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Creativity over Time and Space

A Historical Analysis of European Cities*

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Abstract

Creativity is often highly concentrated in time and space, and across different domains. What explains the formation and decay of clusters of creativity? We match data on notable individuals born in Europe between the XIth and the XIXth century with historical city data. The production and attraction of creative talent is associated with city institutions that protected economic and political freedoms and promoted local autonomy. Instead, indicators of local economic conditions such as city size and real wages, do not predict creative clusters. We also show that famous creatives are spatially concentrated and clustered across disciplines, that their spatial mobility has remained stable over the centuries, and that creative clusters are persistent but less than population.

Keywords: innovation, agglomeration, political institutions, immigration, gravity, human capital. JEL: R10, O10, J61, J24

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1 Introduction

Creativity is often highly concentrated in time and space, and across different domains. In the XV century, Florence was home to an amazing number of groundbreaking innovators in literature, paintings, sculpture and philosophy. At the turn of the XIX century, Vienna hosted pioneers in paintings, medicine, biology, psychology, philosophy, music, who interacted with each other. Antwerp in the XVI century, London and Paris in the XVII and XVIII centuries, San Francisco and New York in the past few decades, are other recent examples (Banks, 1997; Kandel, 2012).

What explains the formation and decay of such creative clusters? Are they driven by local economic conditions, by specific features of local institutions, or by mere chance? More generally, asides from these exceptional clusters, how concentrated are creative activities in time and space and across fields? And most important of all, what general lessons can be drawn from the historical analysis of creative clusters, to foster innovation and the production of creative talent? Given the central role of innovation in human progress, knowing the answer to these questions is particularly important.

In this paper we analyze data on European creative elites born in the XI-XIX centuries. We exploit information on the date and place of birth and death of notable individuals in arts, humanities, science and business. Our main source is *Freebase.com*, a large data base owned by Google and coded by Schich et al. (2014), that stores information from a variety of publicly editable sources, most notably Wikipedia. After integrating these individual data with additional information scraped from the internet, we match them with a historical data set on European cities and local institutions put together by Bairoch et al. (1988) and Bosker et al. (2013). Our unit of observation is thus a city in a particular century between the XI and XIX centuries.

Notable individuals in creative endeavours are a measure of upper tail talent and human capital. They are more likely to capture radical innovations and creativity, compared to general indicators of human capital. Moreover, these data cover periods and domains where patents data are not available. They are thus suitable to study the formation and decay of creative clusters, something that takes place over the long run. As discussed in the next section, our indicators of local creativity are correlated with measures of technological innovation and micro-inventions collected by Meisenzahl and Mokyr (2011) for the UK in the period leading to the Industrial Revolution.

We consider two main variables. First, the number of famous people born in a city (per 1000 inhabitants) during a century. Births of famous creatives are a measure of the local opportunities for innovation offered to highly talented young individuals. As emphasized by Kubler (1962), radical innovations in arts and science reflect a fortuitous match of individual predispositions with local opportunities for innovation.[1] From this perspective, location of birth is more informative

[1] "When a specific temperament interlocks with a favorable position, the fortunate individual can extract from the

than location of death, because the external environment has a greater impact when individuals are young than when they are old, by providing role models and opportunities for social learning and training - see also Bell et al. (2019).[2]

Our second variable of interest is the number of famous immigrants, defined as the number of deaths (per 1000 inhabitants) of famous creatives born elsewhere. This variable reflects mobility late in life, and captures the attractiveness of a locality for famous creatives due to opportunities for professional enhancement or market for one's services. Given the breadth of our data in terms of time, geography and disciplines, we don't have information on where these notable individuals did their most important work. We doubt that this is an important omission, however, since any invention reflects ideas and experiences accumulated through a life time.[3]

We provide two main findings. First, there is no evidence that local economic conditions play an important role in the formation or decay of creative clusters, except in a few specific disciplines. In line with other historical studies - eg. Bosker et al. (2013, p.1418) - we use urban population as an index of local economic conditions. Neither current nor lagged population are correlated with famous births or immigrants, although there is some heterogeneity across disciplines: changes in births of famous non-performing artists and in deaths of famous immigrants in business are preceded by changes in population in the same direction. Population size is an imperfect measure of local economic conditions. We thus repeat the analysis with historical data on real wages of skilled workers. Here the sample only includes about 30 major European cities, but time is measured in decades rather than centuries, and for most cities the period goes from 1400 to the mid XIX century. There is no evidence that wages started increasing before famous births or the arrival of famous immigrants. This is true for all disciplines. A possible concern with wage data is that they do not exhibit enough variation, but there is no correlation with creativity even if we restrict the sample to cities and decades where wage variation is more pronounced. On the other hand, our wage data do predict urban population, indicating that they vary sufficiently to have explanatory

situation a wealth of previously unimagined consequences. This achievement may be denied to other persons, as well as to the same person at a different time. Thus every birth can be imagined as set into play on two wheels of fortune, one governing the allotment of its temperament, and the other ruling its entrance into a sequence. ...By this view, the great difference between artists are not so much those of talent as of entrance and position in sequence. ....Predispositions are probably much more numerous than actual vocations allow us to suppose.....Times of opportunities differ more than the degree of talent. " Kubler (1962), p. 7, 8.

[2]Interactions between creatives who sustain and encourage each other while at the same time competing are particularly important in the early stages of artistic or scientific careers. Quoting from Galenson (2009, p.278) : "Location matters to artists primarily early in their careers, because of the need of contacts with other artists". Galenson (2009) contains several examples of the importance of collaborations amongst young artists. For instance, referring to the interaction between Picasso and Braques, Picasso is quoted as saying: "Almost every evening, either I went to Braque's studio, or Braque came to mine. Each of us *had* to see what the other had done during the day". Galenson (2009), p. 37.

[3]Quoting again from Kubler (1962), p. 6: "In the long view, biographies ... are only way stations where it is easy to overlook the continuous nature of artistic traditions".

power in other contexts.

This finding may seem surprising to economists, and it could reflect measurement error in our indicators of economic conditions. But it is in line with historical anecdotal evidence. Although there are instances where good local economic conditions and artistic florescence went hand in hand, like the emergence of a market for Belgian and Dutch paintings in the XV and XVI century (De Marchi and Van Miegroet, 2006), there are also prominent examples that point in the opposite direction. For instance, London under queen Elisabeth, Florence during the Renaissance, and Spanish cities in the XVII century are examples of peak creativity achieved during difficult economic times, while rich Genoa remained in artistic obscurity for several centuries.[4]

Our second main result is that, instead, the agglomeration of creative individuals is strongly correlated with being a free city, as measured by the dummy variable "Commune" coded by Bosker et al. (2013). Becoming a Commune is followed by a rise in births of famous creatives and an inflow of famous immigrants. The association between city institutions and famous births is illustrated in Figure 1. The treatment variable is Commune, and it is measured at about the beginning of each century. Becoming a Commune (date 0 in Figure 1) is associated with a 5 percentage point increase in the births of creative individuals (per 1000 inhabitants) during the same century (an increase of about 25% relative to the average number of famous births), with an additional increase in the subsequent century. We obtain similar results in a gravity model where we study the bilateral flow of creative immigrants across European cities, using a diff-in-diff methodology. Economic and political freedoms make a city an attractive destination: becoming a Commune is associated with an increase in the inflow of notable individuals, that almost doubles in size.

The institutions typical of free cities had several implications of great relevance for the agglomeration of creative activities. First, Communes protected basic economic freedoms and promoted trade. As emphasized by Cox (2017), self-governing cities were often in competition to attract merchants and financial capital, as well as talents and human capital. This made free cities a dynamic social environment, in frequent contact with other trading centers and open to external ideas and innovations. Second, Communes guaranteed freedom of movement and from censorship and other personal freedoms; for this reason they often received exiles escaping religious or political persecutions from elsewhere. "Immigrants would settle in towns because they sought liberty, not

[4]Banks (1997) writes: "Elizabethan London (the apogee of English Renaissance - ed.) suffered “dearness without scarcity” (inflation); this fell most heavily on the aristocracy and the very poor. Then the wool trade collapsed, England entered “the worst economic depression in history” (Wilson, 1965), and Parliament anxiously debated means of averting a Bellum Rusticum." Lopez and Miskimin (1962) describe a similar picture for Renaissance Florence, presenting four pieces of evidence for this period: (a) an increase in the fraction of the poor; (b) a decline in the city’s population; (c) the fact that the Medici bank had around half the capital of the Peruzzi bank in 1340; (d) a decrease in wool production. Spanish cities in the XVII century are yet another example of negative correlation between artistic excellence and economic prosperity: "XVII century Spain was an epoch of staggering economic difficulties above which painting, poetry, and the theater flowered imperishably" (Kubler 1962, p. 114) - see also Lopez (1953).

simply because they wished to trade." (Bartlett, 1993) - see also Burke (2016). Third, Communal institutions created an inclusive social order, that reinforced civic and social capital and emphasized the importance of the common good over particularistic interests. These cultural traits created a fertile ground for innovative activities that would benefit all, such as the pursuit of knowledge and artistic creations.[5] Creative activities directed towards the common good were also incentivized by the Commune. To consolidate their autonomy and territorial expansions and to strengthen identification with the community, independent cities promoted works of art that could become symbols of the city and enhance its prestige - see for instance Paoletti and Radke (2005), Connell (2002) on Florence and Norman (1999) on Siena. All these features of Communes encouraged creative activities and radical innovations, compared to cities that did not have these special institutions.

As described by Pirenne (2014) and Parker (2004), communal institutions often evolved from within the city, and were guided by the aspiration of the urban middle classes to gain freedom and independence from external influence (primarily in opposition to the Church or an external Lord). In some cases, autonomy and freedom were granted in order to encourage new settlements during periods of intense migration (Bartlett, 1994). An obvious concern, therefore, is that the economic and social changes that led to the emergence of communal institutions also had a direct effect on creative endeavors, for instance by creating a demand for works of art or of education. Our first finding, that economic conditions are not correlated with current of subsequent creativity, reduces this concern somewhat. Nevertheless, to limit the scope of omitted variables, we construct two instrumental variables. Our main instrument exploits the idea that political transitions were facilitated by external forces, such as a vacuum of regional powers or contagion effects in the aspirations of cities. The diffusion of communal institutions occurred in regional waves. Communes emerged in Northern Italy between the XI and XII centuries, then they spread to Southern France; nearly at the same time as in Italy, Communes also began to appear in the Flanders and in Northern France (Pirenne 1925). Independent cities emerged in Germany in the XIII century, also in association with migration to the East where imperial control was weaker (Parker, 2004). According to historians, these patterns reflect regional factors that influenced the transition into Commune, such as wars of succession at the time of death of the local lord overseeing an entire region, or an enfeebled sovereign, or the support of the Church against imperial bishops during the Investiture Conflict (Tierney, 1983; Rubin, 1986; Parker, 2004; Becker et al., 2020). External forces could also work in reverse if regional external threats induced transition into despotic rule (as with the Signorie in Italy), or if the consolidation of central states deprived cities of their autonomy. These regional factors also reflected knowledge spillovers and contagion effects in the design of political

[5]Quoting from Brucker (2015), p. 30 "Central to the Commune's function was the premise that its corporate components, representing the interests of particular groups, would reconcile their differences within its ambit and under its guidance. Once defined, the common good (il ben comune) was expected to take precedence over the interests of any specific group or constituency."

institutions. As emphasized by Bartlett (1993), towns imitated successful institutional innovations of others, giving rise to families of urban law.[6] To capture these effects, we instrument Commune with the incidence of Commune in the remainder of the region (defined by current NUTS 1 administrative borders), adapting a strategy introduced by Persson and Tabellini (2009) and Acemoglu et al. (2019) in studying democratic transitions. The identifying assumption is that, conditional on time and city fixed effects and other covariates, the regional waves of institutional transitions influence city level creativity only through the city political institutions. To make this assumption less restrictive, we also control for regional waves of creativity (measured by the spatial lag of births of notable individuals in the region). These IV estimates confirm the results of the event study and are very robust. On average, births of creative people increase by 10 percentage points or more during the century (almost a 50% increase relative to the average), upon a transition into Commune.

As a robustness check, we also rely on a second instrument inspired by Schulz (2019): whether a city was exposed to the medieval Church policy of banning cousin-marriage. As argued by Goody and Goody (1983), this religious innovation led to the dissolution of kin networks in early medieval Europe. This resulted in profound cultural transformations, also documented in Schulz et al. (2019), which in turn facilitated the emergence of participatory political institutions. Schulz (2019) shows that exposure to medieval Church predicts weak kin networks across countries, European regions and ethnicities, and that more intense and prolonged exposure to the Church policy is associated with commune formation. The Church exposure variable constructed by Schulz (2019) varies over time and it is not strongly correlated with our first instrument, the regional incidence of Commune in each century. Using Church exposure as a second instrument for Commune confirms the robustness of our estimates.

Finally, the paper describes a number of stylized facts on the temporal and spatial patterns of creative clusters. First, births of creative people and famous immigrants are more *spatially concentrated* than population, and they are *clustered across disciplines*. Hence spillover effects associated with local proximity and/or local factors are important for creative activities, and operate across disciplines and not just within each field. This finding is consistent with the discussion and evidence in Jacobs (1969) and Glaeser et al. (1992).[7] Second, births and immigration are *persistent*, but less than population. Cities that are at the frontier of creativity in one period retain an advantage that persists for a while but not indefinitely. This too echoes similar results on clusters of innov-

[6] One example discussed by Bartlett (1993) is the law code of Cuenca-Teruel, that spread in Southern Spain with the Reconquest of previous Mulsim territories during the XII and XIII centuries. Other well known examples are the legal codes of Lubeck and Magdeburg, that were widely imitated in the Baltic region and in Northern Germany in the XIII century.

[7] Jacobs (1969) emphasizes the significance of urban variety and argues that it nurtures cross-fertilization of ideas. Glaeser et al. (1992) find that urban diversity fosters employment growth in industries.

ation (Saxenian, 1994; Duranton, 2007; Kerr, 2010). Estimating a transition matrix, we also find that persistence of creativity is higher at the bottom of the distribution than at the top. Most small and uncreative cities remain in that condition. But at the top of the distribution there is more reshuffling in creative clusters than for population: while most large cities keep growing and remain large, creative clusters exhibit more change over the centuries. Third, the overall spatial proximity of births and the distribution of birth-to-death distances *did not change much* over the centuries. This stability is somewhat surprising, in light of the consolidation of states and the improvements in the means of transportation throughout this period. It suggests that the agglomeration of creative activities is not very sensitive to the cost of transportation and communication, but reflects historically stable forces.[8]

Our paper is related to a large literature. A strong link is with the important work of Mokyr (1990) on the history of technology, and Mokyr et al. (2002) and Mokyr (2016) on the flow of ideas across Europe, and their role in the industrial revolution. Mokyr (2002, 2016) mostly focus on the second half of our sample period, and emphasize the importance of interactions within a European community of intellectuals. Our results suggest that self-governing cities were an important component of the relatively free environment in which these exchanges thrived. Our paper is also related to Cox (2017), who argues that local autonomy and economic freedoms were key to European growth in the period leading to the industrial revolution. Finally, our study is also motivated by the literature on upper tail human capital and the industrial revolution (Mokyr, 2009; Meisenzahl and Mokyr, 2011; Squicciarini and Voigtländer, 2014).

The link between democratic institutions and innovation has been studied in the context of economic growth by Acemoglu and Robinson (2012) and Acemoglu (2008), while De Long and Shleifer (1993), Bosker et al. (2013) and Guiso et al. (2016) have shown the positive relationship between political institutions and urban development. Others have investigated how local cultural traits affect innovation. In particular, Bénabou et al. (2015a) and Bénabou et al. (2015b) show that religiosity is negatively correlated with indicators of innovation. See also Saxenian (1994), Florida (2005), Falck et al. (2011), Acemoglu et al. (2014), Akcigit et al. (2017a) and Akcigit et al. (2017b).

Our paper is also related to a growing literature on innovation. One line of research, surveyed in Carlino and Kerr (2015), analyzes the connections between agglomeration and innovation. Agglomeration advantages are also reviewed by Combes and Gobillon (2015). Much of this research focuses on recent periods and exploits patent data.

A similar historical perspective to ours is taken by a set of studies using microdata on upper tail human capital, such as Schich et al. (2014), De la Croix and Licandro (2015), Gergaud et al. (2016)

[8]Using more detailed data on famous European musical composers, O'Hagan and Borowiecki (2010) also find that the patterns of their internal migration and emigration have been remarkably stable since the 14th century.

and Laouenan et al. (2021). [9] In particular Gergaud et al. (2016) analyze a database of more than one million famous individuals and more than seven million places associated with them throughout human history (3000BCE-2015AD). They document several interesting facts regarding notable people, including a positive correlation between the number of entrepreneurs and artists and subsequent urban growth, which is consistent with our evidence, and a zero or negative correlation between the share of "militaries, politicians and religious people" and urban growth. Relative to their paper, we focus on the effects of local self-government institutions on the formation of creative clusters. More recently, De la Croix et al. (2020) have studied the mobility decisions of scholars across European universities; relative to this paper, our sample also includes creatives who were not affiliated with any university, such as artists and members of scientific academies. Since the number of individuals in our data set is somewhat smaller than in De la Croix et al. (2020), particularly in the earlier period, our sample is more likely to represent the upper tail of the distribution of creatives. Finally, two related papers study the effects of local institutions on innovation, using historical data on Germany. Donges et al. (2016) show that counties whose institutions are more inclusive as a consequence of the French occupation after 1789 turn out to be more innovative (in terms of patents per capita). Dittmar and Meisenzahl (2020) show that cities enacting in the XVI century legal reforms that established mass public education and increased state capacity began differentially producing and attracting individuals with upper tail human capital.

The outline of the paper is as follows. The next section defines the data and their sources. Section 3 describes a number of stylized facts about the spatial and temporal distribution of creativity. Section 4 studies the correlation between indicators of economic conditions and creativity, while section 5 focuses on the relationship between local institutions and the births of famous creatives. In Section 6 we study the migration of famous people between European cities. Section 7 discusses future directions and concludes.

2 Data and Variable Construction.

The data used in this paper cover Europe between the XI and the XIX century, and matches information on notable individuals with population and institutional variables at the city level.

