1.42, 8.14]	2.50 [1.66, 3.97]	4.75 [3.45, 6.53]	3.05 [1.25, 6.87]	1.58 [1.06, 2.51]	2.37 [1.74, 3.18]	1.51 / 0.41
<i>Conferred from above: granted rights</i>							
Market right (110 / 85)	1.22 [0.34, 4.64]	0.83 [0.52, 1.40]	1.23 [0.84, 1.82]	0.81 [0.29, 2.54]	0.56 [0.37, 0.92]	0.93 [0.69, 1.25]	0.41 / 0.65
Town charter (143 / 54)	1.06 [0.12, 5.26]	0.82 [0.49, 1.49]	1.02 [0.73, 1.44]	0.86 [0.10, 3.50]	0.59 [0.34, 1.05]	0.67 [0.50, 0.90]	0.87 / 0.24
<i>Conferred from above: seats</i>							
Becomes a capital (25 / 419)	1.07 [0.00, 2.39]	2.00 [1.37, 2.81]	6.38 [4.71, 8.05]	1.24 [0.00, 2.22]	1.07 [0.71, 1.50]	1.81 [1.34, 2.41]	3.13 / 1.42
New bishopric (63 / 248)	0.99 [0.48, 1.81]	1.94 [0.88, 3.29]	1.96 [0.84, 3.57]	0.52 [0.29, 1.00]	0.93 [0.50, 1.51]	1.19 [0.61, 1.81]	0.81 / 1.07
New archbishopric (22 / 388)	1.32 [0.59, 2.34]	2.03 [1.34, 3.16]	1.56 [0.98, 2.24]	1.02 [0.54, 1.67]	1.22 [0.83, 1.88]	0.73 [0.54, 0.95]	4.25 / 1.81
<i>Same-sample benchmarks</i>							
Guild, German and Austrian cities (168 / 58)	1.69 [0.79, 4.50]	1.72 [1.20, 2.62]	1.82 [1.32, 2.57]	1.28 [0.63, 3.35]	1.04 [0.74, 1.59]	0.96 [0.72, 1.29]	0.53 / 0.45
Guild, cities in Bosker et al. (302 / 265)	2.06 [1.36, 3.06]	2.36 [1.73, 3.13]	5.44 [4.07, 7.06]	1.51 [1.03, 2.20]	1.49 [1.10, 2.00]	2.49 [1.99, 3.09]	1.78 / 0.72
<i>Not classified</i>							
University (70 / 357)	1.91 [0.77, 3.64]	2.14 [1.33, 3.26]	2.30 [1.65, 3.18]	1.72 [0.77, 3.25]	1.31 [0.83, 1.99]	1.16 [0.87, 1.53]	3.79 / 1.12

Ratios of notable births per city as in Table E2, pooled over the early, late, and after windows. Per inhabitant divides births by population within each group before taking the ratio. The last column is each group's mean share, per thousand, of all notable births in the panel in the same century, averaged over the four centuries before the event. Notable births from Laouenan et al. (2022), matched to panel cities within 15 km. Intervals are percentile intervals from 500 bootstrap draws that resample cities.

Table E5: Event cities relative to comparison cities, cohorts from 1300 onward

	Event cities	Population, all comparison cities			Notable births, size band		
		Early	Late	After	Early	Late	After
Guild documentation	580	1.96	2.23	2.65	2.12	2.51	4.71
First printing press	682	2.27	2.49	2.91	2.67	3.33	5.77
Commune	218	1.00	1.29	1.78	3.50	2.43	3.89
Market right	98	1.12	0.98	1.03	1.32	0.81	1.22
Town charter	129	0.85	0.89	1.13	0.88	0.78	0.94
Becomes a capital	16	1.30	2.30	5.42	1.10	2.03	6.18
New bishopric	27	2.79	2.60	1.85	1.01	2.17	1.90
New archbishopric	12	2.36	3.11	3.72	1.32	2.02	1.62
Guild, German and Austrian cities	169	1.52	1.97	2.13	1.72	1.66	1.80
Guild, cities in Bosker et al.	273	1.94	2.21	2.69	2.10	2.37	5.40
University	65	1.91	2.45	2.50	1.81	2.14	2.29

As Table 2, restricted to cohorts first recorded in 1300 or later, which contribute to both the early and the late window. The 1100 cohort contributes nothing to the early window and the 1200 cohort only its third century, because the population file begins in 900. Point estimates only.

Table E6: Notable births in event cities relative to matched cities, tighter population match

Institution (event / matched cities, band 0.5)	Band 0.5		Band 1.0	Baseline population, event / matched	
	Before	After	Before	Band 1.0	Band 0.5
<i>Grew from below</i>					
Guild documentation (617 / 698)	2.30 [1.79, 2.93]	4.58 [3.67, 5.65]	2.43 [1.92, 3.05]	5,801 / 3,145	5,801 / 3,429
First printing press (672 / 652)	3.19 [2.65, 3.86]	6.74 [4.95, 9.34]	3.16 [2.64, 3.78]	6,994 / 3,854	6,994 / 4,041
Commune (315 / 141)	2.62 [1.56, 4.51]	4.31 [2.81, 6.41]	2.75 [1.77, 4.69]	6,203 / 3,691	6,203 / 3,821
<i>Conferred from above: granted rights</i>					
Market right (110 / 68)	0.74 [0.41, 1.56]	1.09 [0.74, 1.65]	0.91 [0.53, 1.74]	2,855 / 2,089	2,855 / 2,185
Town charter (143 / 39)	0.89 [0.43, 2.67]	1.09 [0.78, 1.57]	0.87 [0.47, 1.93]	2,671 / 2,082	2,671 / 2,105
<i>Conferred from above: seats</i>					
Becomes a capital (25 / 328)	1.75 [1.06, 2.64]	5.89 [3.91, 7.99]	1.70 [1.07, 2.56]	16,880 / 7,868	16,880 / 8,583
New bishopric (63 / 171)	1.44 [0.69, 2.52]	1.73 [0.67, 3.20]	1.59 [0.77, 2.68]	8,651 / 5,615	8,651 / 6,544
New archbishopric (22 / 183)	1.42 [0.86, 2.42]	1.29 [0.81, 1.96]	1.79 [1.10, 2.75]	18,045 / 9,309	18,045 / 12,172
<i>Same-sample benchmarks</i>					
Guild, German and Austrian cities (168 / 45)	1.73 [1.19, 2.57]	2.15 [1.58, 3.02]	1.72 [1.16, 2.65]	3,792 / 2,221	3,792 / 2,548
Guild, cities in Bosker et al. (302 / 221)	1.96 [1.36, 3.05]	5.02 [3.88, 6.80]	2.30 [1.69, 3.02]	9,046 / 5,182	9,046 / 5,209
<i>Not classified</i>					
University (70 / 203)	1.64 [0.98, 2.63]	2.05 [1.47, 2.88]	2.10 [1.34, 3.07]	16,357 / 8,731	16,357 / 10,590

As Table E4, with matched cities within 0.5 log points of the event cities' mean population one century before the event. The before columns pool the four centuries before the event. Baseline population is the mean population one century before the event. The band matches the mean of log population, so a few large event cities keep the mean population of event cities above that of matched cities under either band.

Table E7: Notable births per inhabitant in event cities relative to cities in the same size band, by institution

	Notable births per inhabitant		
	Early	Late	After
<i>Grew from below</i>			
Guild documentation	1.28	1.35	2.03
	[0.92, 1.78]	[1.10, 1.67]	[1.74, 2.45]
First printing press	1.55	1.77	2.62
	[1.23, 1.96]	[1.48, 2.12]	[2.11, 3.23]
Commune	3.05	1.58	2.37
	[1.25, 6.87]	[1.06, 2.51]	[1.74, 3.18]
<i>Conferred from above: granted rights</i>			
Market right	0.81	0.56	0.93
	[0.29, 2.54]	[0.37, 0.92]	[0.69, 1.25]
Town charter	0.86	0.59	0.67
	[0.10, 3.50]	[0.34, 1.05]	[0.50, 0.90]
<i>Conferred from above: seats</i>			
Becomes a capital	1.24	1.07	1.81
	[0.00, 2.22]	[0.71, 1.50]	[1.34, 2.41]
New bishopric	0.52	0.93	1.19
	[0.29, 1.00]	[0.50, 1.51]	[0.61, 1.81]
New archbishopric	1.02	1.22	0.73
	[0.54, 1.67]	[0.83, 1.88]	[0.54, 0.95]
<i>Same-sample benchmarks</i>			
Guild, German and Austrian cities	1.28	1.04	0.96
	[0.63, 3.35]	[0.74, 1.59]	[0.72, 1.29]
Guild, cities in Bosker et al.	1.51	1.49	2.49
	[1.03, 2.20]	[1.10, 2.00]	[1.99, 3.09]
<i>Not classified</i>			
University	1.72	1.31	1.16
	[0.77, 3.25]	[0.83, 1.99]	[0.87, 1.53]

Each entry is the ratio of notable births per inhabitant in cities that acquired the institution to that in comparison cities whose population one century before the event lies within 1.0 log point of the event cities' mean, with a 95 percent bootstrap interval beneath it. Per inhabitant divides births by population within each group before taking the ratio, which removes the remaining size difference inside the band. Windows as in Table 2. Appendix E gives the per-city values.

F Robustness of the Matched Event Study

Figure F1 summarizes the guild-city premium, the mean of the post-event coefficients over event times 0 through 4, across the matching and control-group variants of the matched event study. Tightening the baseline-size caliper from 1.0 to 0.5 log points raises the post-event mean from 0.14 to 0.17, and explicit nearest-neighbor matching (1:2 without replacement, 0.5-log caliper) raises it to between 0.16 and 0.19.¹¹ If the premium were residual mean reversion leaking through loose matching, tighter comparability would shrink it toward zero. It does the opposite. Replacing never-documented controls with a control pool that includes not-yet-documented cities leaves the estimate essentially unchanged, and the unconditional Callaway–Sant’Anna overall average treatment effects, which do not condition on baseline size, are smaller but positive under either control group.

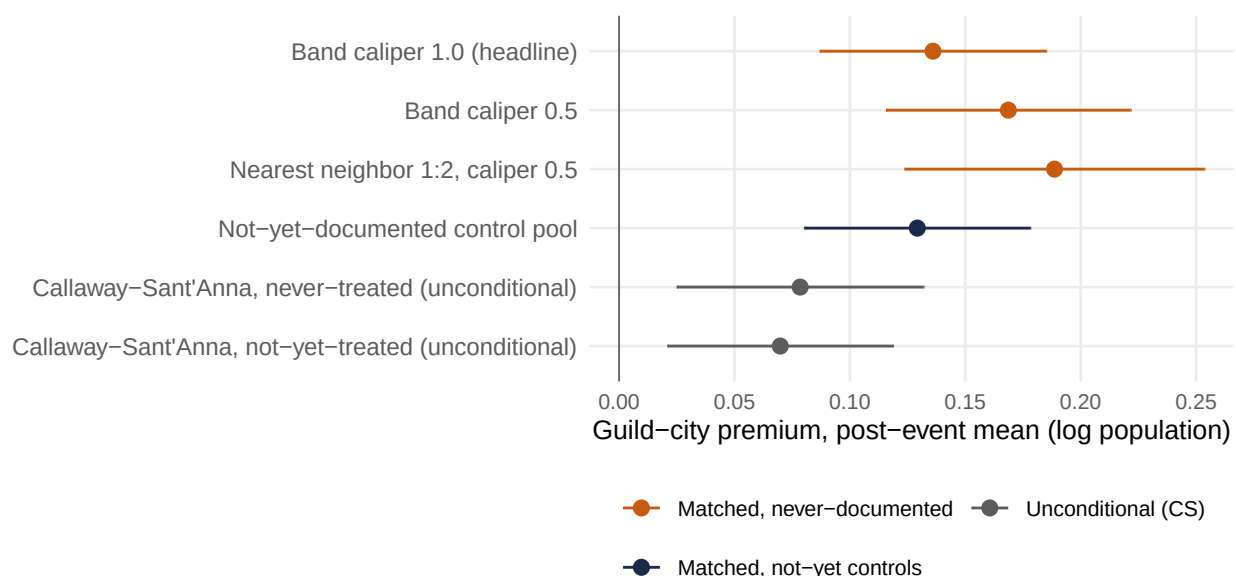


Figure F1: The guild-city premium across matching and control-group variants. Points are post-event means (event times 0 to 4) with 95 percent confidence intervals, standard errors clustered by city. The matched rows share the Figure 8 design. The Callaway–Sant’Anna rows are unconditional overall average treatment effects.