Notable Individuals The records on notable individuals come from *Freebase.com*, as coded by Schich et al. (2014). Freebase is a "large Google-owned knowledge base that is publicly

[9] For related work on creative inviduals in music and visual arts (and more recent periods) see Hellmanzik (2010), Borowiecki (2013), Borowiecki (2015) and Mitchell (2016). Scherer (2004) studies the lives of several hundreds of famous musicians, focusing on the transition between patronage and free lance in shaping the market for the services of these artists. See also Murray (2003) for a boader and more descriptive historical analysis of the determinants of human accomplishments in arts and sciences.

editable and available under a Creative Commons Attribution (CC-BY) license, which allows for both sharing and remixing of the data" (Schich et al. Supplementary Material, p.2). It stores information from a variety of sources, most notably Wikipedia, and contains dates and locations of birth and death, as well as occupations, of notable people. Location information in the records is geocoded, making good quality latitude and longitude data available. Notability of people is "simply defined as the curatorial decision of inclusion" in the (partly crowd-sourced) Freebase (Schich et al. 2014), p. 558). Using these records, we identify 40,980 notable individuals who can be matched by city of birth and/or city of death to the Bairoch et al. (1988) sample (described below). If an individual is born or dies in a small city not included in the Bairoch et al. (1988) sample, we assign it to the closest city in the sample.[10] Of these individuals, we retain 21,906 who became famous thanks to their creative endeavours in the following domains: arts (performing and non-performing), humanities and science, and business. Table 1 provides a count of the individuals active in each domain. The last row reports the total number of creatives.[11] Famous creatives in performing arts include: actors, singers, musician, playwrights; in non-performing arts: writers, novelists, journalists, composers, authors, architects; in humanities and science: mathematicians, physicians, philosophers, scientists, physicists, chemists, historians; in business: entrepreneurs, engineers, business-persons, sailors, managers. A further breakdown of polymaths is available in Table A.1.[12]

Using this information, we define the variable $\textit{Births}_{ct}$ as the number of famous creatives born in city c during century t, per 1000 inhabitants at the beginning of each century. This variable measures the city production of upper-tail creative human capital. As a measure of attraction of upper-tail human capital, we define the variable $\textit{Immigrants}_{ct}$ as the number of deaths in city c of famous creatives born elsewhere during century t, also per 1000 inhabitants. For individuals

[10] Less densely populated areas (mostly in Russia) have few cities included in Bairoch et al. (1988) and distance to the closest city can be large. We thus impose a threshold of 71 Km (corresponding to the 95th percentile of the distance distribution); if distance exceeds this threshold the observation is not included in our sample.

[11] About 25,580 individuals are left unclassfied in Freebase.com. For about 10,500 of these, we were able to establish the main area of work by scraping the internet in March 2017. The last row of Table 1 is not the sum of the rows above, because some creatives were active in more than one domain. The vast majority (86.2%) did all of their work in a single area. Another 12.6% had achievements in two fields, while 1.1% achieved fame in three different categories. A few individuals were prominent in all four fields.

[12] Several theologicians and jurists are included in our sample of creatives, because they were classified as philosophers or active in education. Some prominent examples are San Francis of Assisi, Thomas Aquinas, Martin Luther, John Calvin; Baldo degli Ubaldi, Huig de Groot, Cesaria Beccaria, who are all included in humanities and sciences. The remaining individuals in the Freebase.com database but not included in our analysis were either unclassifiable, or operated in domains were creativity is less important (sports and governance, which includes politicians, administrators, judges, diplomats, soldiers, priests, social activists). Of these, over 800 and almost 700 were active in law and religion respectively, apparently in administrative roles. Adding these other famous lawyers and priests to our sample would not materially change our results. We redefined the variables of interest Births and Immigrants described below to also include these other lawyers and priests in our count of creatives. Their correlation coefficient with the variables Births and Immigrants actually used in the paper is 0.997 and 0.998 respectively.

who die in a century different from that of birth, we face a problem. Ideally, we would like to attribute these famous people to the century in which their migration decision was taken. Hence, using the century of death risks erroneously posticipating their migration decision, while using the century of birth risks erroneously anticipating their migration decision. One of our goals is to estimate the effect of a change in city institutions (or other observables) on migrations. Using the century of birth (irrespective of the century of death) minimizes the risk of erroneously attributing to institutional changes outcomes that actually took place earlier.

Table 2 reports descriptive information on the number of famous creatives (unscaled by city population) born and immigrated in all the cities and total city population in our sample - the city sample by Bairoch et al. (1988) described below**.** The Table shows that there is substantial mobility of famous creatives in each century: the number of immigrants is a large fraction of the number of births, even in earlier centuries. Note that there are much fewer famous creatives in earlier centuries.

Our dataset is very broad in terms of time, geography and discipline. Since the universe from which famous creatives are drawn is open ended, our sample includes individuals who became famous for their achievements, and it is not restricted to members of specific professions or institutions. In particular, compared to De la Croix et al. (2020), our data also include artists and members of scientific academies who were not affiliated with any European university. This broadness comes at the cost of some limitations, however. As notability is not based on uniform criteria, selection into the sample reflects the idiosyncrasies of crowd-sourcing. First, as illustrated in Table 2, we have better records of more recent individuals. Second, Freebase editors may have an English Bias and a Western Bias, as well as a gender bias towards males (Yu et al., 2016; Laouenan et al., 2021); furthermore the database may be unsuccessful in recording information on works where the participation of creative groups (e.g. orchestras or research teams in firms) outdoes that of creative individuals. In our regression analysis we always include century fixed effects and city fixed effects, which address these concerns.[13] Third, it is possible that information is more readily available for individuals that were born in (or migrated to) cities that at the time were renowned centers of excellence in their discipline. If so, our data would overweight creative clusters and discount cities that only gave birth to (or attracted) a few famous creatives. This kind of non-linearity would not be a problem, however, since our goal is to describe and explain patterns in clusters of creativity, more than explaining the location of a few isolated innovators. The opposite mismeasurement is also possible: young individuals born in the vicinity of an existing creative cluster are likely to move there in their formative years, and yet we may classify them as not born in the creative cluster because their birthplace is a city nearby - see the brief narrative on Florence in the

[13]We have verified that indeed our estimated city fixed effects are correlated with linguistic distance between English and the main language spoken in each city.

early Renaissance (Section A.I of the Appendix) for some prominent examples. A more serious concern would be over-recording of famous creatives who were born or died in important political and economic centers, because this would create spurious positive correlation with some of our variables of interest. This may be an issue for state capitals, but it is less likely to be a problem for the cities that became commune, given that in our analysis we control for city population.

A final limitation is that these data treat all notable individuals equally, without weighting them by their achievements and visibility. Below we also discuss the robustness of our results to a similar data set that weights individuals by citations. Specifically, Yu et al. (2016) collect records of individuals present in more than 25 languages in Wikipedia, which contain dates and locations of birth, as well as occupations. Compared to the dataset constructed by Schich et al (2014), this dataset is significantly smaller and does not include information on the place of death. However, it is manually verified, and it is enriched with the Historical Popularity Index (HPI), a measure that integrates information on the number of languages in which a biography is present in Wikipedia, the time since birth, and the number of page-views between 2008 and 2013. Moreover, the creatives in Yu et al. (2016) belong to the upper tail of the fame distribution in Schich et al (2014), which also addresses concerns related to city-based determinants of visibility for lesser known individuals. Using these records, we identify 1583 notable individuals who (a) can be matched by city of birth to the Bairoch et al. (1988) sample and (b) became famous thanks to their creative endeavours in the arts (performing and non-performing), humanities and science, and business. We define the variable *Births, Yu et al.*$_{ct}$ as the HPI-weighted number of famous creatives born in city c during century t, per 1000 inhabitants at the beginning of each century. The correlation between *Births* and *Births, Yu et al.* is 0.48.

Finally, a word on the timing of construction of the records of notable individuals in our sample. Freebase editors are our contemporaries, and this has the advantage of generating some distance between the date of the innovation and the construction of their record, or of the weights used by Yu et al. (2016). This distance arguably allows for a better assessment of breakthrough ideas that may have been too radical (and therefore not accepted) at the time of conception.[14] The creators of this type of innovation would be more likely to be recorded in posterous editions than by their contemporaries. And conversely, individuals generating fashionable ideas that did not stand the test of time would be less likely to be recorded in posterous editions. All that said, we have compared *Births* with records from the *Index Bio-bibliographicus Notorum Hominum (IBN),* which was compiled from around 3000 biographical sources (mainly dictionaries and encyclopedias) with year of publication between 1600 and 1980 - see De la Croix and Licandro (2015). We define the variable *Births, IBN.*$_{ct}$ as the number of famous creatives in IBN born in city c during century t, per

[14]The artists van Gogh and Gauguin are two example of creatives whose works were acclaimed only after their deaths.

1000 inhabitants. Unfortunately the geocoding information available to us covers only 59 cities in our estimation sample. We therefore cannot perform our main estimation analysis with these data. However, the correlation between our variable *Births* and the variable *Births, IBN* is 0.57.

Correlation with measures of technological innovation The famous creatives included in our sample are not such a large number. Hence, we are really measuring the upper tail of creativity and innovation, particularly in the early part of the sample where the numbers are smaller. This is not necessarily a drawback. Since the returns to innovation are often highly non-linear, a focus on exceptional clusters of creativity is particularly appropriate. Nevertheless, there is evidence that these exceptional clusters were also a locus of less radical innovation. Meisenzahl and Mokyr (2011) collected data on mechanics and engineers born in UK between 1660 and 1830, and on the patents that they created.[15] Many of these individuals were not great inventors, but rather highly skilled and able craftsmen, who adapted new technologies and provided micro innovations. Almost one third of the 747 innovators in Meisenzahl and Mokyr (2011) are also included in our sample of famous creatives - probably the individuals with greater accomplishments. But interestingly, our variable *Births* is also correlated with the birthplace of the remaining mechanics and engineers, included in Meisenzahl and Mokyr (2011) but not classified as notable individuals in our sample.

Specifically, from the Oxford Dictionary of National Biography we obtained the place of birth of the innovators in Meisenzahl and Mokyr (2011) *not* in our sample, and matched it with the cities in our data set. Let *Inventors* be the number of mechanics and engineers born in a city during a century (per 1000 inhabitants), and *Patents* be their number of patents (also per 1000 inhabitants), both variables restricted to the individuals in Meisenzahl and Mokyr (2011) that are *not* in our data set. We then regress *Log(1+Inventors)* and *Log(1+Patents)* on *Log (1+Births)* plus other city observables corresponding to all the other city covariates described below (namely, the variables *Large state, Bishop, Archbishop, Capital, Plundered, Commune, Population, University)*. As shown in Figures A.1 and A.2 in the Appendix, that depict the added-variable plots, our variable *Births* is positively and significantly correlated with both dependent variables. Specifically, a 10 p.p. change in *Births* is associated with a 1.8 p.p. change in *Inventors* and a 1.6 p.p. change in *Patents.*[16] Thus, for the UK between the XVII and XIX centuries, our proxy for production of creative talent predicts indicators of local innovation, and in particular of the technological micro-innovations that contributed to the industrial revolution.

[15]Meisenzahl and Mokyr (2011, p.42) argue that Britain's industrial precocity owed a great deal to "the technical competence of the British mechanical elite that was able to tweak and implement the great ideas and turn them into economic realities".

[16]Since $Births_{ct} < 1$ (for the vast majority of observations) and $Log(1 + Births_{ct}) \approx Births_{ct}$, we talk of percentage point changes. This is an abuse of language because some cities have *Births* > 1, even though it is true that most observations are between 0 and 1.

European Cities City population is measured at about the beginning of each century. The source is Bairoch et al. (1988). This is a wide-ranging database with information on 2,200 European cities that reached 5,000 residents between 800 and 1,800.[17] Given the scarcity of data on notable individuals in the very early part of the sample, we restrict the analysis to the period between the XI and the XIX centuries, interpolating population for the missing century 1100.[18] In some sensitivity analysis, for Italian cities we also use the population data of Malanima (1998). Information on socio-economic and institutional variables comes from Bosker et al. (2013), who, for a subset of the cities in Bairoch et al. (1988), assembled a large database covering an extensive array of institutional characteristics of European cities between the IX and the XIX centuries. The sample covered by Bosker et al. (2013) includes all cities in Bairoch et al. (1988) that reached 10 000 inhabitants between 800 and 1,800. In our analysis on the effect of institutions, our sample is always that of Bosker et al. (2013), except in section 3 where we describe the main features of the data and we rely on the larger sample of cities by Bairoch et al. (1988). Both panels of cities are unbalanced: because of the gradually increasing (urban) population, the number of cities increased during our sample period (Bosker et al., 2013, p.1421). Note that the data coded by Bosker et al. (2013) seek to capture the institutions that were in place at the beginning of each century. Thus, institutional changes that took place during century t would generally show up in century $t + 1$. In other words, although undoubtedly measured with much timing error, our data are more likely to erroneously postpone institutional changes rather than viceversa, compared to our outcomes of interest (births and immigrations of famous people) - a conservative feature of the data definition, given our goal of estimating the effects of institutional changes.

Our main institutional variable of interest is whether a city had a form of self-governance that gave it some autonomy and could constrain the dominant role of the church, state or feudal lords. This is captured by the dummy variable $Commune_{ct}$ coded by Bosker et al. (2013). This variable measures the extent of local participatory government at the beginning of each century. Typically Communes had autonomy in the regulation of commerce, taxation and other administrative activities. Communal institutions also guaranteed economic and personal freedoms and enforced the rule of law, also through the evolution of civil and penal codes. Besides check and balances on executive authority, Communal political institutions also had forms of limited representative democracy (Pirenne 1925).[19]

[17] In sensitivity analysis we also use the population variable from Malanima (1998), available for 52 (Italian) cities which are missing in Bairoch et al. (1988). The correlation between the two variables is 0.97.

[18] The sample includes cities belonging to the following present-day countries: Albania, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Czechia, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Macedonia, Malta, Netherlands, Norway, Poland, Portugal, Rumenia, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, UK, Ukraine.

[19] Unavoidably, a dummy variable can only imperfectly capture the complexities of hitorically distant political institutions. Bosker et al. (2013) rely on several criteria for their classification. First, they check if historical sources

Forms of local participative government began to develop in the X and XI centuries when Europe was politically fragmented, after the fall of the Carolingian Empire. In the power vacuum that ensued, cities could claim a kind of self-rule that was frequently recognized by the sovereign in return for taxes or loyalty (Jones, 2003). This form of self-government emerged in the XI and XII centuries in Southern Europe and spread elsewhere in the following centuries (Figure A.8 in the Appendix). As emphasized by Clarke (1926), communes were constitutional oligarchies that represented the interests of merchants, bankers and landowners. Representatives of a ruling class initially acted as the link between the town and its overlord, and gradually gained autonomy from external influence and became accountable to the city bourgeoisie. The degree of emancipation of cities varied across Europe and by centuries, depending on the strength of control over his territory by the prince. In the kingdom of Naples and Sicily, control was strong enough that communes were rare or non-existent. By contrast, the cities of Northern and Central Italy took advantage of the conflict between the Empire and the Pope to gain autonomy from both sources of power. Similarly, in Germany the landed aristocracy was fully occupied "in resisting or supporting the Emperor, extending boundaries and colonising new lands in the north and east", and this gave German towns an opportunity to grab autonomy and develop their own city institutions (Clarke 1926). England is somewhere in between: the territory administered by the King was large enough that he had to delegate administrative tasks and tax collection to the main towns in his territory. Yet, unlike in Italy and in the Dutch Countries, the King retained sufficient military capacity to prevent self administered cities from gaining full independence (Angelucci et al., 2017).

The status of Commune is not irreversible, and we observe transitions in both directions, though transitions into the status of Commune (Figure A.9 in the Appendix) are much more frequent that transitions out of it (Figure A.10 in the Appendix). The XII century is the period with the highest number of transitions into Commune, and the highest incidence of Commune in our sample is observed at the beginning of the XVI century. During the XV century, Communes in Italy started to grant long-term authority to a strongman who then acquired absolutist powers over the city and its territory. Here too, external circumstances played an important role, through emulation or because specific external threats convinced towns to grant extraordinary powers to a single individual. As

mention the presence of communal institutions such as consuls or town councils. The date is then attributed to the whole century subsequent to the first evidence of such institutions. As a fallback option, they use the buiding date of a town hall, and if this information is also missing, they use information on the first time city rights were granted (as mentioned in historical encyclopedias), dating the commune from the first century after such rights were first granted. The criterion for exit from Commune status is symmetrical, namely they code if local participatory institutions stopped functioning, because the town council was taken over by a powerful local family (as in hereditary Signorie), or it was dissolved by a central authority or external power (again dating it from the first whole century after the occurence). In the absence of a specific indication of a stop to the town council or of the inclusion of the city into a hereditary Signoria, it is assumed that local participatory institutions kept functioning until 1800, in line with local historical sources. It is therefore possible that measurement error could be a more relevant issue in the coding of exits from Commune than in the coding of entries into this status.

noted by Guiso et al. (2016): "In several cases the Signoria retained the fundamental institutions of the commune, including the principle that power originated from the people and was to be exercised in the people's name. In cities such as Florence and Genoa, the Signoria also preserved the political institutions and the personal liberties that had characterized the commune period." In this regard the Signoria was an evolution of the Commune (Prezzolini, 1948; Chittolini, 1999). Nevertheless, Bosker et al. (2013) (and hence our data) code the transitions into Signoria as a loss of status of Commune. In other parts of Europe, such as the Netherlands, instead, local lords favoured towns, "granted rights of jurisdiction and administration freely and protected commerce from troublesome neighbours" (Clarke 1926). In our estimation strategy we exploit this geographic variation in the emergence and stability of Communal institutions to build an instrumental variable for being a Commune. A second instrument for Commune, constructed from data by Schulz (2019), is described in context.

Notable people could also be attracted by (or be born in) cities that had universities or that were the location of political or religious power, although religion also led to persecutions and hence could also expel rather than attract innovative individuals. To capture these features, we rely on the following variables, also in the data set by Bosker et al. (2013): whether a city has a university *(University),* and three variables indicating a city's status in the political and ecclesiastical hierarchy, namely a dummy variable indicating whether a city is the seat of a bishop *(Bishop),* is the seat of an archbishop *(Archbishop)* and is a state capital *(Capital).* We also make use of variables, constructed by Bosker et al. (2013), indicating the number of times a city was plundered in the previous century *(Plundered),* whether it is ruled by a large state *(Large state),* and whether it belongs to a non-absolutist state (*Non-absolutist state*).[20]

To study the time series properties and their correlation with local economic conditions, we also collected data on the average nominal wage of skilled worker expressed in grams of silver per day from a variety of sources, as well as data on real wages (i.e. adjusted for purchasing power).[21] For details on the data sources, see Section A.II. These data are only available for 28 major European cities for a long enough period (18 for real wages), but they are yearly and they cover several centuries. Table A.2 in the appendix lists the city and years included in our sample. To reduce measurement error and minimize missing observations, we express the wage

[20]The coding of universities in Bosker et al. (2013) may contain some imperfections. As an alternative source, we have explored the sensitivity of the estimates to using the data on universities collected by De La Croix et al. (2020). The estimates remain very similar and the results of interest are largely unchanged. To retain consistency in the source for all the variables, throughout we always use the definition of university in Bosker et al. (2013). The definition of the dummy variables Bishop and Archbishop does not change if and when a city becomes protestant. Section A.II of the Appendix lists the sources that we used to classify a city as protestant.

[21]Skilled workers are typically building craftsmen, carpenters, or, more in general, masters and journeymen. The consumer price index used to obtain real wages is a "Laspeyres index in which the quantity of each good is specified and then the price level computed by valuing those quantities at the prices prevailing in each time and place" (Allen, 2001, p.420)

as a 10-year average (called *Wage*), and obtain an unbalanced panel by decades that covers the period 1260-1890. Because real wages display more time variation, we only report results using this variable, although results are similar with nominal wages. Figure A.3 shows the time variation in real wages in five prominent cities that we further discuss below.

Finally, in some specifications we define region-specific or nation-specific variables. Unless noted otherwise, they all refer to current administrative borders, as defined by Eurostat. NUTS 1 refers to macro-regions, NUTS 2 to regions. Other geographic variables are defined in context below, when we introduce them.

Table 3 reports summary statistics for all these variables including births and immigrants for the 2137 cities in our sample.[22] To give a better sense of the data, Appendix Tables A.3-A.7 list the famous creatives in our sample that were born during periods of peak creativity of five prominent cities, namely Florence in the early Renaissance, Antwerp and Amsterdam between 1200 and 1599, Paris and Vienna in the XVIII and XIX centuries. Section A.I of the Appendix also provides a brief narrative of these amazing periods.