Two further checks address the pre-event path. First, dropping the top size decile of treated

¹¹Because population is recorded in thousands, many cities share a baseline value exactly and nearest-neighbor matching resolves those ties by the order of the data. The estimate reported by our pipeline is 0.19. Re-running under random orderings of the same data gives 0.16 to 0.18, so we report the range. Every ordering exceeds the headline estimate of 0.14, which is what the comparison turns on.

cities does not remove the unconditional post-documentation reversion, so the reversion reflects the size gap between treated and control cities rather than a handful of very large cities. Second, we test parallel pre-trends formally. The pre-period coefficients at $k = -2$ and $k = -3$ are close to zero (-0.008 and -0.034), but a small negative deviation four centuries before documentation (-0.096) leads a joint test of the pre-period coefficients to reject at the 5 percent level ($F = 3.64$, $p = 0.012$). Relative-magnitudes sensitivity bounds (Rambachan and Roth, 2023) quantify what this deviation implies. The on-impact premium remains bounded away from zero for violations of parallel trends as large as the worst pre-period deviation ($\bar{M} = 1$). The persistence of the premium over longer horizons leans more heavily on the parallel-trends assumption since violations can accumulate over century-long periods. The $k = -4$ deviation is consistent with the long lead of Section 4, in which guild cities were already larger than other cities four centuries before the record.

Table F1 repeats the matched event study with notable births in place of log population. The design is that of Figure 8, with the same 617 guild cities, 918 matched cities, and experiment-specific city and century fixed effects. The Poisson column is a count model, which measures proportional change and absorbs any common growth in the source whatever a city’s starting count. Under it notable births in guild cities are flat relative to matched cities in the two centuries before documentation, about 45 percent higher in the documentation century, and higher still afterward. The asinh column is the same specification on the inverse hyperbolic sine of the count, which mixes absolute and proportional change. On that scale a city with births rises as the source grows while a city at zero does not, so a group that starts with more births shows a rising line whatever its trajectory, and the asinh coefficients before documentation are large and negative for that reason. The first three columns give the same comparison in levels, as in Appendix E. We rely on the levels and on the count model.

Table F1: Notable births in guild cities relative to matched cities, in levels and in counts

Centuries from documentation	Births per guild city	Births per matched city	Ratio	Poisson coefficient (SE)	asinh coefficient (SE)
−4	0.27	0.15	1.84	−0.239 (0.187)	−0.454 (0.057)
−3	0.41	0.18	2.26	−0.035 (0.131)	−0.372 (0.047)
−2	0.90	0.33	2.71	0.000 (0.103)	−0.183 (0.037)
−1	1.73	0.70	2.47	0 (ref.)	0 (ref.)
0	4.31	1.19	3.63	0.370 (0.074)	0.345 (0.041)
1	9.94	2.48	4.00	0.509 (0.099)	0.586 (0.051)
2	16.20	3.22	5.03	0.614 (0.118)	0.758 (0.062)
3	23.52	4.32	5.44	0.686 (0.140)	0.946 (0.072)
4	33.17	5.31	6.24	0.668 (0.179)	1.236 (0.079)

Headline matched design (band 1.0, 617 guild cities, 918 matched cities). The first three columns are the level comparison of Table E2. The Poisson column is a count model of notable births on event-time indicators with experiment-specific city and century fixed effects, which measures proportional change and absorbs any common growth in the source whatever a city's starting count. Of the city-experiment units, 464 with no births in any century drop out. The asinh column is the same specification on the inverse hyperbolic sine of the count, which mixes absolute and proportional change and is reported for comparison. Standard errors clustered by city.

G Constructing Market Access

A first-order objection to the matched premium is that guild cities may simply sit in better positions in the pre-modern trade network. This appendix describes the market-access variable we use to address that objection and reports the associated regressions. The construction follows the market-access approach of [Donaldson and Hornbeck \(2016\)](#) adapted to a historical European transport network.

G.1 Definition

For each city i and century t market access aggregates the populations of all other cities, discounted by the cost of reaching them,

$$\text{MA}_{it} = \sum_{j \neq i} \frac{\text{pop}_{jt}}{\text{cost}_{ij}^{\delta}}, \quad (\text{G.1})$$

where the distance-decay exponent δ is set to 1. We exclude the city's own population from the sum because including it would make the measure mechanically dominated by city size. An include-own version correlates with log population at 0.997 and is little more than population relabeled. The exclude-own measure captures access to other cities' markets and correlates with log population at 0.42, so it carries independent information. We use $\log \text{MA}_{it}$ throughout.

The cost term cost_{ij} in Eq. (G.1) is the least-cost journey from i to j over a rasterized transport network. Travel is cheaper along water than over land. Sea, navigable river, road, and open-country portage carry different per-distance costs and the least-cost path trades distance against mode. The cost matrix is time-invariant since the network does not move, so all variation in market access over time comes from the population panel. Figure G1 illustrates two least-cost paths over the cost surface. The Mainz-to-Venice path runs up the Rhine and crosses the Alps at the Brenner Pass rather than taking a more direct overland line. The Antwerp-to-Madrid path hugs the Atlantic coast before turning inland because coastal shipping is far cheaper than crossing the interior.

G.2 Network, Cost Weights, and Crosswalk

The transport network combines major Roman roads, medieval trade routes, navigable rivers, and seas, rasterized to a 10 km grid in the Europe Equidistant Conic projection. Destinations are the