3 Stylized Facts

In this section we document several stylized facts. Our goal here is not to test specific hypothesis or establish causality, but to describe the spatial and temporal patterns of the data.

Spatial agglomeration How concentrated are famous creatives in space? Figure 2 displays the spatial distribution of *Births* in the XV century, the middle of our sample. Darker tones indicate a larger number of *Births*, while population size is captured by the circle diameter. Famous *Births* are shown to be concentrated in a subset of the cities, not always those with larger populations. Amongst the large cities, Florence, Nuremberg and Siena have the most births of creatives, per 1000 inhabitants. These cities are recognized as the centers of the Renaissance in Italy and in Northern Europe respectively. Figure 3 displays the spatial distribution of *Births* in the XIX century, the end of our sample period. Now many more cities are included in the sample, and the darker tones have shifted to Northern Europe and the UK. The spatial distribution of *Immigrants* displays similar patterns, with Florence and Rome having the largest number of famous immigrants per capita in the XV century - cf. Appendix Figures A.6 and A.7. *Births* and *Immigrants* are positively correlated: their correlation coefficient is 0.56 (see Appendix Table A.8). Thus, cities that give birth to creative individuals also tend to attract famous immigrants - in this sense, one can speak of clusters of creativity. Finally, note that in the overall sample around half of city-century

[22] We have 6226 city-century observations; 675 cities and 3091 city-century observations are from the Bairoch et al. (1988) sample.

observations have zero *Births* and around 70% have zero *Immigrants*, although the fraction of cities with zero *Births* and *Immigrants* declines over time.

How did spatial concentration evolve over time? Figure 4 plots the coefficient of variation of *Births*, *Immigrants* and population between cities, in each century between 1300 and 1800. A higher coefficient of variation indicates more geographic concentration (a plot of Gini coefficients is very similar). Recall that *Births* and *Immigrants* are expressed per capita. The following facts stand out. First, *Immigrants* are always more spatially concentrated than both population and *Births*, presumably due to sorting. Second, until 1600 *Births* were also more spatially concentrated than population. These features suggest that local factors or spillovers associated with spatial proximity were particularly important for creative activities. Third, while early on the tendency for famous creatives has been towards less concentration (convergence) over time, the spatial concentration and the spatial patterns of famous creatives did not change much between 1500 and 1800, despite the consolidation of states and the improvements in the means of transportation, suggesting that the forces behind agglomeration of creative activities are historically stable. Nevertheless, *Immigrants* were more concentrated in 1700, a century of significant innovations in several domains.

Persistence Next, we analyze the persistence of clusters of famous creatives. A comparison of Figure 2 and 3 suggests that there is some spatial movement of clusters over time. To further explore the temporal patterns of the data, Table 4 displays Spearman's rank correlation coefficients for *Births*, *Immigrants* and Population over each consecutive century (each row reports Spearman's ρ between the same variable measured in t and in $t+1$). The Spearman's ρ for *Births* and *Immigrants* increases over time but it remains below 0.5 until the last century. *Births* are generally less correlated over time than *Immigrants*, and both are much less auto-correlated than population - though this may also reflect larger measurement error in famous creatives than for population. Table 4 suggests that cities at the frontier of creativity have an advantage, but generally not strong enough to guarantee dominance in creativity in the next century. [23]

To complement this analysis, we estimate Markov transition matrices for *Births*, *Immigrants* and population. Specifically, for each variable (*Births*, *Immigrants* and population) and each century, we partition cities in five groups: the first group includes cities that in a given century had a value of zero for that variable; the remaining groups correspond to the quartiles of the distribution in any given century, conditional on being positive. Table 5 displays the probability that a city transits from the row group to the column group in the next century, estimated by Maximum Likelihood (assuming that transition probabilities have remained constant over time). Thus, with regard to *Births*, the first row says that a city that had 0 *Births* in century t has a 0.61 probability

[23] Conclusions are similar if we distinguish between famous creatives in arts (performing and non-performing) and famous creatives in in humanities and science plus business.

of retaining 0 *Births* in $t+1$, it has a 0.13 probability of being in the first quartile of cities with positive *Births* in $t+1$, and so on.

For all variables, the top left and bottom right cells in Table 5 are the largest, indicating that the probability of remaining in the bottom and top groups, conditional on being there, is the highest. For cities at the top of the distribution, there is strong evidence of more persistence in population than in famous creatives: a city that belongs to the fourth quartile in population has a probability of 0.79 of remaining there in the next century, while for *Immigrants* this probability is 0.49, and for *Births* it is 0.43. On the other hand, at the bottom of the distribution persistence is roughly similar for famous creatives and for population: cities that have just a few famous creatives and belong to the first quartile have a probability of remaining there or falling in group 0 of about 0.55 for *Births* and *Immigrants*; the corresponding value for population is 0.5. In other words, emerging as a large city or a creative cluster is an unlikely event for cities that start out at the bottom of the distribution: most small and uncreative cities remain in that condition. But at the top of the distribution there is more reshuffling in creative clusters than for population: while most large cities keep growing and remain large, creative clusters exhibit more change over the centuries. This pattern conforms with anecdotal evidence about the rise and decline of creativity in cities like Florence, Rome and Vienna.

Notwithstanding the spatial movement of clusters, the overall pattern of spatial proximity of creatives is quite stable over time, despite the consolidation of states and the improvements in the means of transportation throughout these centuries. This can be seen in Figure 5 and 6. The former displays the distribution of the distance between places of birth of every pair of famous creatives born in the same century, for different centuries. The latter displays the distribution of birth-to-death distances. Both distributions remained quite stable in different centuries, despite the changes in the cost of transportation and communication during this period.

Agglomeration across disciplines We then explore whether creative clusters tend to be specialized or diverse. We want to know whether spillover effects and local factors (observed or unobserved) operate across or within disciplines. We thus estimate the matrix of pairwise correlation coefficients of famous people by discipline, for both *Births* and *Immigrants.* Disciplines are disaggregated in performing arts, non-performing arts, humanities and science, and business. Table 6 reports the results, in Panel A for *Births* and in Panel B for *Immigrants*. In the first line of each matrix, we condition on century dummy variables, to make variables comparable over time; thus, we first regress famous people in each discipline (*Births* or *Immigrants*) on a full set of century dummy variables, and then estimate the correlation coefficients across disciplines of the estimated residuals. In the second line of each matrix we condition on both century dummy variables and the

set of observable city characteristics described above.[24] Thus, the second line of each matrix is a measure of co-agglomeration across disciplines due to either unobserved common local factors or spillover effects, while the first raw also includes the effect of observables. In Panel A, the dependent variable is defined as Log(1+*Births in discipline i*). We take the Log of 1+ *Births in discipline i* (rather than of *Births in discipline i*) to retain in the sample the large number of city observations with 0 births - see also the more extensive discussion in the next section. In panel B, the dependent variable is defined as Log(1+*Immigrants in discipline i*) in Panel B.

All correlation coefficients are positive and significant and quantitatively large, indicating that creative elites are clustered across disciplines, as in the prominent examples of Florence and Vienna cited above. Correlation coefficients are very similar with or without conditioning on the full set of observables, implying that common observable shocks are not responsible for the correlations. For instance, based on Panel A of Table 6, if we compare two cities with the same observables, but city A has 10 p.p. more *Births* of non-performing artists (per 1000 inhabitants) than city B, then on average city A also has 5.5 p.p. more (scaled) *Births* in humanities and sciences compared to city B. This suggests that spillover effects and/or unobserved local factors operate across disciplines and not just within each field. Note that correlations tend to be somehow stronger for *Immigrants* than for *Births*.[25]

4 Population, wages and famous creatives

Given the patterns discussed so far, a natural question is whether creative clusters are influenced by local economic conditions. As remarked in the Introduction, the answer is a priori uncertain. On the one hand, good local economic conditions tend to increase the demand for services of creative individuals. On the other hand, the primary goal of artists and scientists is to seek influence and recognition amongst peers; morover, proximity to other creatives facilitates innovation more than proximity to power and money. With these non-experimental data, we cannot provide a definitive answer. Nevertheless, we can exploit the temporal variation in the data, using city size or wages as indicators of local economic conditions in a distributed lag model that only exploits within city correlations.

[24] They are: *Large state, Bishop, Archbishop, Capital, Plundered, Population, University, Commune.*

[25] We have also estimated the correlation coefficients between Births and Immigrants of famous individuals active in law and religion but not classified as creatives, and Births and Immigrants in other creative domains. These correlation coefficients are also positive and not very different from those reported in Table 6, unconditional and after conditioning on observables.

Population We start by estimating the following specification:

$$Y_{ct} = \alpha_c + \delta_t + \pi_1 \log(Population)_{ct} + \pi_2 \log(Population)_{ct-1} + \pi_3 X_{ct} + u_{ct} \quad (1)$$

where Y_{ct} is either $Log(1 + \ Births)$ or Log $(1 + Immigrants)$, α_c and δ_t are city and century fixed effects, and X_{ct} are other covariates described below. We use this functional form to allow for observations where *Births* or *Immigrants* are 0. Standard errors are clustered at the level of NUTS 2 regions.[26] A finding that $\pi_1 + \pi_2$ is not significantly different from 0 would imply that the formation of creative clusters cannot be predicted by contemporaneous or past city size, casting doubts on the possibility of a causal effect. This being a rather short panel, we do not include the lagged dependent variable, but results are similar if we include it.

The results are presented in Table 7. In Columns 1 and 2 we only include the population variables. We cannot reject the null hypothesis that creative people (born or immigrated) are uncorrelated with current and previous population, although the p-value in the Immigrants regression is only barely above 0.1. In columns 3-4 we add current values of *Commune* and of other variables indicating a city's status in the political and ecclesiastical hierarchy, namely *Bishop*, *Archbishop* and *Capital*. Again, we fail to reject the null hypothesis of no positive correlation with current and lagged population, and here p-values are close to 0.9. In results untabulated here, we have explored heterogeneity across disciplines. Births of famous non-performing artists and deaths of famous immigrants in business are correlated with lagged population, as one would expect if good local economic conditions increase the demand for non-performing arts and attracts entrepreneurship.

This evidence is only suggestive, because time is measured at 100 year intervals and population could be measured with error, but the lack of correlation between city size and our indicators of creativity is robust. Results are similar when population of Italian cities is measured by data from Malanima (1998), which is available for a larger number of cities than in Bairoch et al. (1988). We have also used the interaction between a dummy variable indicating whether the city is an Atlantic port and dummy variables from 1500 (Acemoglu et al., 2005) as an alternative proxy for economic success, and reached similar conclusions. Moreover, we obtain very similar results when (a) using *Births* rather than $Log(1+Births)$ as dependent variable, (b) entering two lags rather than one, (c) allowing the coefficient of population to vary before/after the middle of our sample period. Overall, these results suggest that changes in urban population, an indicator of local economic conditions does not play an important role in the formation or decay of creative clusters. As remarked in the Introduction, these negative findings are in line with historical anecdotal evidence.

[26] We use NUTS 2 level rather NUTS 1 level because of the higher number of groups (269 versus 69 in the full sample) but all results in the paper are similar if NUTS 1 is used.

Wages To further investigate the dynamics of the relationship between local economic conditions and famous creatives, we also rely on real wages of skilled workers. Wages are a better measure of local economic conditions than population. Although skilled workers are not the main source of demand for the services of creative, wages of urban workers are likely to be correlated with other sources of income, in particular income from trade. Moreover, wage data are available at yearly frequency for a subset of European cities, and this is important to detect which variable moves first.

We begin our exploration by estimating the following specification:

$$Log(1+Unscaled\ Births)_{ct} = \alpha_c + \delta_t + \sum_{k=0}^{5} \beta_k \log(Wage)_{ct-k} + \sum_{k=1}^{5} \beta_k \log(1+Unscaled\ Births)_{ct-k} + u_{ct} \tag{2}$$

where t now represents a decade. Thus, our lag structure goes back 50 years. Because population is not available at the frequency of 10 years, we measure the dependent variable as the sum of famous births during the decade, not scaled by population (*Unscaled Births*). The sample is an unbalanced panel of 18 cities over the period 1260-1890. Note that here we can include the lagged dependent, despite estimating with a city fixed effect, because the panel is sufficiently long (on average about 34 periods per city).[27] Results are similar when estimating without the lagged dependent variable. Standard errors are clustered at the city level. We also test for first order serial correlation in the estimated residuals, and we can never reject absence of serial correlation.

The results are presented in Column 1 of Table 8: the F test cannot reject that the sum of estimated coefficients of current and lagged real wages is equal to zero. Note that failure to reject is not due to lack of statistical power, because the estimated coefficients on the lagged endogenous variable (lagged births) are always highly significant. This regression suggests that wages do not help predict famous births. To further explore this possibility, we estimate a specification with $\log(Wage)$ as the dependent variable, and the contemporaneous values and leads and lags of $Log(1 + Unscaled\ Births)$ on the RHS (for 5 decades):

$$Log(Wage)_{ct} = \alpha_c + \delta_t + \sum_{k=1}^{5} \beta_k \log(Wage)_{ct-k} + \sum_{k=-5}^{5} \beta_k \log(1 + Unscaled\ Births)_{ct-k} + u_{ct} \tag{3}$$

If the estimated coefficients on the leads of births were significantly different from zero, this would suggest that shocks to wages in period t were correlated with famous births in subsequent periods. As shown in column 2, this is not the case. The F-test of joint significance of the lead values of famous creatives born in city c is not significant. This again suggests that wages are not a leading indicator of subsequent accelerations in famous births.

[27] See Judson and Owen (1999).

In Columns 3-4 we repeat the same set of regressions replacing births with the number of famous immigrants born in each decade (again, not scaled by population).[28] The patterns are very similar to Column 1-2.

In results untabulated here, we have also estimated the same regressions when famous creatives are disaggregated by discipline. Unlike for population, in all four domains real wages are uncorrelated with famous creatives. The conclusions are also very similar if we replace real with nominal wages, which are available for a larger number of city-periods, or if we include a distributed lag of immigrants on the right hand side of (2) - here lagged immigrants have a positive and significant effect on subsequent births.

A possible concern is that real wages are measured with error, and do not display sufficient time variation. However, the results do not change if we restrict the sample to the 9 cities for which the coefficient of variation in real wages over time is above the median. As a further check of the statistical power of these regressions, Appendix Table A.9 replaces the dependent variable with $Log(Population)$ and estimates by century and by half century (since 1700). Here contemporaneous and lagged real wages have positive and significant estimated coefficients, suggesting that they display enough time variation to have statistical power.

Overall, therefore, these estimates confirm that the formation of creative clusters cannot be predicted by contemporaneous or past indicators of economic development.

5 City institutions and birth of famous creatives

We now turn to a more detailed analysis of how city institutions influence the formation of creative clusters. In particular, we study how transitions into and out of the status of Commune influence the births of famous creatives. As already discussed, we expect that more democratic and participatory forms of self-government, protecting economic and political freedoms, favor a more open, inclusive and innovative social environment, and thus are positively associated with births of creative individuals.

5.1 OLS Estimates

The regression equation that forms the basis of our empirical analysis in this subsection is:

$$Log(1 + Births_{ct}) = \beta_1 Commune_{ct} + \beta_2 X_{ct} + \beta_3 Spatial\_Lag\_B_{ct} + \alpha_c + \delta_t + u_{ct}, \qquad (4)$$

[28] Results are similar if immigrants are meausered by year of death, rather than birth.

where X_{ct} are city-level covariates, α_c and δ_t are city and century fixed effects. The covariates X_{ct} belong to two groups: those less likely to be affected by the status of Commune (*Large state, Bishop, Archbishop, Capital, Plundered)*, and those more likely to be influenced by Commune or correlated with the error term, and hence to possibly be "bad controls" (*Population, University*). Exchange of ideas is crucial for successful innovation, and interactions could take place with neighboring areas, and not just within the city. An isolated city is in a very different situation compared to a city located in the middle of a very creative area. To control for these spatial determinants of creativity, we also show estimates including the spatial lag of $Log(1 + Births_{ct})$, defined as $Spatial\_Lag\_B_{ct} = \sum_{d \neq c} \varpi_d Log(1 + Births_{dt})$, where the weights ϖ_d are the inverse of distance between cities d and c within the same NUTS 1 region, and 0 outside the NUTS1 region. This spatial lag thus measures the "creative potential" in the macro region, namely neighboring creativity. It captures possible direct effects of being close to other creative cities, as well as possibly omitted variables correlated with creativity in the vicinity of each city. As discussed below, our instrumental variable approach exploits regional waves of institutional change, and this spatial lag is also important to make the IV exclusion restriction more credible.

Table 9 shows OLS estimates of equation (4). Standard errors are clustered at the region (current NUTS 2) level. In Column 1 we estimate a parsimonious version of the baseline specification where we include period dummies and city fixed effects only. In Column 2, we add the first set of controls. In Column 3 we add the remaining covariates in X_{ct}, and in Column 4 we add the *Spatial Lag* of the dependent variable. All columns report a positive and significant coefficient on Commune. According to the estimate in column 4, becoming a Commune is associated with a 6 percentage point increase in *Births*, or an increase of 0.7 unscaled births (a 26% increase relative to the average).[29] Regarding the other city-level variables, we find a positive and significant coefficient for (possibly endogenous) University, and for Capital. Religious institutions have a negative estimated coefficient, weakly statistically significant only in some specifications.[30]

Note that the inclusion of $Log(population)$ and of $University$ in column 3 does not affect the estimated coefficient of $Commune$, suggesting that the effect of local political institutions is unlikely to go through these two channels. On the other hand, the inclusion of the spatial lag reduces the estimated coefficient of Commune from 0.70 to 0.58 in column 4, and the estimated coefficient of the spatial lag of $Log(1 + Births_{ct})$ is large and highly significant, suggesting the possible presence of spatially correlated unobserved determinants of creativity, or positive spillover

[29]Since $Births_{ct} < 1$ (for the vast majority of observations) and $Log(1 + Births_{ct}) \approx Births_{ct}$, the coefficient on Commune can be interpreted as a percentage point increase after a transition into commune status. Multiplying the coefficient of Commune (0.07) by mean population in the sample (in thousand; 11.8) yields the change in unscaled births.

[30]In results untabulated here we have explored heterogeneity by protestant affiliation after the Reformation but did not identify any robust patterns.

effects from being close to other creative cities.

Finally, note that transition into Commune status of city c may indirectly affect creative births also in non-treated cities different from c. As emphasized by anecdotal evidence and as shown in section 6, when a city becomes a Commune it attracts creative immigrants. Through social learning, this may reduce births of famous creatives in the cities experiencing the outflow. The opposite could also happen, since creative individuals may exert positive spillover effects on neighboring cities. Such general equilibrium effects imply that, even neglecting the identification issues due to unobserved heterogeneity and discussed in subsection 4.3, we cannot interpret the estimated coefficient on Commune as an average treatment effect. Note however that some of these general equilibrium effects may be captured by the inclusion of the spatial lag of creative births in column (4) of Table 9. Moreover, adding to the regressors also the spatial lags of famous immigrants into neighboring cities and/or the spatial lag of population does not materially change the numerical value or the statistical significance of the estimated coefficient of Commune (results available upon request).