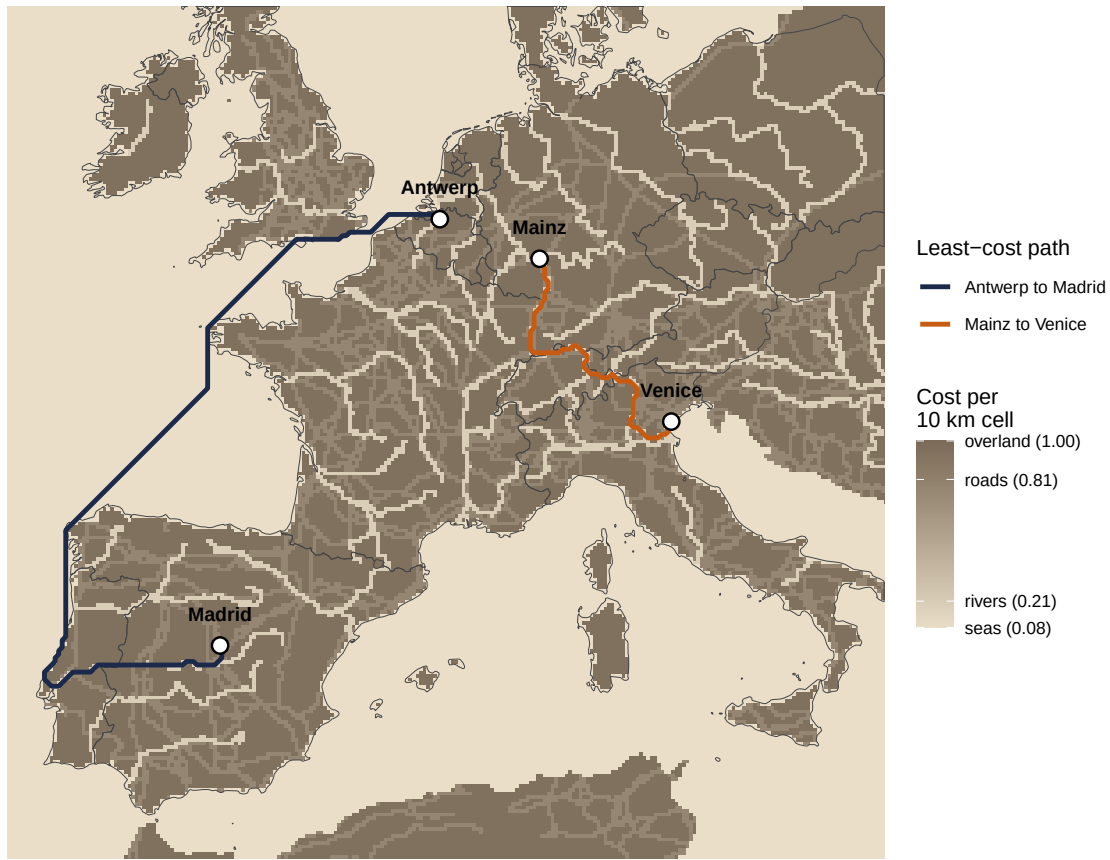


Figure G1: Two illustrative least-cost paths over the Bairoch cost surface. Darker cells are cheaper to traverse (seas, then rivers, then roads, then open country). Europe Equidistant Conic projection.

Buringh population cities, so market access uses the same population universe as the rest of the paper. City names are matched to the network by a cascade of dictionary, direct, synonym, and fuzzy matches.

The relative per-distance costs of the four travel modes are uncertain, so we compute market access under four cost schedules drawn from the historical transport-cost literature. The headline schedule follows [Bairoch et al. \(1988\)](#) with road, river, and sea costs of 0.81, 0.21, and 0.08 relative to open-country portage at 1.00. Three alternatives from [Boerner and Severgnini \(2014\)](#), [Masschaele \(1993\)](#), and [Campbell et al. \(1993\)](#) vary these weights. The results below are reported for the Bairoch schedule and are not sensitive to the choice.

G.3 Market Access and the Guild Premium

Table G1 adds log market access to the conventional specifications of Appendix H. In the growth regression market access enters positively and the guild coefficient is essentially unchanged. In the level regression market access is a strong predictor and absorbs about a quarter of the guild coefficient. The guild coefficient remains positive. Conley spatial-HAC standard errors at 100 km and 200 km cutoffs, reported for the growth specification, leave the guild coefficient statistically significant.

Table G1: Guild Presence and Population, Controlling for Market Access

	OLS Growth		TWFE Level	
	(1)	(2)	(3)	(4)
Guild presence	0.0891*** (0.0195)	0.0873*** (0.0192)	0.0666** (0.0241)	0.0505* (0.0232)
Log market access		0.0510** (0.0167)		0.6437*** (0.1105)
Conley 100 km SE (guild)		0.0185		
Conley 200 km SE (guild)		0.0198		
N	13,324	13,324	13,296	13,296

Columns (1)–(2): the growth-on-levels specification (country and century fixed effects). Columns (3)–(4): the two-way fixed effects level specification (city and century fixed effects). Guild presence in (1)–(2) is the composite $\lambda\beta_1$. Huber-White standard errors clustered at a 100 km radius in parentheses; Conley spatial-HAC standard errors for the growth specification reported below. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Sample restricted to city-centuries with finite market access.

The sharper test uses the matched design. Table G2 re-estimates the matched event study of Section 5.1 and now requires each control city to resemble the treated group at baseline on log market access as well as on log population, both among cities of the same guild strength. The premium is unchanged. It is about 0.13 log points on impact and holds over the following four centuries with a post-event mean near the headline estimate. The result is robust to clustering standard errors by 100 km spatial cluster rather than by city, reported in brackets.

Figure G2 shows why. Panel A plots the distribution of market access for ever-documented and never-documented cities. The two overlap almost entirely and guild cities sit no higher, so access to other markets does not distinguish them. Panel B overlays the matched premium with and without the additional market-access matching. The two paths coincide. Guild cities do not owe their premium to superior positions in the trade network.

Table G2: Matched Event Study, Additionally Matching on Baseline Market Access

Event time	Log population
−4	−0.091** (0.032) [0.032]
−3	−0.031 (0.025) [0.026]
−2	−0.006 (0.018) [0.019]
−1	0 (ref.)
+0	0.133*** (0.018) [0.023]
+1	0.157*** (0.026) [0.032]
+2	0.133*** (0.031) [0.037]
+3	0.134*** (0.037) [0.046]
+4	0.134** (0.042) [0.049]

Matched controls have the treated cities' guild strength and lie within a 1.0-log caliper on baseline population and a 0.5-log caliper on baseline log market access. Reference period −1. City-clustered standard errors in parentheses; 100 km spatial-cluster standard errors in brackets. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