5.2 Event Study

A concern for the estimation of the relationship between *Commune* and *Births* arises from the possibility of differential pre-trends. Moreover there may be some interesting post-transition dynamics which are not captured by the estimation procedure in the previous OLS Table. We therefore turn to use an "event-study" approach as in Kline (2011) and Autor (2003). This allows us to test for the presence of differential pre-trends and recover any dynamics of the Commune effect. We compare changes in *Births* of treated cities (i.e. localities that experience the transition into Commune status) both to cities that have not yet been treated and cities that will never be treated during our sample period.

Specifically, the regression equation is:

$$\log(1 + Births_{ct}) = \sum_{\tau=-2}^{T} \beta_\tau D_{ct}^\tau + \alpha_c + \delta_t + u_{ct}, \tag{5}$$

where α_c and δ_t are city and century fixed effects, and D_{ct}^τ are a sequence of "event-time" dummies that equal one when the transition to Commune is τ centuries away in city c and T is the end of the sample period (expressed in event time). Therefore $\tau = 0$ is the year of transition to Commune and the β_τ coefficients characterize the time path of creativity relative to the date of transition for "treated" cities, conditional on the unobserved variance components $\alpha_c, \delta_t, u_{ct}$. We estimate (5) by OLS, including separate indicator variables for two centuries before the transition, the century of the transition, one century after, and for centuries 2 and forward. In other words, we constrain the

effects of the transition to remain constant from century 2 onwards. We normalize β_{-1} to zero, so that all post-event coefficients can be interpreted as treatment effects.[31]

Figure 1 displays the estimates. There is no evidence of significant pre-existing trends in Births of famous people, before the transition into Commune. Becoming a Commune at the beginning of the century (date 0 in Figure 1) is associated with a 5 percentage point increase in the birth of creative individuals (per 1000 inhabitants) during the current century, with an additional increase in the subsequent century. Results are very similar when adding the same controls as in Table 9, including the spatial lag. In results not tabulated here, we have explored more complex dynamics by including additional periods of indicator variables.[32] The data reject these more complex specifications in favor of those found in Figure 1. Specifically, we find no evidence of an accumulating impact on Births beyond 2 centuries, nor is there evidence of mean revision in the longer term. It thus appears that the extent of the dynamics of the Births response to the transition is resolved within 2 centuries.

5.3 2SLS Estimates

An important limitation of the estimation framework in Figure 1 is the possibility that both local institutions and creativity may be influenced by time-varying omitted factors. For instance, the emergence of a vibrant and successful class of merchants and financiers could induce political transitions into Commune, and also exert a direct effect on the demand for the services of innovative artists. To tackle this challenge, we adapt a strategy introduced by Persson and Tabellini (2009) and Acemoglu et al. (2019) in their analysis of democratic transitions in a panel of countries. Namely, we instrument Commune with the proportion of other cities with Commune status in the region (defined by the current NUTS 1 administrative borders) and in the same century, leaving out the own-city observation - we call our instrument *Regional Commune.* This instrumental variable relies on the idea that transitions into commune were influenced by external factors common to an entire region, and exploits the fact that transitions into or out of Commune occur in regional waves. As argued in the introduction, this spatial correlation of changes in city institutions reflects a power vacuum (or consolidation) in higher levels of government that affected several cities in the same region, or regional conflicts between Imperial Bishops and the Church associated with the Investiture Conflict, or learning and contagion effects across neighboring cities.

The identifying assumption is that, conditioning on all included regressors, regional waves of

[31] For cities treated with the status of Commune, we include all observations before the first transition into Commune, and all observations after the first transition for which the status of Commune is retained. Once the status of Commune is abandoned, the corresponding observations are dropped from the sample (and subsequent spells of Commune are not included in the sample).

[32] This was made possible by the fact that most transitions into Commune status take place early in our sample period.

institutional transitions influence city level creativity only through a city's own political institutions. To make this assumption more credible, the regressors also control for regional creativity, measured by the spatial lag of *Log(1+Births)*. Controlling for the spatial lag of the dependent variable reduces the concern that neighboring cities with strong institutions produce or attract more creatives, which in turn exerts direct spillover effects in the region through migration or knowledge diffusion. Nevertheless, the identifying assumption could still be violated if general equilibrium effects were important. For this reason, in the sensitivity analysis we also rely on a second (uncorrelated) instrument discussed below.

The 2SLS estimates are shown in Table 10, which also reports a summary of the first-stage and the reduced-form results. The sequence of specifications mirrors that in the OLS Table. *Regional Commune* is always highly significant both in the first stage and in the reduced form regressions (F-statistics for the excluded instrument range from 18 to 23). Table A.10 in the Appendix reports the full first stage estimates.

On average, upon a transition into Commune, births of creative people (per 1000 inhabitants) increase by about 12 percentage points in the more inclusive specification with the spatial lag. This corresponds to about 1.4 more creative births per century, or about a 47% increase relative to average births. The estimated coefficient of *Commune* is about twice as large as in the corresponding OLS regression. The fact that our IV strategy produces larger effects of city institutions on creativity may reflect attenuation bias in the OLS estimates due to measurement error in *Commune*. Another possibility is that the effect of political institutions is heterogeneous across cities. If so, then consistent OLS estimates the average effect of *Commune* on creativity across all cities. On the other hand, 2SLS estimates the average effect for the cities that are marginal in the transition, in the sense that they become communes if and only if there exists a regional wave of institutional change.[33] If the effect of *Commune* on creativity is larger for cities that are marginal in the transition, the 2SLS estimates exceed those of consistent OLS.

Also note that the results are not affected by inclusion of city size on the RHS, which is never statistically significant, although we know from Bosker et al. (2013) that becoming a Commune is also associated with an increase in city size. This reinforces our previous claim that the formation of creative clusters does not seem to operate through local economic conditions. The coefficient estimates of the other institutional variables (not shown) are very similar to the OLS estimates.

To further reduce the concern that contemporaneous general equilibrium effects or omitted variables correlated with the instrument may violate the identifying assumption, we have also used *Regional Commune* lagged by one century as the instrument; the coefficient of Commune remains significant. The estimates are also not materially changed if the spatial lag of famous immigrants or of population are included amongst the regressors. These results are available upon request.

[33] See Imbens and Angrist (1994) for a discussion. For a recent example, see Eisensee and Strömberg (2007).

Overall, the evidence is consistent with the idea that becoming a Commune, and enjoying the resulting autonomy and economic and political freedoms, spreads a culture of openness that encourages innovation and creativity in arts, sciences and business.

5.4 Sensitivity Analysis

The main empirical result in this Section is that city institutions protecting economic and political freedoms explain the production of creative elites. We now investigate the robustness of the estimates.

Alternative instrument A first issue concerns the validity of our instrument. Even after conditioning on the spatial lag of Births, the regional incidence of Commune could exert a direct influence on the birth of famous creatives in cities within the region**,** violating our exclusion restriction. We thus consider also a second instrument, suggested by Schulz (2019), that measures city exposure to the Church ban of kin marriage. In the middle of the VI century, the Church banned kin marriage. This policy contributed to the dissolution of kin networks throughout Europe, leading to profound cultural transformations, including greater individualism, more impersonal prosocial psychology and a more universalistic value system - see Goody (1983), Schuz et al. (2019), Enke (2019), Greif and Tabellini (2017). But Church policy was not uniformly implemented, and areas less exposed to the Church doctrine were slower to abandon kin networks. Schulz (2019) exploits this geographic and temporal variation, and shows that transitions into Commune were more likely in cities that were more exposed to the Church ban. He also provides evidence that exposure to the medieval Church predicts weak kin networks across countries, ethnicities and European regions, and that weaker kin networks are associated with more democratic governance traditions in ethnicities and countries. Inspired by this work, we exploit exposure to the Church ban of cousin marriage as a second instrument for Commune. Specifically, following Schulz (2019), define the variable *W. Church Exposure* as the sum of all instances (in 50-year intervals) that a city was within a 100-km radius of the nearest bishopric between 550AC and century t - the first synods that banned cousin marriage took place between 500 and 550. This variable thus captures proximity to a religious authority only during the period of the ban. The identifying assumption is that, conditioning on all included regressors, Church exposure influences city level creativity only through a city's own political institutions. To allow for the fact that proximity to a religious authority could affect creativity in ways other than through city institutions, in some of the regressions we also control for century fixed effects interacted with a dummy variable that equals one if the city has ever been the seat of a bishop.

The 2SLS estimates are shown in Table 11, which also reports a summary of the first-stage and

the reduced-form results. Period dummies, city FE and the full set of city-level controls (including the variables *Bishop* and *Archbishop* and the *Spatial lag of Births*) are always included. Column (1) displays the just identified model with only *W. Church Exposure* as instrument. Column (2), our preferred specification, displays the over-identified model with *Regional Commune* and *W. Church Exposure* as instruments (the unconditional correlation between *Regional Commune* and *Church Exposure* is 0.3). The p-value of Hansen's J statistic for the over-identification test is reported at the bottom, and the over-identification restriction is not rejected. *Church Exposure* is significant both in the first stage and in the reduced form regressions (the F-statistics for the excluded instrument is 14). On average, upon a transition into Commune, births of creative people (per 1000 inhabitants) increase by about 13 percentage points. In Column (3) and (4) we also control for whether the city was ever the seat of a bishop interacted with period dummies. The estimates are very similar to those in Column (1) and (2).

Alternative measures of creativity. In our data, being famous is equivalent to being included in the database *Freebase.com.* Yu et al (2016) have created a similar database that weights individuals by their influence (see section 2). Table A.11 in the Appendix replicates the 2SLS estimates of Table 10, replacing the dependent variable *Births* with the corresponding weighted variable obtained from Yu et al (2016). The estimated coefficient of $Commune$ is positive and significant across all different IV specifications, although the size of the implied estimated effect of a transition into Commune is a bit smaller than with the unweighted data used in Table 10 (expressed in percent of the mean of the dependent variable).[34]

Specification and Sample Restrictions In results untabulated here we have explored the sensitivity of the estimates to alternative specifications and sample restrictions. First, we have included the interaction between a dummy variable indicating whether the city is an Atlantic port and dummies from 1500 onwards, as in Acemoglu et al. (2005). Second, we eliminated city-year observations with unusually high values of *Births* (trimming observations above the 99% percentile). Results are largely unchanged.

In the previous analysis we exploited all transitions into and out of Commune, estimating an average effect. In Appendix Table A.12 we estimate the effect of transitions in the two directions separately. Thus, when estimating the effect of entry into $Commune$, we drop the city-century observations following a negative transition (from $Commune = 1$ back to $Commune = 0$). And

[34]The conclusions regarding the role of local institutions are also unchanged in the OLS estimates using this weighted dependent variable. Regarding the event study, while the visual pattern is similar to that in Figure 1, the individual β_τ coefficients are not estimated very precisely. We therefore performed a more formal test of the null hypothesis that the transition into *Commune* has no impact on local creativity: we tested the hypothesis about the average of the β_τ coefficients for $\tau = 0$ and $\tau = 1$. The estimated average increase over the two centuries starting with the year of the opening is 13 p.p. and significant at 10%.

when studying the effect of exits, we drop the city-year observations prior to a positive transition (from $Commune = 0$ to $Commune = 1$). The OLS estimates remain very similar to those reported in Table 9, with a p-value below 1%, suggesting that the effect of Commune on *Births* is symmetric for transitions on both directions. When estimating by 2SLS, the estimated coefficient of *Commune* remains similar to the IV estimates reported in Table 10 (and is larger for transitions into $Commune$ than out of it) but the standard errors increase. The estimated coefficient of $Commune$ is significant at 10% for the positive transitions, and loses significance for the negative ones.

A natural question is whether our results are due to a particular period in history, or to a specific set of countries. To answer, we have dropped the earliest centuries (XI, XII and XIII altogether) or the most recent one (XIX) and the results are very similar. However when we start dropping the XIV century (in addition to the three earliest centuries) or the XVIII century (in addition to the most recent one) the coefficient of Commune, while positive, is no longer significant. We have also included the interaction between Commune and a dummy for the period from 1400 onwards (instrumented with the interaction between *Regional Commune* and this dummy). The coefficient of Commune remains positive and significant while the interaction is not significant. Similar results were obtained with a dummy for the period from 1500 onwards. These results suggest that the results do not differ much across centuries, but that the central period 1300-1799 is particularly important for the observed correlations.

We have also dropped (individually) countries representing at least 5% of the sample (France, Germany, Italy, Spain, UK) and pairs of countries representing macro-regions (Spain and Portugal, France and Germany). The coefficient of Commune remains positive and significant. When dropping the 7 countries belonging to Eastern Europe, the coefficient of Commune, while losing significance, is not very different from the one on the full sample (equal to 0.083 with standard error of 0.051). Finally, the estimates remain very similar if the sample is restricted to the borders of the former Carolingian Empire plus Britain. This suggests that our results are not driven by a particular geographic area, but the positive effect of Commune on births of famous creatives is present throughout Europe. All these results are available upon request.

Poisson Estimation The log-linear specification described above has several advantages. OLS is the best linear unbiased estimator, its consistency properties are transparent and we can easily estimate also by instrumental variables. Moreover, scaling the dependent variable by *Population* reduces concerns about omitting an important regressor, or viceversa including an important "bad control" - Bosker et al. (2013) show that transitions into Commune have significant positive effects on city $Population$ during the same century. Nevertheless, a possible problem with the log-linear specification is the large number of zero observations in *Births* (about half of the overall observa-

tions have 0 births - see Appendix Figure A.4). To cope with it, here we also estimate by QMLE Poisson, conditional on the same fixed effects described above. Thus, the dependent variable is the number of famous creatives not scaled by population.

Here the concern that *Population* is an endogenous regressor is important, because the dependent variable is unscaled and hence the error term is likely to be correlated with $Population$. To avoid including a "bad control", rather than controlling for $Log(Population)$ as a regressor, we include a set of dummy variables that classify cities according to their place in the size distribution or according to their size. These dummy variables are more time invariant than *Population*, and hence they are less likely to suffer from the "bad control" problem that plagues *Population*, and yet their inclusion makes cities of different size comparable. We estimate with two different definitions of the set of dummies. First, we enter separate dummies for belonging to each of the deciles going from the first to the ninth (in the overall sample of observations), plus one dummy for belonging to the set of percentiles from the 90th to the 94th and one for the percentiles 95th to 98th; thus, the default group consists of cities belonging to the 99th percentile. This specification groups cities so that the first 9 groups have roughly the same number of observations. The last decile would include observations that are very heterogeneous in terms of size, because there are few very large cities. To make these cities more comparable within this top decile, we split it in the finer partition described above. In our second and alternative definition, we include a set of dummy variables that classify cities according to the value of *Log(Population)*, irrespective of the frequency in each bin. Specifically we split the range of variation of *Log(Population)* in the entire sample into 10 equally sized intervals, and enter a dummy variable for each interval except the last one (which is the default). Thus, this specification groups cities so that each interval corresponds to cities of roughly similar size and that differ from each other by about the same percentage, irrespective of the frequency distribution.

Table 12, reports these Poisson estimates. Note that, having changed the dependent variable, we redefine the spatial lag accordingly, as the spatial lag of *unscaled* famous births. City and century fixed effects are always included. We also control for all city observables described above (except Population) plus the spatial lag of the dependent variable. In column 1 we include the dummy variables based on the frequency distribution of $Log(Population)$, while in column 2 we include the dummy variables based on the values of $Log($*Population*$)$. The estimated coefficient of Commune is very similar in both specifications. The estimated coefficient of 0.94 for Commune implies that the birth rate of FC in each century is exp(0.94) = 2.6 times larger in cities that are Commune, compared to the others. On average a non-Commune city in the sample features about 1.4 births of famous creatives per century, implying that becoming a Commune is associated with an increase of about 2.1 famous births per century. This is much larger than in the OLS estimate of the log-linear specification of Table 11, where we estimated that transitions into Commune are

associated with an increase of about 0.7 unscaled births per century. [35] Overall, although these Poisson estimates cannot exploit our instrument for Commune, they confirm the main finding above.

6 Migration of famous creatives

In this section we study the determinants of the migration of famous people between European cities, in a gravity model. This section has one goal: to describe how migration is correlated with observable features of European cities, and in particular which institutional features make a city an attractive destination.

6.1 Microfoundations

Let m_{jit} denote the number of immigrants (unscaled by city size) who die in city i and were born in city j during century t (throughout the century refers to the date of birth, as explained above). Also let b_{jt} denote the number of famous individuals born in city j during century t. By definition, we have:

$$m_{jit} = p_{jit} b_{jt} \tag{6}$$

where p_{jit} is the share of individuals who move from j to i in century t.

The share p_{jit} is the result of a deliberate decision to migrate. We model it as in the standard Random Utility Model, following Beine et al. (2016) and McFadden (1974). Specifically, let subscript k denote individuals, and define U_{kjit} as the utility of individual k born in j if he moves to i in century t. We assume:

$$U_{kjit} = w_{it} - c_{jit} + \varepsilon_{kjit} \tag{7}$$

where w_{it} refers to a deterministic component of utility, such as income and other benefits from being in city i, c_{jit} denotes the cost of moving from j to i in century t and ε_{kjit} is an individual specific random component of his utility. Note, that, due to our data limitations, we assume that the deterministic component of utility from being in city i, w_{it} , only depends on time and on the destination city, for all individuals irrespective of their origin.

If we assume that ε_{kjit} is independently and identically distributed according to an Extreme Value Type-1 distribution, then (6) and (7) imply that the expected number of immigrants from j

[35] Being *Bishop* has a negative significant coefficient and *Capital* a positive significant coefficient, confirming the inference from OLS regressions that religious institutions are negatively correlated with creative births, while being a state capital has a positive association. The coefficients on the other city-level variables are not significant.

to i in century t can be written as - see Beine et al. (2016):

$$E(m_{jit}) = \phi_{jit} y_{it} b_{jt} / \Omega_{jt} \tag{8}$$

where $\phi_{jit} = \exp(-c_{jit})$ is decreasing in the cost of moving from j to i, $y_{it} = \exp(w_{it})$ is a measure of attractiveness of location i, and $\Omega_{jt} = \sum_l \phi_{jlt} y_{lt}$ is the expected utility from all possible alternatives available to an individual born in j - including also the decision to stay (corresponding to $j = l$). Thus, the flow of immigrants from j to i is higher if city i is more attractive relative to the average of all other cities (weighted by the cost of moving and including the city of origin), if the city of origin j has more famous natives (i.e. more potential migrants), and if the cost of moving from j to i is lower.

Adding a well behaved error term e_{jit} to Equation (8), such that $E(e_{jit}) = 1$, allows us to estimate the following gravity equation with dyadic data referring to cities of birth and of death for which $i \neq j$:

$$m_{jit} = \phi_{jit} y_{it} \frac{b_{jt}}{\Omega_{jt}} e_{jit} = \exp(w_{it} - c_{jit}) \frac{b_{jt}}{\Omega_{jt}} e_{jit} \tag{9}$$

6.2 Data and Estimation

Since the dependent variable is a count variable with a very large number of zeros, we estimate equation (9) by Poisson Maximum Likelihood in the sample of cities included in Bosker et al. (2013). Table A.13 in the Appendix summarizes the main features of the dependent variable. There is a very large number of zeros (more than 99% of all observations), and when positive most dyadic observations have only a few immigrants from the same origin city per century. Nevertheless, more than 83% of the cities in our restricted sample received at least one immigrant throughout the period, and several of them, such as Paris and London, received several hundredths overall. The number of destination cities included in the data set ranges from 77 in the XI century to 358 in the XIX century. Note that we discard all the dyadic city-century observations where the origin city-century has 0 births, since the probability of receiving an immigrant from that origin is always zero by construction.

The variables on the right hand side of (9) have the following observable counterparts.