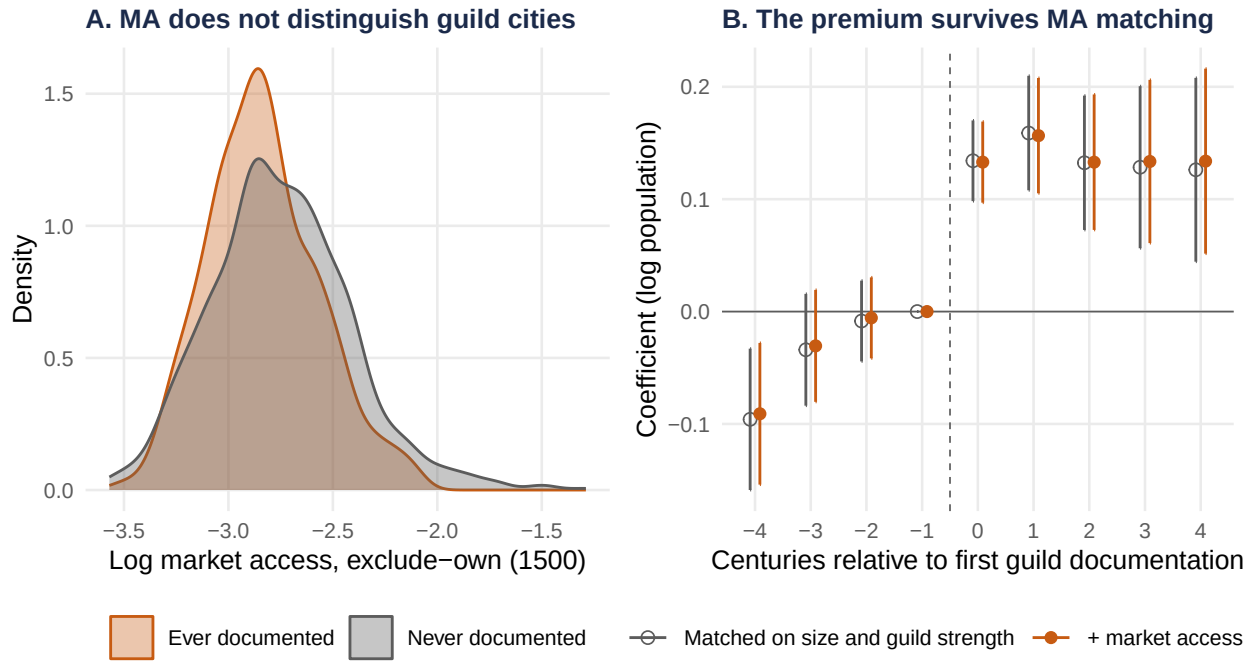


Figure G2: Market access and the guild premium. Panel A: the distribution of exclude-own log market access in 1500 for ever-documented and never-documented cities. Panel B: the matched event-study premium, matched on guild strength and baseline size (headline) and additionally matched on baseline market access. Bands are 95 percent confidence intervals, standard errors clustered by city.

H Conventional Regression Benchmarks

This appendix reports the conventional panel specifications that Section 5.1 uses as a benchmark, with their full tables.

H.1 Conventional Estimates

The conventional approach in the urbanization literature relates population growth to initial size and institutional presence. In the convergence framework of [Duranton and Puga \(2014, p. 7\)](#) city populations adjust toward a steady state at rate λ , and parameterizing the log steady state as linear in guild presence yields the growth-on-levels regression

$$\Delta_{t,t+1} \log N_{it} = \lambda\beta_0 - \lambda \log N_{it} + \lambda\beta_1 G_{it} + \varepsilon_{it}, \quad (\text{H.1})$$

where $G_{it} \in [0, 1]$ is the share of the preceding century with documented guild activity. The specification estimates $\lambda\beta_1$ and λ separately so the steady-state coefficient is recovered as their ratio and the implied level shift from a full century of guild presence is $e^{\beta_1} - 1$. The level analog is a two-way fixed-effects regression of log population on guild presence with and without the lagged dependent variable. Appendix H.4 gives the derivation and the full tables.

Figure H1 reports the magnitudes. Within cities guild presence is associated with populations about 22 percent higher without conditioning on initial size and about 7 percent higher once initial size is conditioned on, with an implied long-run association of about 14 percent, the same as the matched premium. The growth-on-levels regressions, which identify from variation across cities within countries, imply far more. The steady-state parameter is stable across specifications at about 0.69–0.72, which implies a steady-state population roughly twice as large. In the pre-plague sub-panel the point estimate implies a level shift in the thousands of percent. No urban institution plausibly doubles equilibrium city size. The magnitudes are what Section 4 leads one to expect from a regressor drawn from cities already twice the size of other cities, and the regression framework shows the same selection directly. Initial city size predicts the subsequent duration of documented guild activity (Appendix H.3) and a doubling of initial size predicts about four additional years of documented guild activity over the following century.

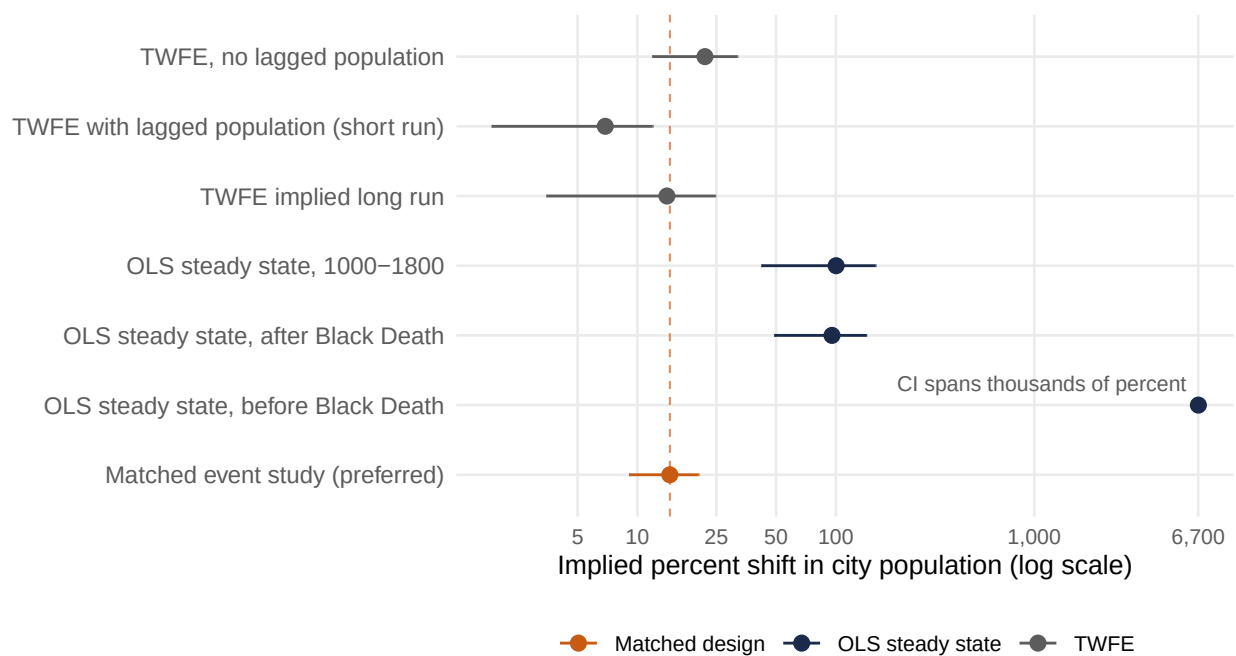


Figure H1: Implied percent shift in city population associated with a full century of guild presence, by specification. Points are delta-method point estimates with 95 percent confidence intervals. The horizontal axis is on a log scale. The dashed line marks the matched event-study estimate. The confidence interval for the pre-Black Death steady-state estimate spans thousands of percent and is omitted for legibility. Full tables in Appendices [H.2](#) and [H.4](#).

Deviations of a city from its steady state decay at about 10–13 percent per century in the full panel, implying a half-life of five to seven centuries, and the rate is about 3.5 percent before the Black Death and about 17 percent after it. At century frequency the pre-modern urban hierarchy is persistent. Growth depends on size, against a strict reading of Gibrat’s law (Gabaix, 1999), and slow convergence is what turns a modest cross-city growth differential into a steady-state multiple of two.