To measure the bilateral cost of moving, c_{jit}, we use geographic distance (expressed in 100 kilometers), a time varying variable measuring the fraction of each century in which cities i and j belonged to the same historical state (Schönholzer and Weese, 2018), and a set of dummy variables that equal 1 if cities i and j belong to the same (modern) NUTS1 region, and to two (modern) countries that share the same first official language (Bahar and Rapoport, 2018).

The utility of being in the destination city i, w_{it}, is proxied by population size (that only in this section is measured in 100,000) as a proxy for economic development, and by a set of dummy

variables that capture the most relevant institutional variables in the dataset by Bosker et al. (2013), namely *Commune, University*, *Capital, Bishop, Archbishop*, and *Plundered*. We expect that being a *Commune*, a state *Capital* and having a *University* all make a city a more attractive destination, while having been *Plundered* has the opposite effect. The two ecclesiastic variables have an ambiguous sign: on the one hand the Church was a sponsor of creative endeavours in artistic domains, but on the other hand it was also a source of discrimination and censorship.

The number of famous births in the origin city j is measured in logs (to be consistent with the exponential functional form of the Poisson regression (see (9)) and includes all famous people born in city j during century t, irrespective of whether or not they died in a different city, since they were all at risk of migrating.

Finally, the so called "multilateral resistance" term Ω_{jt} refers to the attractiveness of all the alternative destinations, for an individual born in city j. This term has no easily observable counterpart. We thus incorporate it as follows. In a first and most restrictive specification, we assume that the only relevant alternative to moving from j to i is remaining in the origin city, and thus proxy Ω_{jt} with w_{jt}, namely with the same institutional variables described above but referring to the origin city. Here we also include a full set of century fixed effects, to capture possible symmetric changes in the cost of moving or in the available alternatives. We then relax this assumption by adding also origin and destination fixed effects, to capture possible time invariant omitted variables. Finally, we estimate with a full set of destination and origin-century fixed effects, with which we fully capture the multilateral resistance term Ω_{jt} and any other variable that varies by origin and century (as well as time invariant destination variable). Standard errors are always clustered two ways, by origin and by destination, as suggested by Cameron et al. (2011).

The inclusion of destination (and origin) fixed effects implies that we are identifying the parameters of interest with a diff-in-diff methodology. Namely we assume that *changes* in the institutions of interest are randomly assigned to cities, after controlling for the remaining covariates. In particular, we must assume that there is no time-varying unobserved heterogeneity making cities that adopt specific institutions also more likely to attract or send out immigrants (for reasons unrelated to the institutional changes). Note that immigrants are measured by century of birth, to minimize the risk that the migration decision precedes the institutional change.

6.3 Results

Table 13 reports the estimates for the three specifications: with only century fixed effects (column 1), with century, destination and origin fixed effects (column 2), and with destination and origin-year fixed effects (column 3). The more credible specification is the one reported in column (3), but the estimated coefficients of the destination variables remain very stable in columns (2) and (3).

Being a *Commune* and a state capital is associated with an inflow of immigrants; the coefficient on *University* is not significant; *Bishop* has a negative coefficient. The estimated coefficients on all the distance measures are highly significant and with the expected sign. Cities that gave rise to more births send out more migrants (the estimated coefficient less than 1 implies that some of famous births do not migrate, as we know from the presence of several natives who die in the city of origin). Finally, population size is not robustly associated with any migration patterns.

The estimated coefficient of 0.520 for *Commune* implies that the arrival rate of immigrants in each century from the same origin city is 70 percent larger in cities that are *Commune*, compared to the others.[36] On average a non-Commune city receives about 1.6 immigrants per century from all origin cities in this sample, implying that becoming a *Commune* is associated with an increase of about 1.1 famous immigrants per century. Becoming a bishop-city is associated with a drop of about the same size in the immigration rate (though estimated less precisely; p-value is 0.11). Becoming a state capital is associated with an increase in the arrival rate of immigrants of 130 percent, implying about 2 more immigrants per century.

7 Concluding Remarks

It is often argued that open and tolerant political institutions, that protect individual rights and prevent abuse of power by authoritarian leaders, are a prerequisite to sustain innovation-based growth. This argument is strongly supported by the historical evidence of European cities.

As of yet there is no systematic study of the spatial patterns of creativity over a long historical period. After describing the main features of the formation and decay of creative clusters, we study how changes in city institutions affect local creativity. We find that institutions promoting local autonomy and protecting economic and political freedoms encourage the production and attraction of creative talent. The effects are quantitatively large. Becoming a Commune is associated with an increase in the births of famous people of about 40% relative to the average, while the attraction of famous immigrants almost doubles in size upon becoming a Commune. Overall, our estimates strongly suggest that inclusive local institutions and an open environment facilitate the attraction and production of upper-tail human capital in creative occupations.

What are the mechanisms through which becoming a Commune fosters local creativity? We know from Bosker et al. (2013) that transitions into Commune are also associated with subsequent increases in city size. Could this be the mechanism, namely transitions into Commune enhance local economic conditions (or occur in tandem with economic development), and this in turn induces an increase in local creativity? Although this mechanism cannot entirely be ruled out, given

[36] The percent change is calculated as (exp(0.520)-1)*100

the non-experimental nature of our data and difficulties in measuring local economic conditions, the historical evidence seems inconsistent with this conjecture.

This leaves open the question of what are the mechanisms through which Communal institutions favor the production and accumulation of creative talent. Section A.I of the Appendix provides a brief narrative of a few European cities that became amazing creative clusters in specific periods. These narrative suggests the following considerations about how participatory city institutions and local autonomy might have influenced innovation and creativity.

First, the protection of personal and economic freedoms and an inclusive environment changed the local culture, making it more receptive to innovations and new ideas, enhancing the importance of the common good over particularistic interests, and fostering the appreciation of individual achievements in creative endeavors. Second, the new institutions also changed incentives, through a more meritocratic and less rigid social environment, but also by encouraging works of art and innovations that would enhance the prestige of the city. The Italian Renaissance period exemplifies these two mechanisms. Third, free cities attracted talented and creative individuals who escaped censorship and persecution elsewhere, and this created role models and facilitated social learning, breeding new generations of innovators. Venice, which attracted large numbers of creative immigrants from Greece, Turkey, but also from several European cities, stands out as an example of this mechanism (De Maria, 2010). The inflow of Jews into Vienna from all over the Hasburg empire, after travel restrictions were removed in the mid XIX century, is another example (Weinzierl, 2003). Fourth, the political priority given to the protection of the interests of merchants facilitated the emergence of market infrastructures and exchange networks that could also be exploited for creating a market for works of art. The history of Dutch and Belgian cities, such as Bruges, Antwerp and Amsterdam in the XV, XVI and XVII centuries is an important example. These mechanisms are not mutually exclusive. Discriminating their relative importance and understanding how they operate in different circumstances is an important task for future research, also to assess the external validity of these findings for modern economic development.

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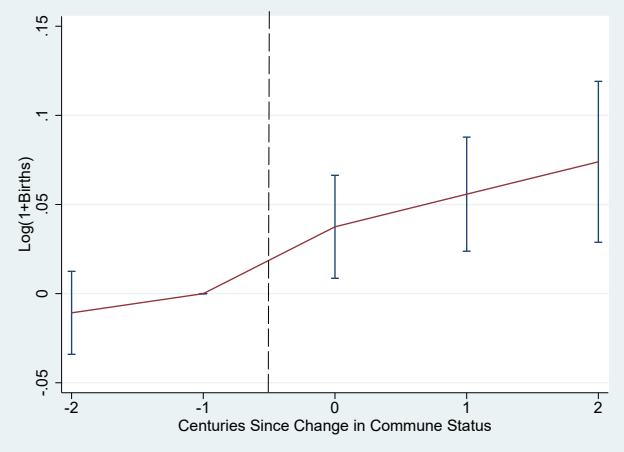
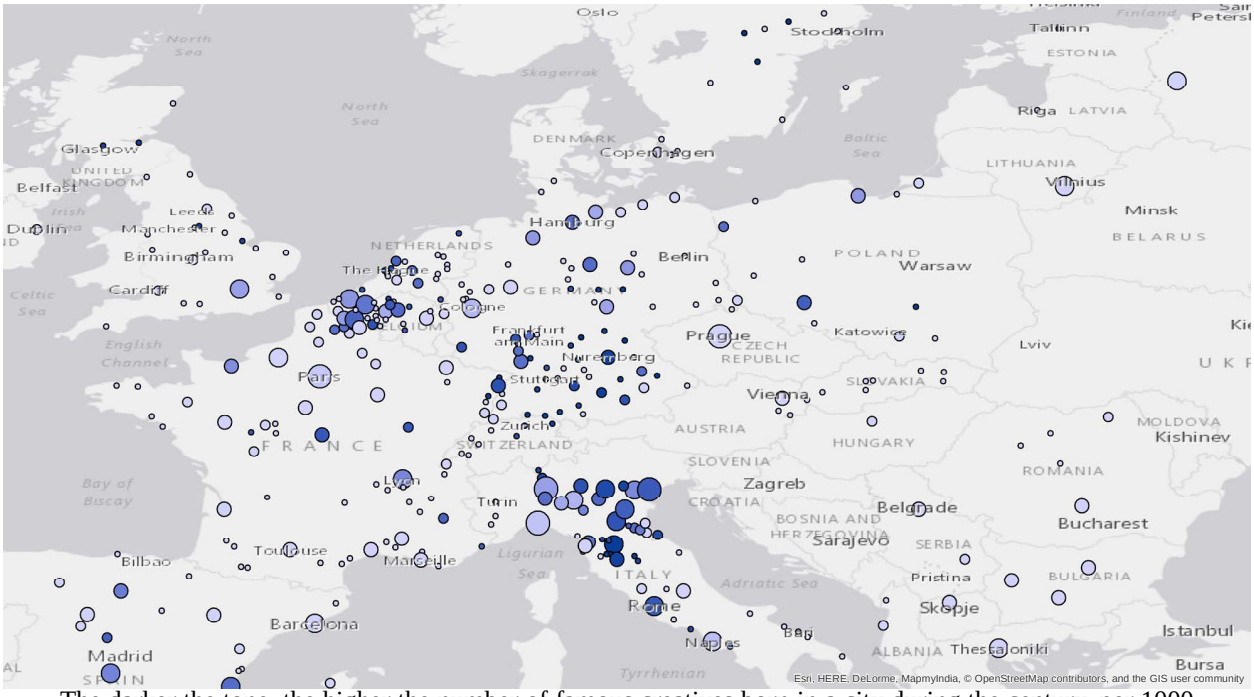
Figures and Tables

Figure 1: Transitions into Commune and Births of Famous Creatives



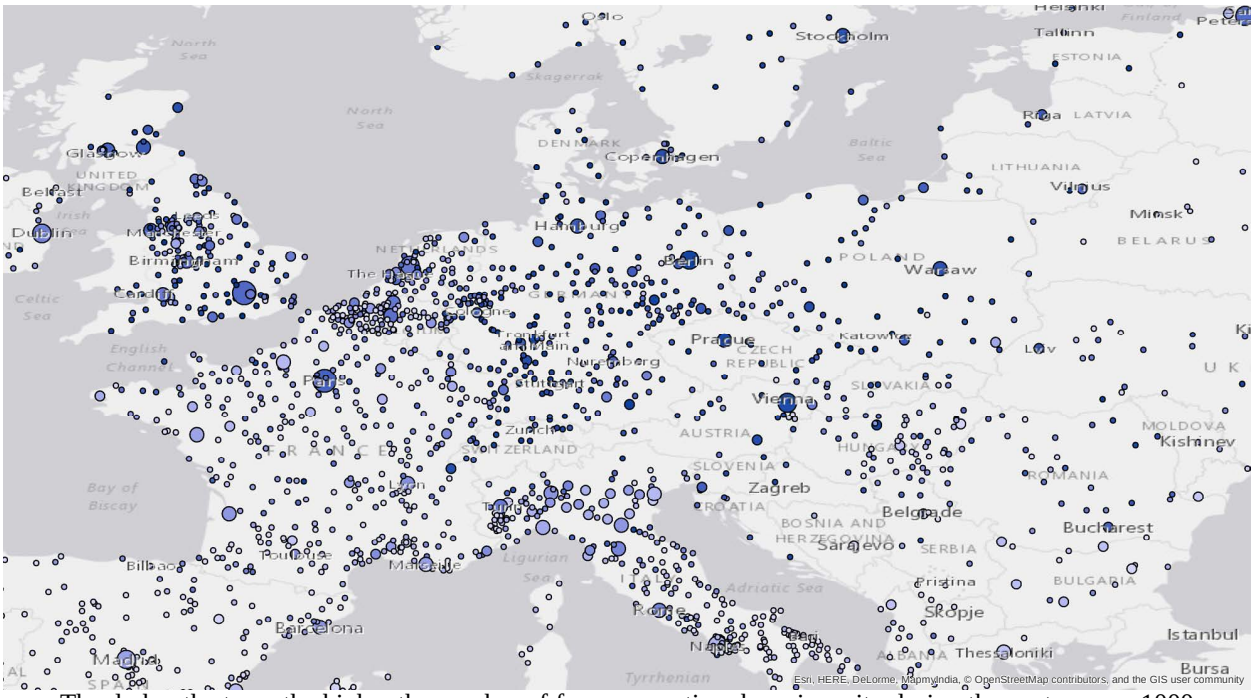
The figure plots point estimates for leading and lagging indicators for the change in commune status. We estimate (5) by OLS, including separate indicator variables for two centuries before the transition, the century of the transition, one century after, and for centuries 2 and forward. In other words, we constrain the effects of the transition to remain constant from century 2 onwards. We normalize β_{-1} to zero, so that all post-event coefficients can be interpreted as treatment effects. The dependent variable is $Log(1 + Births)$. The variable $Births$ is equal to the number of famous creatives born in a city, per 1000 inhabitants. Vertical bars correspond to 95 percent confidence intervals with region-clustered standard errors. We include city FE and century FE. Results are very similar when adding the full set of controls, including the spatial lag.

Figure 2: Spatial Distribution of Births of Famous Creatives, XVth century



The darker the tone, the higher the number of famous creatives born in a city during the century, per 1000 inhabitants. The larger the circle, the larger the population of the city. The names in the map indicate the location of present-day cities, which may have been small or may have not existed in the XVth century. The map only displays those cities in our sample which are geographically more central.

Figure 3: Spatial distribution of Births of Famous Creatives, XIXth century



The darker the tone, the higher the number of famous creatives born in a city during the century, per 1000 inhabitants. The larger the circle, the larger the population of the city. See Figure 2 for further notes.

Figure 4: Coefficient of Variation of Births, Immigrants, Population, XIV to XIX century

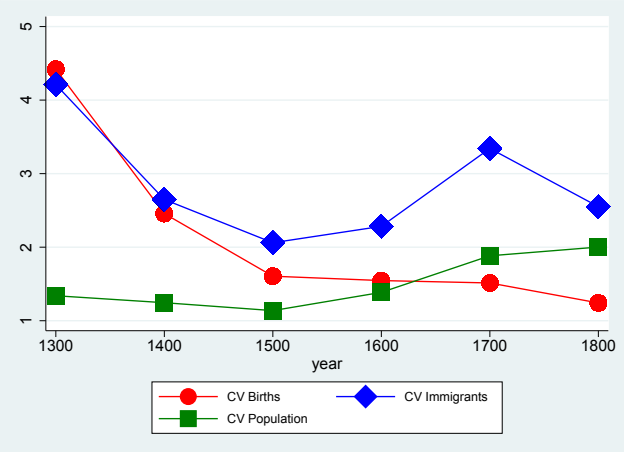


Figure 5: Distribution of Distances between Place of Birth of Any Two Famous Creatives.

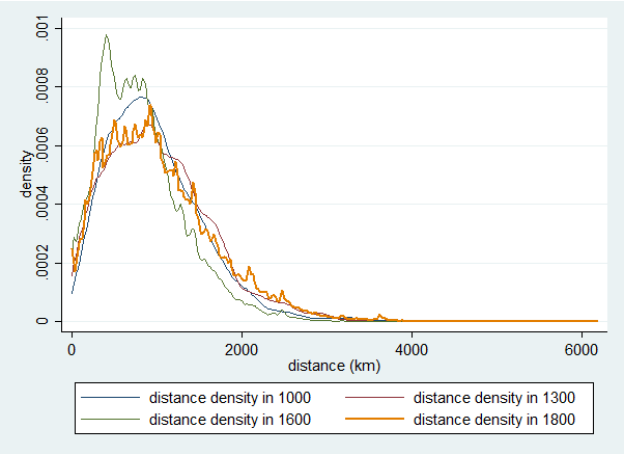


Figure 6: Distribution of Birth-to-death Distances over Time

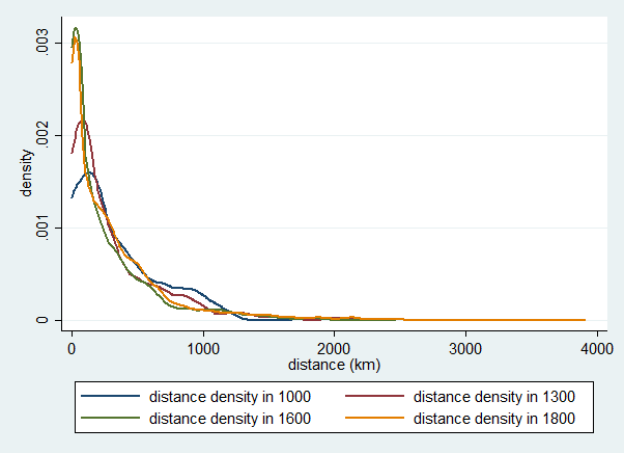


Table 1: Freebase Professional Categories

	Number of people
Performing arts	4692
Non performing arts	10002
Humanities and Sciences	8402
Business	2083
Total number of creative individuals	21906

The counts refer to the number of people for which a city of birth or death in Europe is observed during our sample period. The total number of creative individuals is lower than the sum across categories because some individuals are present in more than one category.

Table 2: Count of Famous Creatives and Population

Century	Unscaled Births	Unscaled Immigrants	Mean City Population (1000's)	Number of Cities	Num. Cities w/ Population $>$ 15000
1000	27	20	16.8	119	47
1100	45	33	11.2	186	57
1200	79	45	18.3	163	73
1300	109	79	12.1	502	107
1400	567	346	11.6	419	87
1500	1243	746	10.7	632	108
1600	1633	1068	11.6	904	141
1700	3642	2036	10.6	1187	164
1800	15027	6774	12	2114	301

Table 3: Summary Statistics

Variable	Mean	(Std. Dev.)	Min.	Max.	N
Births	0.316	(0.809)	0	13.25	6226
Immigrants	0.195	(1.04)	0	31	6226
(Unscaled) Births	3.082	(16.713)	0	774	6226
(Unscaled) Immigrants	2.344	(20.362)	0	827	6226
Commune	0.504	(0.5)	0	1	3091
University	0.118	(0.323)	0	1	3091
Non-Absolutist State	0.352	(0.478)	0	1	3091
Population	11780.794	(25219.232)	316.228	948000	6226
Large state	0.627	(0.484)	0	1	3091
Bishop	0.382	(0.486)	0	1	3091
Archbishop	0.118	(0.323)	0	1	3091
Capital	0.07	(0.255)	0	1	3091
Plundered	0.022	(0.146)	0	1	3091
Births, Yu et al.	0.925	(3.607)	0	99.557	6226
Real Wage of Skilled Workers	8.111	(2.711)	2.9	20.863	727

2137 individual cities; 675 cities are from the Bairoch et al. (1988) sample. Population is interpolated for year 1100

Table 4: Spearman's Rank Correlation Coefficient for Key Variables over Time

Century	(1) Births	(2) Immigrants	(3) Population
XIV-XV	0.164**	0.308***	0.838***
XV-XVI	0.331***	0.398***	0.870***
XVI-XVII	0.424***	0.500***	0.839***
XVII-XVIII	0.423***	0.462***	0.791***
XVIII-XIX	0.593***	0.516***	0.700***

Each row reports Spearman's rho for a given variable measured at t and t+1. For instance, the row "XVI-XVII" reports the measure of statistical dependence between the variable in the column measured in XVI century and the same variable measured in the XVII century.