The two-way fixed effects and reverse-causality estimates correspond to Figure H1. The growth regressions correspond to the convergence specification in Eq. (H.1). The event-study coefficient table reports every point plotted in the matched event-study figure.

H.2 Two-Way Fixed Effects Estimates

The two-way fixed effects specification is

$$\log N_{it} = \rho \log N_{i,t-1} + \theta G_{it} + \alpha_i + \gamma_t + \varepsilon_{it}, \quad (\text{H.2})$$

estimated with and without the lagged dependent variable. The implied long-run association with the lag included is $\theta/(1 - \rho)$. It accounts for city-specific characteristics, α_i , and century shocks common to all cities, γ_t , so omitted time-invariant determinants of city size are absorbed. The first column excludes the lagged dependent variable. The naive association between guild presence and population within each city is about 22 percent ($e^{0.198} - 1$).¹² This estimate is likely overstated because it ignores the strong autocorrelation of population over time.

The second specification shows an association between guild presence and urban population similar to the growth specifications of Appendix H.4. City population at the end of the century remains highly autocorrelated with population at the beginning. Cities with guild activity throughout the preceding century had a 7 percent larger population at the end of it than cities of the same initial size without guild activity. Because Eq. (H.2) includes the lagged dependent variable, the short unbalanced panel may bias its coefficient downward (Nickell, 1981, pp. 4–9). Given the positive relationship between lagged city size and subsequent documentation (Table H3), the guild-presence

¹²City fixed effects identify only from cities observed more than once, so the 28 cities with a single usable observation drop out of every specification with city fixed effects. Those specifications use 13,296 observations across 1,726 cities, against 13,324 and 1,754 for the growth regressions, which use country rather than city fixed effects.

Table H1: TWFE: City Population Level

		Log Population
	(1)	(2)
Lag Pop, ρ		0.4945*** (0.0150)
Guild Presence, θ	0.1980*** (0.0418)	0.0666*** (0.0241)
City & Century FE	Yes	Yes
Adj. R2	0.7967	0.8438
N Obs	13,296	13,296
N Cities	1,726	1,726

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

City fixed effects identify only from cities observed more than once, so the 28 single-observation cities drop out.

coefficient θ may correspondingly be biased upward.

Table H2: TWFE: Before & After the Black Death

	Log Population	
	Before Black Death	After Black Death
	1000–1300	1400–1800
Lag Pop, ρ	0.3085*** (0.0308)	0.3479*** (0.0163)
Guild Presence, θ	0.1582*** (0.0504)	0.0425 (0.0284)
City & Century FE	Yes	Yes
Adj. R2	0.9018	0.8296
N Obs	4,644	8,426
N Cities	1,308	1,726

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

Table H2 reports the same TWFE specification for the subpanels before and after the Black Death. Population levels remain highly autocorrelated in both. Guild presence had a more pronounced association with population size before the plague, about 17 percent ($e^{0.158} - 1$), than after it, about 4 percent, an estimate not statistically distinguishable from zero. As in the growth regressions of Appendix H.4, craft guilds had a stronger association with urban population in the

late medieval period than in the pre-industrial period after the Black Death. The two subpanels span the four centuries before and the five centuries after the fourteenth-century plague and may be more subject to Nickell bias than the overall panel.

H.3 Initial Size Predicts Documentation

The selection that Section 4 measures in levels can also be seen within the regression framework by flipping the variables in Eq. (H.2). City population at the start of the century, $\log N_{i,t-1}$, is on the right-hand side and the share of guild presence during the subsequent century is on the left-hand side as in Eq. (H.3).

$$G_{it} = \phi \log N_{i,t-1} + \alpha_i + \gamma_t + \varepsilon_{it}. \quad (\text{H.3})$$

The city and century fixed effects of the previous specification remain.

The relationship between city population at the beginning of the century and the subsequent duration of documented guild activity is positive and precisely estimated. In Table H3 the coefficient on log population at the beginning of the century is 0.06, so a one-log-unit increase in population is associated with roughly 6 more years of guild activity in the subsequent century.¹³ The relationship is statistically significant but its magnitude is muted next to the associations between guild presence and subsequent population of 7 percent (Table H1) and between guild presence and the city's growth trajectory of 7–9 percentage points per century (Table H4).

Table H3: Reverse Causality: Initial Size Predicts Later Documentation

	Guild Presence
Lag Pop, ϕ	0.0586*** (0.0092)
City & Century FE	Yes
Adj. R2	0.3824
N Obs	13,296
N Cities	1,726

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

¹³One log unit is roughly a one-standard-deviation increase. The standard deviation of log population in the panel is 0.92 (Table C1).

H.4 Growth Regressions

This subsection reports the growth-on-levels regressions based on the convergence specification in Eq. (H.1). The specification derives from the adjustment process $N_{i,t+1} = (N_{it}^*)^\lambda N_{it}^{1-\lambda}$, where N_{it}^* is the steady-state population and $\lambda \in [0, 1]$ is the speed of convergence. Taking logs gives $\Delta_{t,t+1} \log N_{it} = \lambda(\log N_{it}^* - \log N_{it})$, and substituting the linear parameterization of the log steady state, $\log N_{it}^* = \beta_0 + \beta_1 G_{it} + \nu_{it}$, yields Eq. (H.1). As discussed in Section 5, the exponentiated steady-state magnitudes implied by these estimates are too large to be taken as causal effects of guild activity. We present them as descriptive associations and as motivation for the matched event-study design in the main text.

Table H4 reports the speed of convergence and the combined association of guilds with the change in population. The speed of convergence is similar in the naive specification of column (1) and the specification of column (2) that controls for country, at $\lambda \approx 0.1$. Consistent with Eq. (H.1), the coefficient on initial population is negative, which indicates an inverse relationship between initial size and subsequent growth. The table reports the absolute value of the convergence rate for ease of interpretation. The combined association of guild presence with growth is also similar in the first two specifications. Guild presence is associated with a centennial growth trajectory 7 percentage points higher.¹⁴

Column (3) of Table H4 includes both country and century fixed effects.¹⁵ The speed of convergence is higher in this specification at 13 percent, which points to a downward bias in the first two specifications. The combined association of guild presence with growth is also higher at 9 percent. The coefficients in all specifications remain statistically significant with Huber-White standard errors clustered by 100 km spatial cluster. The recovered steady-state coefficient, $\hat{\beta}_1 = \widehat{\lambda\beta_1}/\hat{\lambda}$, is consistent across specifications at about 0.69–0.72 (delta-method standard error ≈ 0.15 –0.22, significant at the 1 percent level). Because β_1 enters the steady-state population in logs, a city with guild activity over the entire preceding century has a steady-state population roughly 100 percent higher ($e^{\beta_1} - 1$) than an otherwise comparable city without recorded guild activity. No urban institution plausibly doubles equilibrium city size and we interpret magnitudes of this order as a signal

¹⁴The coefficient on the change in logs approximates the difference in growth in percentage points. The exact percentage difference is $e^{(\lambda\beta_1)} - 1$.