Table 5: Markov Transition Matrices for Key Variables across Cities

	Births					Immigrants					Population				
t/t+1	**0**	**q1**	**q2**	**q3**	**q4**	**0**	**q1**	**q2**	**q3**	**q4**	**0**	**q1**	**q2**	**q3**	**q4**
0	.61	.13	.12	.09	.05	.75	.09	.07	.06	.03	.61	.2	.09	.07	.03
q1	.17	.42	.24	.12	.04	.23	.47	.19	.07	.04	.25	.3	.23	.19	.03
q2	.22	.22	.24	.19	.12	.32	.19	.15	.18	.16	.1	.1	.21	.44	.15
q3	.12	.08	.19	.32	.29	.22	.12	.16	.23	.27	.05	.05	.13	.35	.41
q4	.19	.03	.1	.26	.43	.15	.03	.1	.23	.49	.01	.01	.05	.14	.79

This Table displays the probability of transition from each row to each column, estimated by Maximum Likelihood. For each variable (Births per 1000 inhabitants, Immigrants per 1000 inhabitants, and Population) and each century, we divide cities in five groups: the first group includes cities that in a given century featured a value of zero (the first row / column). The remaining groups correspond to the quartiles of the distribution in any given century conditional on being positive. The Table displays the probability of moving between each of the five categories from century t to century t+1, estimated by Maximum Likelihood.

Table 6: Coagglomeration

	Arts Non-Performing	Arts Performing	Humanities and Sciences
	Panel A: Births		
Arts, Performing	0.435 ***		
	0.430 ***		
Humanities and Sciences	0.521 ***	0.293 ***	
	0.553 ***	0.352 ***	
Business	0.369 ***	0.276 ***	0.369 ***
	0.416 ***	0.261 ***	0.433 ***
	Panel B: Immigrants		
Arts, Performing	0.665 ***		
	0.678 ***		
Humanities and Sciences	0.609 ***	0.410 ***	
	0.656 ***	0.504 ***	
Business	0.480 ***	0.473 ***	0.356 ***
	0.534 ***	0.594 ***	0.474 ***

Each entry represents a pairwise correlation of residuals from regressions of famous people per capita in each discipline by city of birth (Panel A) or death (Panel B) on city FE and period dummies (upper row) and city FE and period dummies plus controls (lower rows). The dependent variable is defined as Log(1+*Births in discipline i*) in Panel A and Log(1+*Immigrants in discipline i*) in Panel B. * p<0.1, ** p<0.05, *** p<0.01.

Table 7: Population and Famous Creatives

	(1) Births	(2) Immigrants	(3) Births	(4) Immigrants
Log (Population)	-0.016	-0.008	-0.015	-0.011
	(0.013)	(0.012)	(0.013)	(0.013)
L.Log (Population)	0.016	0.016*	0.017	0.014*
	(0.013)	(0.009)	(0.011)	(0.008)
Bishop			-0.057**	-0.049*
			(0.027)	(0.026)
Archbishop			-0.063*	-0.025
			(0.037)	(0.033)
Capital			0.062**	0.064*
			(0.027)	(0.033)
Commune			0.068***	0.047***
			(0.014)	(0.014)
$\beta_{Pop} + \beta_{L.Pop} = 0$,pv	0.995	0.102	0.922	0.864
Observations	3,434	3,434	2,191	2,191
Adjusted R-squared	0.141	0.291	0.281	0.143

The dependent variable is Log (1+Births) in columns (1) and (3), and Log (1+Immigrants) in columns (2) and (4). $\beta_{Pop} + \beta_{L.Pop} = 0$,pv is the p-value of equality to zero of the sum of coefficients of the variable Population measured in t and in t+1. Period dummies and City FE always included. Standard errors (clustered at the NUTS 2 region level) in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 8: Real Wage of Skilled Workers and Famous Creatives

	Y=Log(1+Un.Births.)		Y=Log(1+Un.Immig.)	
Dependent Variable	Log(1+Un.Births.)	Log(Wage)	Log(1+Un.Immig.)	Log(Wage)
F5.Y		0.023*		0.002
F4.Y		0.007		-0.004
F3.Y		-0.031***		0.023
F2.Y		-0.004		0.000
F1.Y		-0.001		-0.007
Y		0.010		-0.010
L1.Y	0.350***	0.001	0.348***	-0.012
L2.Y	0.167***	0.025*	0.200***	0.023**
L3.Y	0.173**	-0.006	0.091*	-0.012
L4.Y	0.102	0.003	0.126*	0.010
L5.Y	0.072*	-0.005	0.076	0.002
Log(Wage)	-0.005		-0.108	
L1.Log(Wage)	-0.041	0.731***	0.100	0.746***
L2.Log(Wage)	0.006	-0.014	0.200	-0.030
L3.Log(Wage)	-0.150	0.084	0.049	0.088
L4.Log(Wage)	0.239	-0.055	-0.139	-0.046
L5.Log(Wage)	0.032	0.053	-0.020	0.053
Observations	614	546	614	546
$F^{L.Wage}, pv$	0.634	0.000	0.645	0.000
$F^{L.Births}, pv$	0.000	0.021		
$F^{L.Immigrants}, pv$			0.000	0.971
$F^{F.Births}, pv$		0.592		
$F^{F.Immigrants}, pv$				0.297

The frequency of observation is a decade. The variable Wage represents the average real wage of skilled workers over the decade. The variable Un.Births is the (unscaled) number of Births. The variable Un.Immigrants is the (unscaled) number of Immigrants. $F^{L.X}, pv$ is the p-value of the F-test of joint significance of the lags of the variable X when X is the dependent variable, and of the contemporaneous and lag values when X is not the dependent variable. $F^{F.X}, pv$ is the p-value of the F-test of joint significance of its leads. Period dummies always included.

Table 9: Commune and Births, OLS Regressions

	(1)	(2)	(3)	(4)
Commune	0.072***	0.067***	0.070***	0.058***
	(0.012)	(0.011)	(0.012)	(0.012)
Large state		-0.033**	-0.035**	-0.008
		(0.014)	(0.014)	(0.013)
Bishop		-0.032	-0.028	-0.009
		(0.023)	(0.023)	(0.022)
Archbishop		-0.047	-0.058*	-0.056*
		(0.032)	(0.032)	(0.030)
Capital		0.057**	0.060**	0.064***
		(0.025)	(0.025)	(0.025)
Plundered		-0.019	-0.016	-0.015
		(0.027)	(0.026)	(0.024)
Log (Population)			-0.005	-0.014*
			(0.009)	(0.008)
University			0.059**	0.059**
			(0.024)	(0.023)
Spatial Lag of Log (1 + Births)				1.016***
				(0.141)
Observations	3,045	3,045	3,045	3,045
Adjusted R-squared	0.300	0.305	0.308	0.377

Dependent Variable is Log (1 + Births). Standard errors (clustered at the NUTS 2 region level) in parentheses. Period Dummies and City FE always included. * p<0.1, ** p<0.05, *** p<0.01.

Table 10: Commune and Births, 2SLS Regressions

	(1)	(2)	(3)	(4)
			Panel A: 2SLS estimates	
Commune	0.178***	0.168***	0.172***	0.124**
	(0.052)	(0.052)	(0.057)	(0.056)
Spatial Lag of Log (1 + Births)				0.996***
				(0.140)
Observations	2,961	2,961	2,961	2,961
Adjusted R-squared	0.116	0.127	0.129	0.225
Fstat, instrum., 1st stage	22.67	20.40	18.26	18.10
Baseline Controls	NO	YES	YES	YES
Additional Controls	NO	NO	YES	YES
			Panel B: First stage estimates	
Regional Commune	1.508***	1.498***	1.446***	1.437***
	(0.316)	(0.331)	(0.338)	(0.336)
			Panel C: Reduced form estimates	
Regional Commune	0.256***	0.234***	0.231***	0.163***
	(0.061)	(0.061)	(0.063)	(0.058)

Dependent Variable is Log (1 + Births). Standard errors (clustered at the NUTS 2 region level) in parentheses. Period Dummies and City FE always included. * p<0.1, ** p<0.05, *** p<0.01.

Table 11: Commune and Births, using Western Church Exposure as IV

	(1)	(2)	(3)	(4)
	Panel A: 2SLS estimates			
Commune	0.230*	0.132**	0.229**	0.132**
	(0.121)	(0.053)	(0.109)	(0.054)
Observations	2,961	2,961	2,961	2,961
Adjusted R-squared	0.164	0.211	0.165	0.211
Fstat, instrum., 1st stage	8.770	14.14	11.38	14.31
Chi2(1) p-value		0.353		0.314
Period FE X Ever bishop			YES	YES
	Panel B: First stage estimates			
W. Church Exposure	0.038***	0.030**	0.043***	0.035**
	(0.013)	(0.014)	(0.013)	(0.014)
Regional Commune		1.394***		1.307***
		(0.347)		(0.334)
	Panel C: Reduced form estimates			
Church Exposure	0.009**	0.008*	0.010**	0.009**
	(0.004)	(0.004)	(0.004)	(0.004)
Regional Commune		0.171***		0.155**
		(0.059)		(0.060)

Dependent Variable is Log (1 + Births). Western Church exposure measured in 50 years. Chi2(1) is the p-value of the Hansen J -statistic testing the over-identifying restriction. Columns (1) and (3): just identified model with only one instrument. In Column (3) and (4) we control for whether the city was ever the seat of a bishop interacted with period dummies. Standard errors (clustered at the NUTS 2 region level) in parentheses. Period Dummies, City FE and full set of city-level controls always included. * p<0.1, ** p<0.05, *** p<0.01.

Table 12: Commune and Births: QMLE Poisson Estimates

	(1)	(2)
Commune	0.905**	0.941***
	(0.386)	(0.345)
Spatial Lag of Unscaled Births	0.086***	0.059***
	(0.024)	(0.021)
Large state	0.092	0.191
	(0.132)	(0.116)
Bishop	-0.771*	-0.734
	(0.445)	(0.466)
Archbishop	-0.243	-0.417
	(0.468)	(0.549)
Capital	0.608**	0.626**
	(0.279)	(0.288)
Plundered	-0.340**	-0.265
	(0.172)	(0.176)
University	-0.260	-0.179
	(0.311)	(0.333)
Observations	2,012	2,012
Log-likelihood	-2792	-2759
Population Decile Dummies	YES	NO
Log Population Dummies	NO	YES

Dependent pariable is number of births (not scaled by population). Estimation method: QMLE Poisson. Period dummies and city FE always included. In Col 1 we enter separate dummies for belonging to each of the deciles going from the first to the ninth, plus one dummy for belonging to the set of percentiles from the 90th to the 94th, one for the percentiles 95th to 98th; thus, the default group consists of cities belonging to the 99th percentile. In Col 2 we split the range of variation of Log(Population) in the entire sample into 10 equally sized intervals, and enter a dummy variable for each interval except the last one (which is the default). Standard errors (clustered at the city level) in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Table 13: Determinants of the Migration of Famous Creatives

	(1)	(2)	(3)
To Population	0.209***	–0.062***	–0.038
	(0.056)	(0.021)	(0.026)
To Commune	0.959***	0.510**	0.520**
	(0.157)	(0.209)	(0.213)
To Plundered	–0.666**	0.098	0.106
	(0.281)	(0.195)	(0.215)
To Capital	2.846***	0.957***	0.857***
	(0.299)	(0.153)	(0.173)
To Archbishop	0.128	–0.284	–0.211
	(0.257)	(0.268)	(0.309)
To University	0.405*	–0.428*	–0.474
	(0.226)	(0.227)	(0.289)
To Bishop	–0.302	–0.591*	–0.538
	(0.215)	(0.328)	(0.336)
Log From (Unscaled) Births	0.909***	0.950***	
	(0.046)	(0.037)	
From Population	–0.113***	0.001	
	(0.029)	(0.022)	
From Commune	0.091	0.095	
	(0.074)	(0.109)	
From Plundered	0.316***	0.117	
	(0.091)	(0.086)	
From Capital	0.071	0.035	
	(0.120)	(0.103)	
From Archbishop	0.150	0.051	
	(0.122)	(0.363)	
From University	0.007	0.169	
	(0.064)	(0.112)	
From Bishop	0.022	–0.385***	
	(0.097)	(0.129)	
Distance	–0.176***	–0.167***	–0.165***
	(0.032)	(0.019)	(0.019)
Same First Lang	1.529***	1.379***	1.361***
	(0.234)	(0.112)	(0.110)
Same NUTS 1	0.537***	0.624***	0.594***
	(0.147)	(0.087)	(0.087)
Same State	0.628***	1.486***	1.573***
	(0.251)	(0.107)	(0.120)
Dyadic Observations	714,855	714,855	714,855
Period Dummies	YES	YES	NO
Destination FE	NO	YES	YES
Origin FE	NO	YES	NO
Origin-Century FE	NO	NO	YES

In this Table we estimate a gravity equation on dyadic data; estimation method is QMLE Poisson. Dependent Variable is Number of Immigrants. Twoway clusterd standard errors (by origin and by destination) in parentheses. Population size measured in 100,000. Distance measured in 100 Km. * p<0.1, ** p<0.05, *** p<0.01.

Creativity over Time and Space

Appendix - For Online Publication

Michel Serafinelli, Guido Tabellini

19th March 2021

A.I Some prominent examples

We now describe in greater detail a few European cities that became amazing creative clusters in specific periods. Our goal in this subsection is to gain a better sense of our data, and also to show that they are consistent with anecdotal and historical evidence on creative cities. Throughout we focus on birth of famous creatives, since this is the variable of main interest.

Florence and the early Renaissance. Florence became a Commune during the XII century, and Bosker et al. (2013) code it as a Commune during the XIII-XV centuries, consistently with the principle of dating Commune on the basis of the institutions in place at the beginning of each century. City autonomy was established in two waves during the XII century, and both coincided with the death of a German Emperor (i.e. a period of power vacuum at the center).[1]

Appendix Table A.3 lists the famous creatives that according to Freebase were born in Florence or its vicinity in the period 1100-1499, namely from the century of transition into Commune until it becomes a Signoria. During this period Florence became the cradle of the Renaissance movement. This is reflected in our data. No famous creative is born until 1239, and then there is an impressive acceleration, with the apogee reached during the XV century, when Florence was the city in our sample with the highest number of famous births relative to population (cf. Figure 2).

Several historians have emphasized the important role of civic capital in stimulating Florentine creativity, and its link with Communal institutions. Quoting from Clarke (1926), chp. II :"Renaissance civilisation is primarily an urban civilisation; its greatest contributions to art and literature come from the towns. Florence was the centre of this great movement; by the beginning of the fourteenth century she had already produced the first Renaissance architect of secular buildings,

[1]The first official record of the establishment of a Commune in Florence dates 1138 (not long after the death of the German Emperor Henry V); after temperorarily losing its independence due to Frederick Barbarossa, Florence became again a free city towards the end of the XII century, taking advantage of the death of Frederick's successor, Henry VI - cf. Najemy (2008).

Arnolfo di Cambio; the first great Renaissance painter, Giotto; the first modern historian, Villani; and the first modern poet, Dante. The city was a unit small enough to develop rapidly patriotism, consciousness of individual responsibility and a spirit of emulation, a development which found artistic expression, in a manner unknown in half-organised, half-populated monarchies." - see also Brucker (2015). Other famous creatives born in Florence (or its vicinity) during this period and listed in Table A.3 include the painters Cimabue and Botticelli, the architect Brunelleschi, the explorer Amerigo Vespucci, the historian Niccolò Machiavelli and many others. Note that some famous creatives that spent the early part (or most) of their lives in Florence are not listed in Table A.3. In particular, the historian Villani was born and died in Florence but for some reason he is not included in Freebase. The architect Arnolfo di Cambio was born not far from Florence, but Florence is not the city in Bairoch (1988) closest to his birthplace - the closest city is Poggi Bonci. Likewise, Leonardo is assigned to Pistoia, the closest city to his birthplace (Vinci), although he spent his formative years (and several productive periods) in Florence. Despite such omissions, Florence emerges in our data as an exceptional creative cluster. Communal institutions in Florence also stimulated innovations by preserving a decentralized and competitive market for artists. Quoting from De Marchi and Van Miegroet (2006), p. 74: "... though in the course of the 15th century the Medici family acquired more and more power, Florence remained a republic; there was no Ducal Court. For this reason and because commissioning bodies were many, with a variety of goals, there was no “single dominating authority” around which taste might coalesce."

Antwerp and Amsterdam, and the emergence of a market for paintings

Communal institutions spread in several Belgian and Dutch cities a few centuries later than in Italy. Bosker et al. (2013), code Antwerp and Amsterdam as a Commune from 1300 and 1400 until the end of the sample, respectively. Here too, transition into Commune was followed by diffuse and important artistic innovations, particularly in paintings. Antwerp is the most creative city in our sample in the XVI century; Amsterdam is the most creative in the XVII century (and the second most creative in the XVI century). Appendix Tables A.4 and A.5 list the famous creatives in Freebase born in Antwerp (or its vicinity) between 1200 and 1599 and Amsterdam between 1200 and 1699. There is no famous birth until one century after the transition into Commune, while the XVI and XVII centuries stand out as exceptional, particularly for painters. Thus, the well known and remarkable clustering of painters in these two cities is fully captured by our data.

According to art historians, city institutions played an important role in the agglomeration of innovative artists in these two cities, although the mechanism is different than in Florence. Antwerp and Amsterdam were important trade centers. This facilitated the emergence of a market for paintings - cf. De Marchi and Van Miegroet (2006). First, merchants were an important source of demand for paintings - both local merchants as well as foreigners who travelled to the city to exchange other goods. Second, the market and transport infrastructures created to exchange goods

were also used in the market for paintings, enabling a local production in excess of the local demand (i.e. Belgian and Dutch paintings were exported all over Europe). Competition amongst different painters for a large and heterogeneous demand, as well as an open and welcoming culture amongst local guilds, encouraged new entries and innovation in varieties. Interestingly, the use of existing market infrastructures to foster a market for paintings was encouraged by city authorities: "In the case of Antwerp the city authorities played a central role, adapting to paintings and prints an older marketing institutions - the display hall, used for textiles at fair times in Bruges. ... A second distinctive feature in Antwerp was the deployment of cloister-like structures known as *panden*, some of them operating for the selling of paintings on a year-round basis. Strikingly, the city authorities took an active role in promoting these dedicated sales venues." - De Marchi and Van Miegroet (2006), p. 86,87. More generally, "Guild openness, civic encouragement, widespread dealing, plus specialization and division of labor practiced in the many crafts making up the painters' guild, and especially between masters' workshops, as well as a marketing and exporting orientation– all these features marked Antwerp as an environment for the production and sale of paintings the like of which had not been seen before", ibid, p. 89.