¹⁵Century fixed effects absorb factors that all cities in the panel experienced in a given century.

Table H4: City Population Growth, 1000–1800

	(1)	(2)	(3)
Rate of Convergence, λ	0.0960*** (0.0066)	0.0949*** (0.0068)	0.1282*** (0.0074)
$\lambda\beta_1$	0.0665*** (0.0210)	0.0686*** (0.0207)	0.0891*** (0.0195)
Guild Presence, β_1	0.6936 (0.2146)	0.7222 (0.2119)	0.6947 (0.1480)
Country Controls	No	Yes	Yes
Century Controls	No	No	Yes
Adj. R2	0.0310	0.0327	0.2781
N Obs	13,324	13,324	13,324
N Cities	1,754	1,754	1,754

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

The β_1 row is the ratio $\lambda\beta_1/\lambda$; its standard error is computed by the delta method.

that documented guild presence is itself selected on city size.

These findings are robust to spatial correlation in the regression errors. Re-estimating each specification in Table H4 with Conley spatial-HAC standard errors (Conley, 1999) at a 100 km cutoff, matching the clustering radius, yields standard errors for the guild-presence term $\lambda\beta_1$ nearly identical to the clustered ones (about 0.019–0.022 across columns). Widening the Conley cutoff to 200 km leaves the guild-presence coefficient statistically significant at conventional levels in every specification. In column (3) the coefficient of 0.0891 has a Conley 200 km standard error of 0.0216.

To assess the adjustment process before and after the Black Death we ran the specification of Eq. (H.1) on two subsets of the panel. Table H5 reports the subpanel for 1000–1300 on the left and the subpanel for 1400–1800 on the right. New cities entered the panel throughout the earlier period while the number of cities remained constant in the later one. Both columns include the fixed effects of the third specification of Table H4. The subpanel before the Black Death has fewer cities and covers a shorter period than the pre-industrial subpanel.

The speed of convergence was much sharper after 1400, at 17 percent, than before, at 3.5 percent, which is consistent with greater labor mobility across cities in the early modern era than in the late Middle Ages (De Vries, 1984, pp. 212–213). The association between guild presence

Table H5: City Population Growth Before & After the Black Death

	Before Black Death	After Black Death
Rate of Convergence, λ	0.0350*** (0.0101)	0.1655*** (0.0087)
$\lambda\beta_1$	0.1475*** (0.0435)	0.1111*** (0.0209)
Guild Presence, β_1	4.2210 (1.7410)	0.6710 (0.1216)
Country & Century Controls	Yes	Yes
Adj. R2	0.0265	0.3466
N Obs	4,870	8,454
N Cities	1,534	1,754

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

The β_1 row is the ratio $\lambda\beta_1/\lambda$; its standard error is computed by the delta method.

and population growth was stronger in the earlier period, a growth trajectory about 15 percentage points higher against 11 percentage points after the Black Death. The steady-state coefficient for guild presence, β_1 , was far larger and much less precisely estimated in the pre-plague subpanel ($\beta_1 = 4.22$, delta-method standard error 1.74) than after it ($\beta_1 = 0.67$, standard error 0.12). Exponentiating the pre-1300 estimate implies an implausibly large level shift. Given the smaller subpanel and weaker fit (adjusted R^2 of 0.03 before the plague against 0.35 after in Table H5), we emphasize the qualitative contrast of a stronger guild–population relationship before the Black Death rather than the exponentiated magnitude. After the Black Death a full century of guild presence is associated with a steady-state population about 96 percent higher ($e^{0.67} - 1$).

Recall that our measure of guild presence is the share of a century with any historical mention of an active guild in a city. It carries no information on guild strength or on guilds’ capacity to help or hinder economic development. These results identify only when and by how much documented guilds corresponded with changes in urban population growth.

H.5 Event-Study Coefficient Tables

Table H6 reports every coefficient plotted in the matched event-study figure of the main text together with the matching and control-group variants.

Table H6: Matched Event-Study Coefficients: Log Population

Event time	Band 1.0	Band 0.5	NN 1:2	Not-yet controls
−4	−0.096** (0.032)	−0.076* (0.034)	−0.075* (0.038)	−0.100** (0.032)
−3	−0.034 (0.025)	−0.011 (0.028)	−0.032 (0.030)	−0.037 (0.025)
−2	−0.008 (0.018)	0.001 (0.020)	−0.018 (0.021)	−0.010 (0.018)
−1	0 (ref.)	0 (ref.)	0 (ref.)	0 (ref.)
+0	0.134*** (0.018)	0.114*** (0.020)	0.132*** (0.021)	0.131*** (0.018)
+1	0.159*** (0.026)	0.151*** (0.028)	0.187*** (0.031)	0.153*** (0.026)
+2	0.132*** (0.030)	0.166*** (0.033)	0.192*** (0.040)	0.126*** (0.030)
+3	0.128*** (0.037)	0.198*** (0.040)	0.214*** (0.048)	0.121*** (0.037)
+4	0.126** (0.042)	0.214*** (0.047)	0.218*** (0.055)	0.114** (0.042)

Event time in centuries relative to first documented guild activity; reference period −1. Standard errors clustered by city in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Columns vary the matching rule (baseline-size band caliper 1.0 or 0.5 log points; nearest-neighbor 1:2 without replacement) and the control pool (never- vs not-yet-documented cities).

I Heterogeneity by Guild Strength and Period

The conventional specifications of Appendix H were also estimated by guild strength. Guild strength is mapped to modern-day country boundaries and is time-invariant, so these tests do not account for changes in guild strength over time.

Following Ogilvie’s classification, cities in the British Isles and Low Countries are treated as having “weak” guilds, cities in France, Italy, Switzerland, and Luxembourg as “intermediate”, and cities in Austria, Germany, and Iberia as “strong”. Cities in all other countries are labeled “other”.¹⁶

Table I1 reports the OLS growth regression with guild-strength fixed effects in place of country fixed effects. The substitution dampens the association between guild presence and population growth. The implied steady-state shift is about 86 percent ($e^{0.62} - 1$), slightly below the roughly 100 percent estimate in Table H4.