Paris and Vienna in the XVIII and XIX centuries

Finally, we turn to two more recent creative clusters, Paris in 1700-1899 and Vienna in the second half of the XIX century. Paris is close to the top of the distribution for *Immigrants* in our sample during the XVIII and XIX centuries (less so for *Births*), and Vienna is in the top 5% of the distribution for *Births* in the XIX century.

This is consistent with direct historical and anecdotal evidence. The poet and art critic Guillaume Apollinaire wrote in 1913: "In the XIX century Paris was the capital of the art.". Some decades later, Vienna emerged as the cultural capital of Europe, hosting the Vienna Circle in philosophy, the Vienna school of music with a new generation of composers, the Vienna School of Medicine, the Vienna school of economics, and large numbers of great architects, artists and scientists. The famous creatives included in Freebase and born (or who died) in Paris and Vienna during this period sum to several hundreds, too many to be listed in a table. Appendix Tables A.6 and A.7 instead report the names of creatives born in these two cities and included in the database by Yu et al. (2016), that only considers the most influential individuals. What is striking in these two tables is not only the number of easily recognizable historical figures, but also the breadth in terms of disciplines.

Anecdotal evidence suggests that important agglomeration effects are at the heart of the success of these two cities in attracting and giving birth to famous innovators. Many painters such as Cézanne, van Gogh and Pissarro expressed the view that having been in Paris was essential for their artistic achievements: "There is a theory that I heard you profess, that to paint it is absolutely necessary to live in Paris, so as to keep up with ideas" (Paul Gaugin to Camille Pissarro,

1881, quoted by Galenson 2009, p. 282). Vienna is even more remarkable than Paris, in that interactions and spillover effects between artists and scientists were commonplace and particularly fruitful. Eric Kandel, winner of the Nobel prize in medicine and also born in Vienna, describes how Viennese painters such as Klimt and Schiele were deeply influenced by the exchange of insights about unconscious mental processes with members of the Vienna School of Medicine. "One of the characteristic features of Viennese life at the time was the continual, easy interaction of artists, writers, and thinkers with scientists. The interaction with medical and biological scientists, as well as with psychonalists, significantly influenced the portraiture of these (..) artists" (Kendal 2012, p. xv). Similar interactions were taking place between musicians, poets, architects, philosophers, scientists. Other famous creatives born in Vienna (or its vicinity) during this period and listed in Table A.7 include the composer Arnold Schoenberg, the philosopher Ludwig Wittgenstein, the psychologist Melanie Klein, the architect Otto Wagner, the physicist Ludwig Boltzmann and many others.

Transition into Commune occurred much earlier for both cities, and so it cannot explain the rise of creativity in these two cities. Nevertheless, the emergence of Vienna as a creative cluster was shortly preceded by national political reforms. "In 1848 Austria's liberal middle class became energized and forced the country's absolute, almost feudal monarchy, .. to evolve along more democratic lines. The ensuing reforms were based on a view of Austria as a progressive, constitutional monarchy...characterized by a cultural and political partnership between the enlightened middle class and the aristocracy. This partnership was designed to reform the state, to support the secular cultural life of the nation, and to establish a free market economy, all based on the modern belief that reason and science would replace faith and religion." - Kandel (2012), p. 8. Vienna was the main beneficiary of these progressive reforms. After the reforms, the city "attracted talented people, especially Jews, from all over the empire...(and) benefitted from an influx of talented individuals from different religious, social, cultural, ethnic and educational backgrounds" - Kandel (2012), p. 9. Thus, although city institutions were not involved, the example of Vienna tells a similar story as the rise of other creative clusters in earlier centuries.[2]

A.II Details on Data Sources

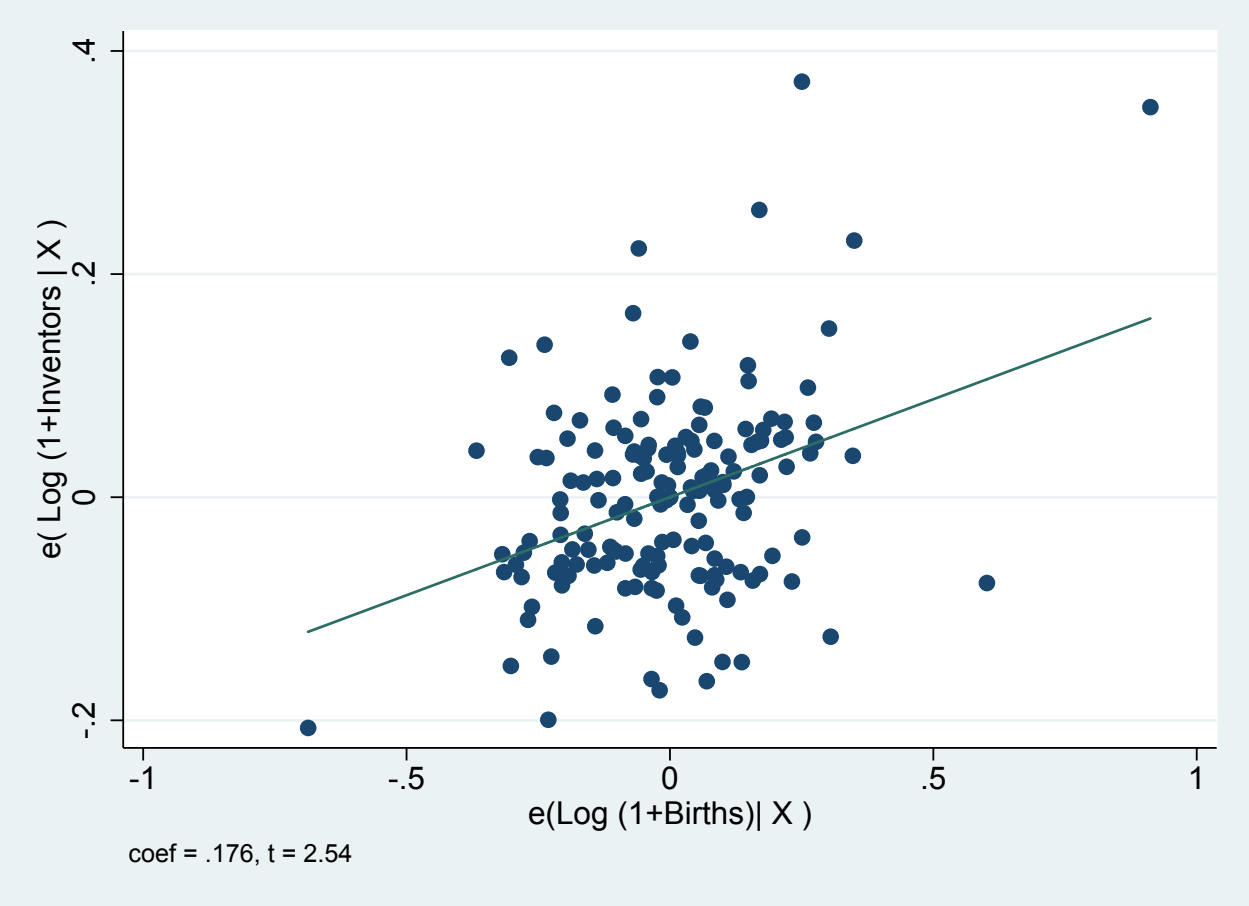
Wages The main source is Allen (2001), who in turn relies also on other studies. In addition, we used the data gathered by Bennassar (1999), Boulton (1996), Cabourdin (1968), Feliu (1991), Gibson and Smout (1995), Rappaport (2002), and Scholliers and Avondts (1977).

[2]The case of Paris is more complex, since Paris was already a very creative city during the XVIII century, before the French revolution.

Protestant Cities Our data on protestant cities has been collected using several sources covering the different parts of Europe. For Prussia we used 19th century information from the Ifo Prussian Economic History Database (Becker et al., 2014). For the Netherlands we used the 1795-1971 Dutch Censuses (DANS, 2005). For Switzerland we used census data from the Federal Statistical Office (FSO, 2012). For Hungary we used retrospective data on religion retrieved from the 2011 census (HCSO, 2013). For the Czech Republic we used a dataset with information collected in the 1921, 1930, 1950, 1991, 2001, and 2011 censuses (CSU, 2017). For England and Wales we retrieved data both from the Online Historical Population Reports Website (OHPR, 2007b), and from Field (2012). Census data from the OHPR (2007a) was used to retrieve data for Scotland. Finally for Northern Ireland we relied on data edited by Canny (2001).

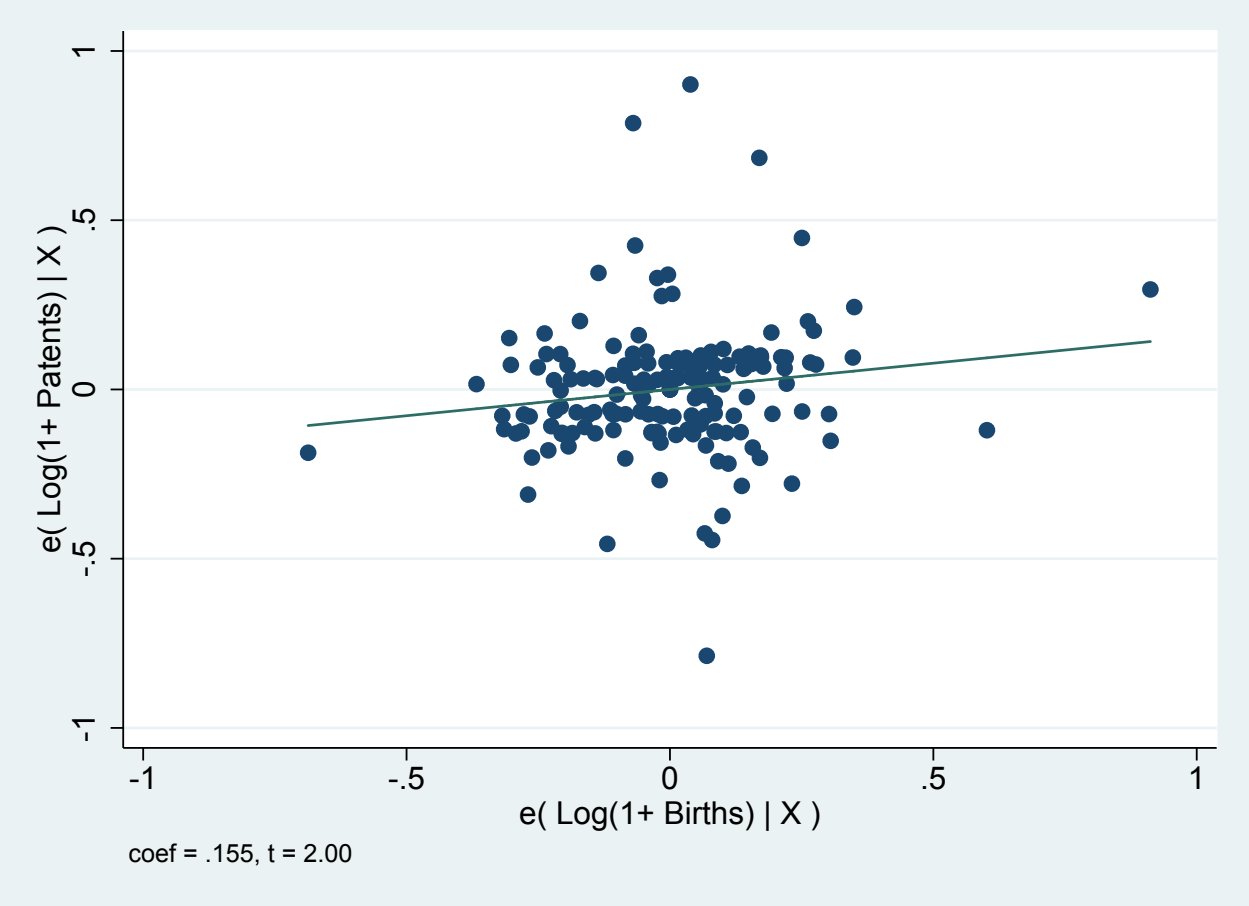
A.III Additional Figure and Tables

Figure A.1: Famous Creatives and Inventors, added-variable plot



We control for City FE, Century FE, Large state, Bishop, Archbishop, Capital, Plundered, Commune, Population, University. Standard Errors clustered by Region.

Figure A.2: Famous Creatives and Patents, added-variable plot



We control for City FE, Century FE, Large state, Bishop, Archbishop, Capital, Plundered, Commune, Population, University.Standard Errors clustered by Region.

Figure A.3: Real Skilled Wages for 5 Prominent Cities

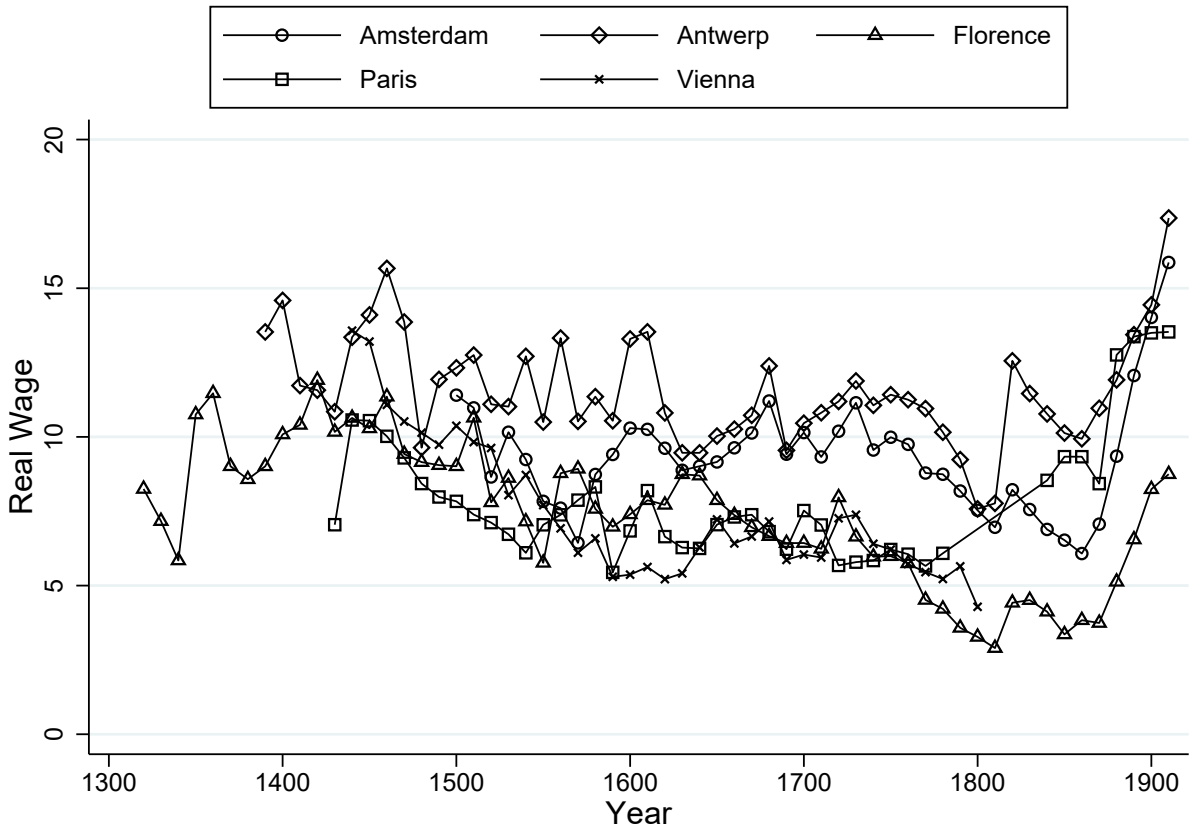
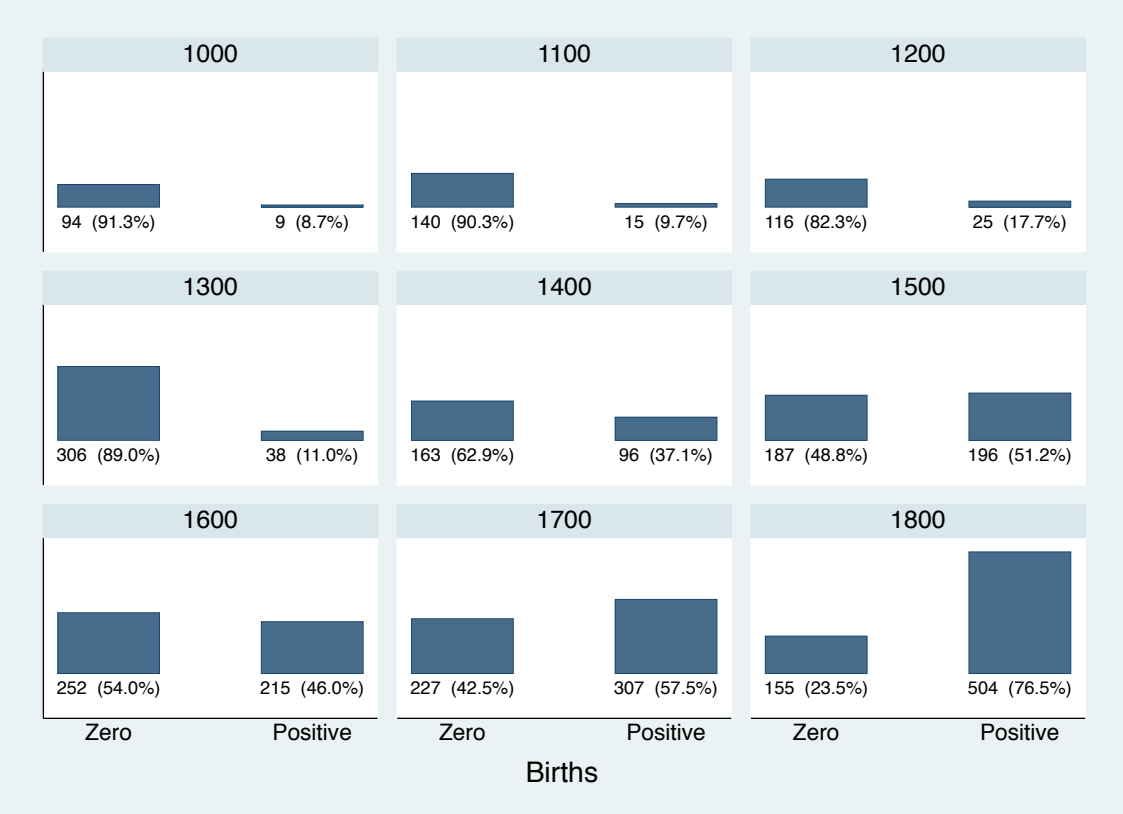
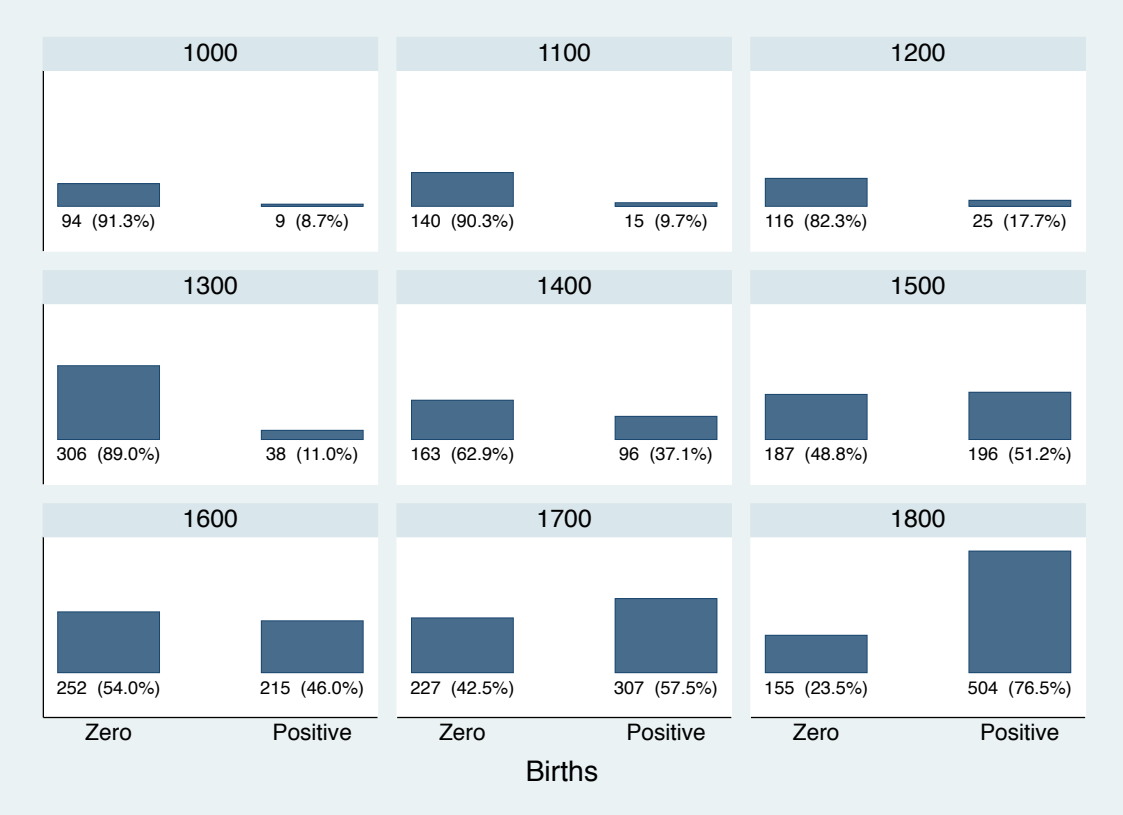