The same OLS specification with country and century fixed effects was estimated on three subpanels of cities grouped by guild strength. Column (1) of Table I2 reports cities in weak-guild countries, where guild activity throughout the preceding century is associated with a steady-state population about 240 percent higher ($e^{1.23} - 1$). Guild presence in intermediate-guild countries (column 2) is associated with 8.5 percentage points more centennial growth and a steady-state

¹⁶See Appendix B.6.

Table I1: OLS Growth Estimates with Guild-Strength Fixed Effects

	Population Growth
Rate of Convergence, λ	0.1246*** (0.0073)
$\lambda\beta_1$	0.0776*** (0.0195)
Guild Presence, β_1	0.6225 (0.1541)
Guild-Strength FE	Yes
Century FE	Yes
Country FE	No
Adj. R2	0.2768
N Obs	13,324
N Cities	1,754

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

The β_1 row is the ratio $\lambda\beta_1/\lambda$; its standard error is computed by the delta method.

Table I2: OLS Growth Estimates by Guild-Strength Subpanel

	Weak	Intermediate	Strong
Rate of Convergence, λ	0.1474*** (0.0189)	0.1029*** (0.0108)	0.1538*** (0.0123)
$\lambda\beta_1$	0.1807*** (0.0467)	0.0853*** (0.0261)	0.0736** (0.0279)
Guild Presence, β_1	1.2262 (0.3152)	0.8286 (0.2482)	0.4788 (0.1768)
Country & Century FE	Yes	Yes	Yes
Adj. R2	0.2627	0.3514	0.2864
N Obs	2,195	5,939	4,353
N Cities	309	737	566

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

The β_1 row is the ratio $\lambda\beta_1/\lambda$; its standard error is computed by the delta method.

population about 129 percent higher ($e^{0.83} - 1$). Strong-guild countries in column (3) show the weakest relationship, about 7 percentage points more centennial growth and a steady-state shift of about 61 percent ($e^{0.48} - 1$).

The rate of convergence is roughly 15 percent in weak- and strong-guild countries and 10 per-

cent in intermediate-guild countries. Each is close to the overall rate of 13 percent in the full panel.¹⁷

¹⁷See column (3) in Table [H4](#).

Table I3: TWFE by Guild-Strength Subpanel

	Log Population		
	Weak	Intermediate	Strong
Lag Pop, ρ	0.4913*** (0.0382)	0.5092*** (0.0230)	0.4802*** (0.0254)
Guild Presence, θ	0.1101* (0.0624)	0.0709*** (0.0233)	0.0515 (0.0397)
City & Century FE	Yes	Yes	Yes
Adj. R2	0.8241	0.8879	0.8143
N Obs	2,185	5,931	4,347
N Cities	299	729	560

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Huber-White standard errors clustered by 100 km spatial cluster.

Table I3 reports the TWFE level specification of Eq. (H.2) estimated separately for each guild-strength subpanel. The lagged dependent variable, city population at the beginning of the century, is included and its coefficient remains high. The relationship between guild presence and city size follows the same pattern as the OLS growth regressions. Cities in weak-guild countries show a stronger relationship between guild activity and population size and city populations in strong-guild countries show little relationship with guild presence over the nine centuries. Although these tests rest on a classification that does not change over time, they illustrate how guild presence and city dynamics varied across Europe.

I.1 Matched Event-Study Heterogeneity

Figure 11 reports the matched event study of Section 5.1 estimated separately by Ogilvie’s guild strength and by cohort relative to the Black Death. The premium is positive in every group but decreases with guild strength, from about 0.26 in weak-guild countries to 0.12 in intermediate and 0.08 in strong, and it is somewhat larger for cohorts first documented at or before 1300 (0.18) than for later cohorts (0.11). The strength gradient is consistent with the restriction channel emphasized by Ogilvie operating at the margin of a net-positive association. The guild-strength classification is defined at the country level, however, and the weak-guild group comprises the British Isles and the Low Countries, the regions that also differed from the rest of Europe in trade access, agricultural productivity, and political institutions after 1500 (Acemoglu et al., 2005). The gradient therefore cannot be separated from everything else that distinguishes northwestern Europe and we present it as descriptive.

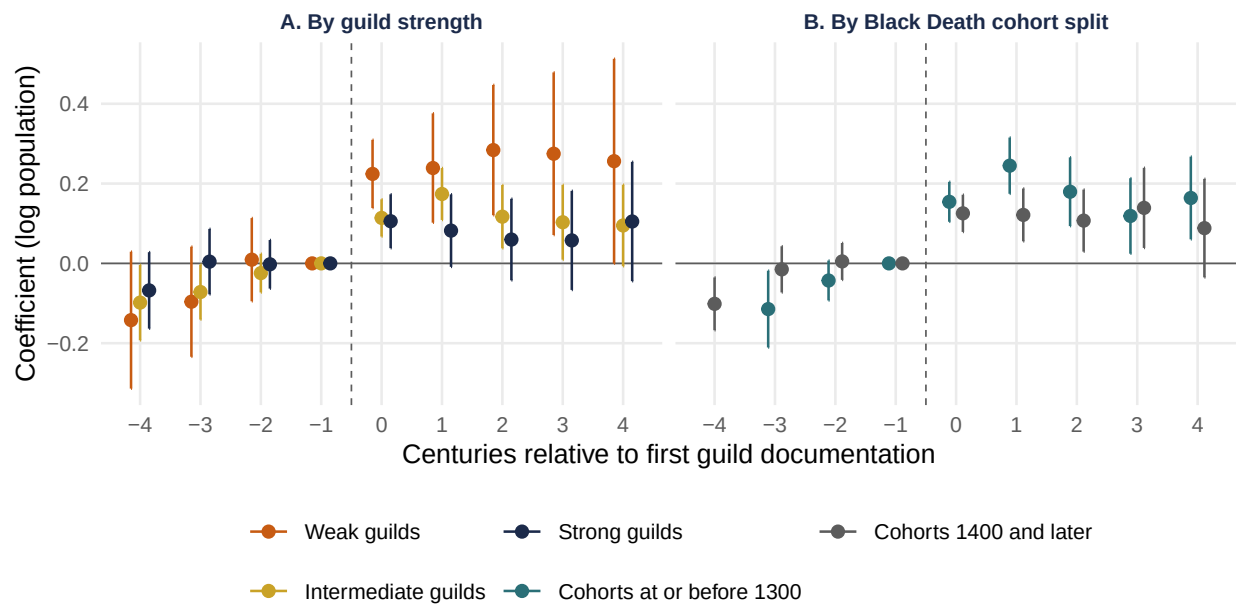


Figure 11: Matched event-study heterogeneity. Panel A splits the matched design by Ogilvie’s guild strength. Panel B splits by cohort of first documentation relative to the Black Death. Log population, 95 percent confidence intervals, standard errors clustered by city.

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