Figure A.4: Share of Cities with Zero and Positive Births, by Century



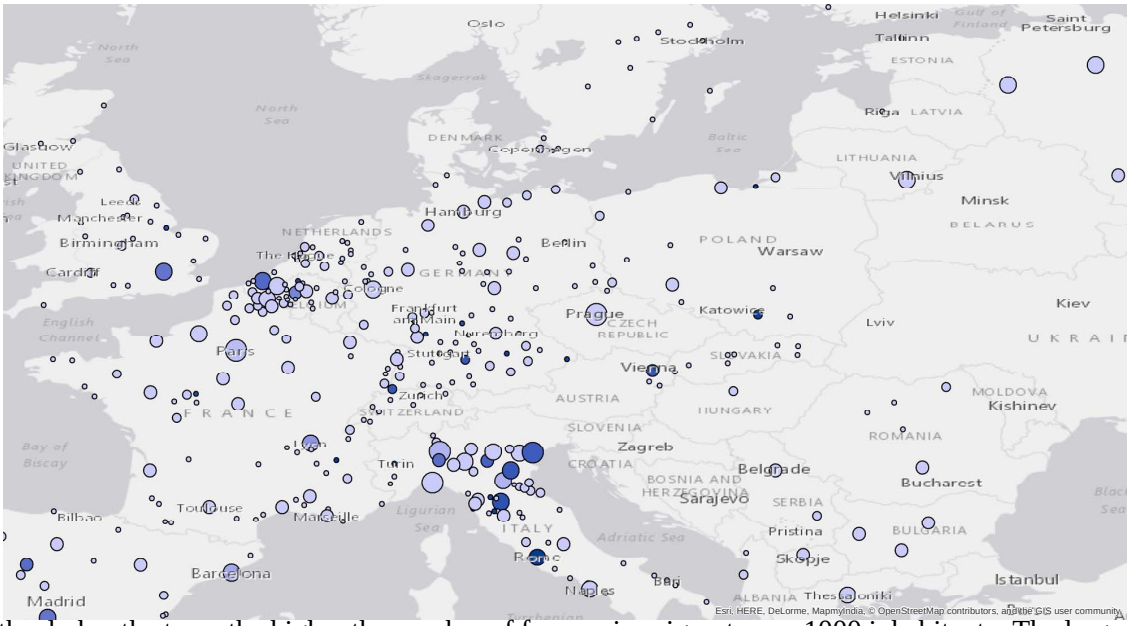
The Figure reports the share of cities by century with zero *Births*

Figure A.5: Share of Cities with Zero and Positive Immigrants, by Century



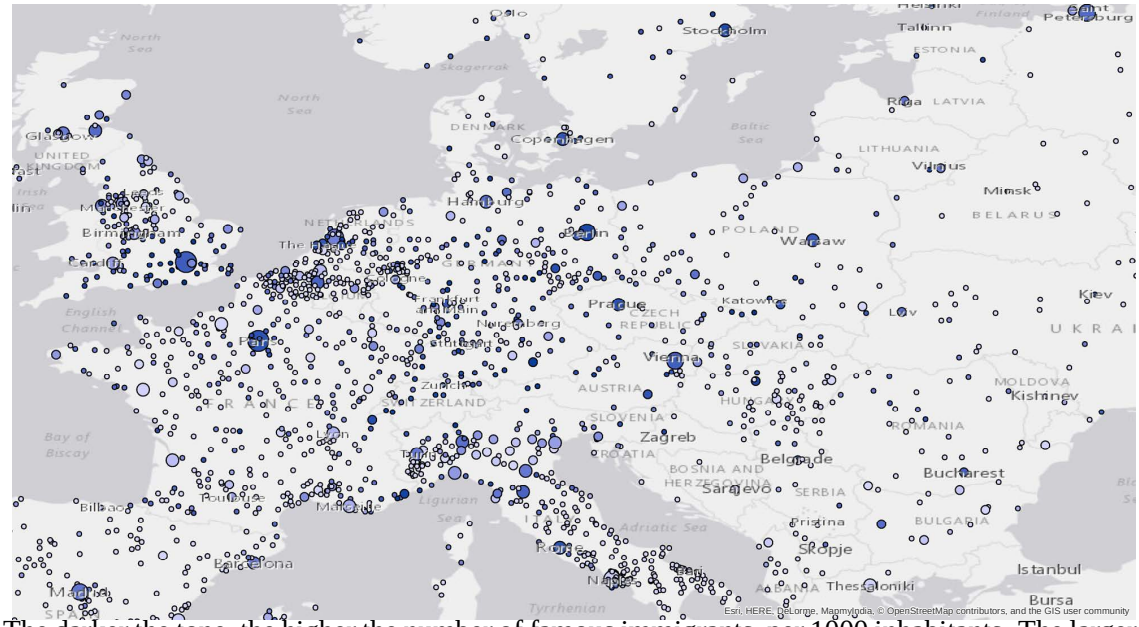
The Figure reports the share of cities by century with zero *Immigrants*

Figure A.6: Spatial Distribution of Immigrants, XVth century



the darker the tone, the higher the number of famous immigrants, per 1000 inhabitants. The larger the circle, the larger the population of the city.

Figure A.7: Spatial Distribution of Immigrants, XIXth century



The darker the tone, the higher the number of famous immigrants, per 1000 inhabitants. The larger the circle, the larger the population of the city.

Figure A.8: Commune Status over Time

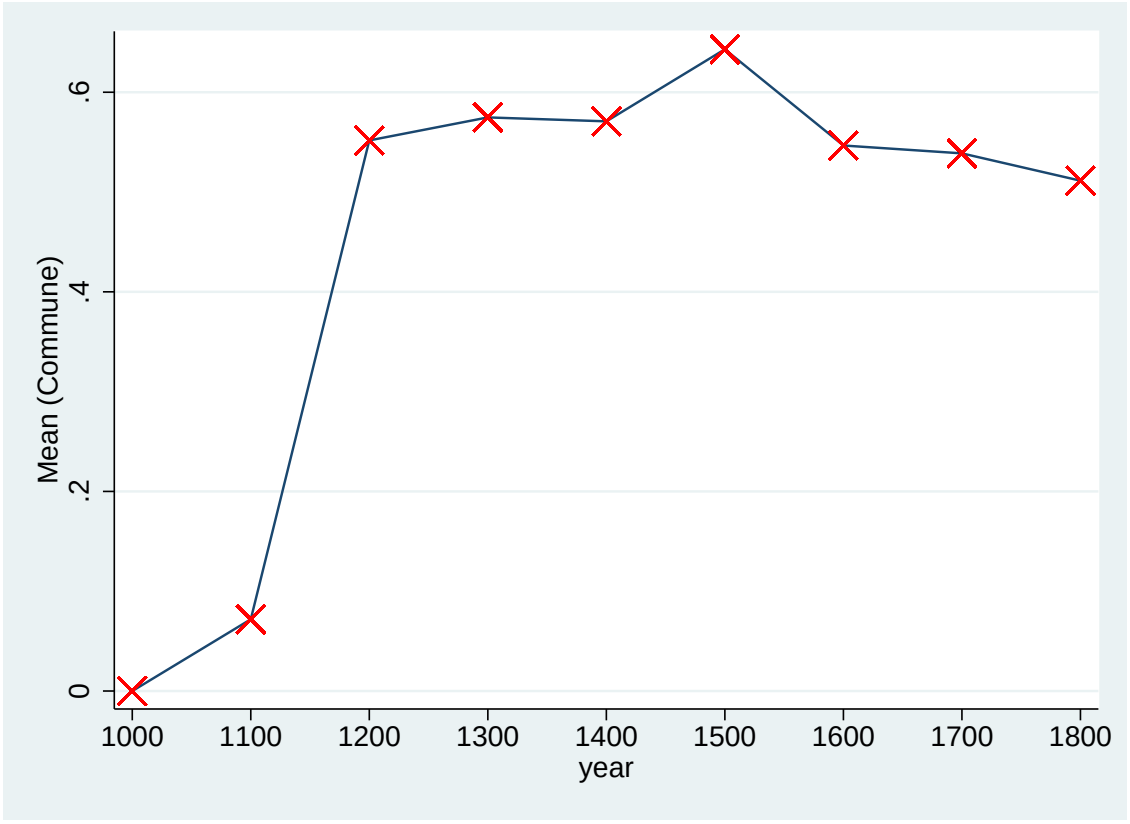


Figure A.9: Entry into Commune Status

Figure A.10: Exit from Commune Status

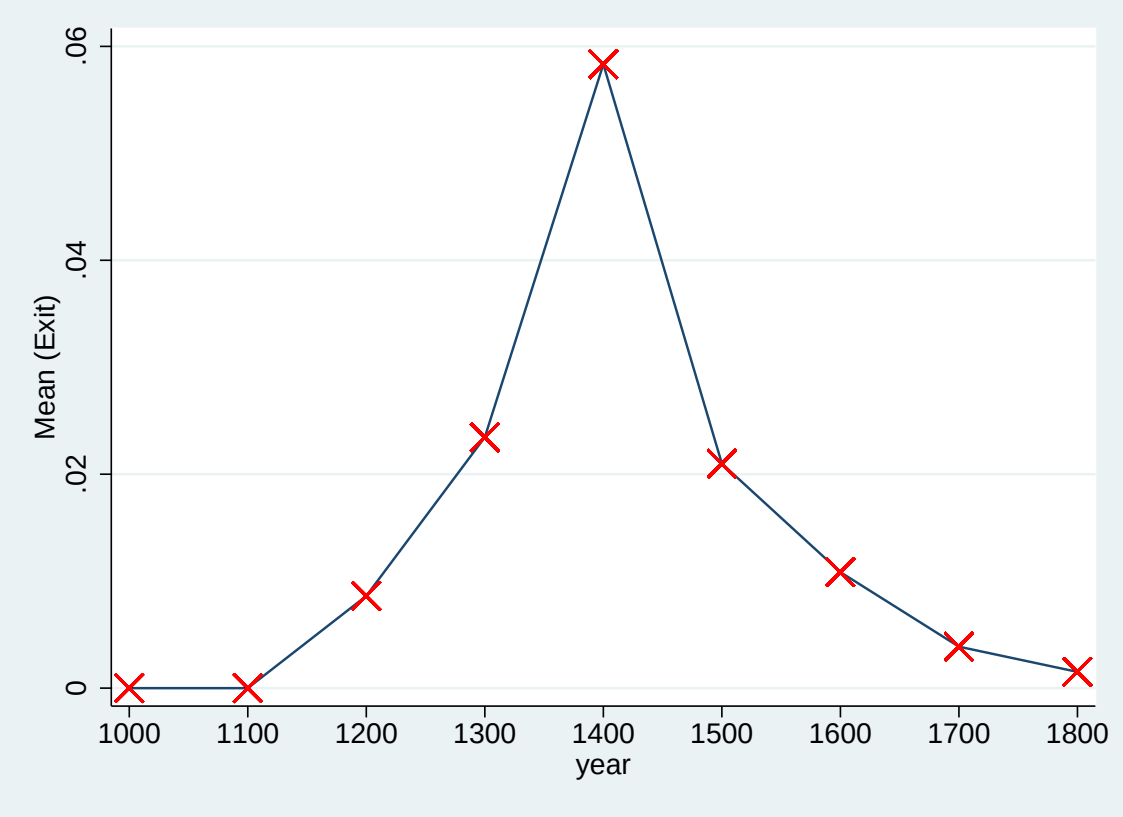


Table A.1: Polymaths

	Number of people
Performing arts + Non-performing arts	1072
Performing arts + Humanities and Sciences	40
Performing arts + Business	15
Non-performing arts + Humanities and Sciences	1245
Non-performing arts + Business	211
Humanities and Sciences + Business	181
Total two categories	2764
Performing arts + Non-performing arts + Humanities and Sciences	180
Performing arts + Non-performing arts + Business	10
Performing arts + Humanities and Sciences + Business	2
Non-performing arts + Humanities and Sciences + Business	55
Total three categories	247
All four categories	5
Total	21906

Note: Many of the creative individuals we considered achieved fame in multiple fields. For example, each of those listed under “Non-performing arts + Humanities and Sciences" achieved prominence both as a non-performing artist and in some field of the humanities or sciences, though not as a performing artist or in business.

Table A.2: Time Coverage of Data on Wages

City	Period
Amsterdam	1500-1910
Antwerp	1373-1913
Augsburg	1502-1803
Barcelona	1500-1804
Cambridge	1450-1700
Canterbury	1450-1700
Cavaillon	1600-1785
Dover	1450-1700
Edinburgh	1553-1642
Florence	1326-1913
Gdansk	1535-1814
Ghent	1835-1914
Krakow	1409-1910
Leipzig	1520-1913
London	1264-1913
Lviv	1520-1800
Lyon	1500-1592
Madrid	1520-1913
Milan	1520-1913
Munich	1427-1765
Naples	1514-1806
Oxford	1264-1913
Paris	1400-1911
Strasbourg	1395-1875
Valencia	1392-1785
Valladolid	1502-1560
Vienna	1440-1913
Warsaw	1558-1913

Note: Data do not necessarily cover the whole period as reported here; some gaps may be present.
Sources: Allen (2001), Bennassar (1999), Boulton (1996), Cabourdin (1968), Feliu (1991), Gibson and Smout (1995), Rappaport (2002), and Scholliers and Avondts (1977)

Table A.3: Born in Florence (1100-1499)

Name	Year of Birth	Year of Death	Place of Death	Occupation
Gaddo Gaddi	1239	1312	Florence	Painter
Cimabue	1240	1302	Pisa	Painter
Guido Cavalcanti	1255	1300	Florence	Poet
Dante Alighieri	1265	1321	Ravenna	Poet
Giotto di Bondone	1267	1337	Florence	Painter
Taddeo Gaddi	1300	1366	Florence	Painter
Antonio Pucci	1310	1388	Florence	Poet
Giottino	1324	1357	Florence	Painter
Baldassarre Bonaiuti	1336	1385	Florence	Historian
Giovanni di Bicci de' Medici	1360	1429	Florence	Banker
Palla Strozzi	1372	1462	Padova	Banker
Andrea Stefani	1375	1460	Lucca	Composer
Filippo Brunelleschi	1377	1446	Florence	Architect
Lorenzo Ghiberti	1378	1455	Florence	Sculptor
Donatello	1386	1466	Florence	Sculptor
Cosimo de' Medici	1389	1464	Florence	Banker
Fra Angelico	1395	1455	Rome	Painter
Lorenzo il Vecchio	1395	1440	Florence	Banker
Michelozzo	1396	1472	Florence	Architect
Paolo Uccello	1397	1475	Florence	Painter
Paolo dal Pozzo Toscanelli	1397	1482	Florence	Astrologer
Filarete	1400	1469	Rome	Architect
Luca della Robbia	1400	1482	Florence	Sculptor
Filippo Lippi	1406	1469	Spoleto	Painter
Matteo Palmieri	1406	1475	Florence	Historian
Bernardo Rossellino	1409	1464	Florence	Sculptor
Piero di Cosimo de' Medici	1416	1469	Florence	Banker amd Patron
Agostino di Duccio	1418	1481	Perugia	Sculptor
Andrea del Castagno	1421	1457	Florence	Painter
Benozzo Gozzoli	1421	1497	Pistoia	Painter
Giovanni di Cosimo de' Medici	1421	1463	Florence	Banker
Lucrezia Tornabuoni	1425	1482	Florence	Writer
Antonio Rossellino	1427	1479	Florence	Sculptor
Antonio Pollaiuolo	1429	1498	Rome	Painter
Pierfrancesco di Lorenzo de' Medici	1430	1476	Florence	Banker
Marsilio Ficino	1433	1499	Florence	Philosopher
Andrea del Verrocchio	1435	1488	Venezia	Painter
Andrea della Robbia	1435	1525	Florence	Sculptor
Cosimo Rosselli	1439	1507	Florence	Painter

Jacopo da Sellaio	1441	1493	Florence	Painter
Piero Pollaiuolo	1443	1496	Rome	Painter
Sandro Botticelli	1445	1510	Florence	Painter
Francesco Botticini	1446	1498	Florence	Painter
Domenico Ghirlandaio	1449	1494	Florence	Painter
Lorenzo de' Medici	1449	1492	Florence	Writer
Baccio Pontelli	1450	1492	Urbino	Architect
Antonio da Sangallo the Elder	1453	1534	Florence	Architect
Girolamo Benivieni	1453	1542	Florence	Poet
Amerigo Vespucci	1454	1512	Sevilla	Explorer
Pietro Accolti	1455	1532	Rome	Cardinal and Writer
Benedetto Buglioni	1459	1521	Florence	Sculptor
Lorenzo di Credi	1459	1537	Florence	Painter
Piero di Cosimo	1462	1521	Florence	Painter
Lorenzo di Pierfrancesco de' Medici	1463	1503	Florence	Banker
Niccolo Machiavelli	1469	1527	Florence	Historian
Pietro Torrigiano	1472	1528	Sevilla	Sculptor
Giovanni Francesco Rustici	1474	1554	Tours	Painter
Mariotto Albertinelli	1474	1515	Florence	Painter
Giovanni Rucellai	1475	1525	Rome	Poet
Jacopo Nardi	1476	1563	Venezia	Historian
Franciabigio	1482	1525	Florence	Painter
Francesco Guicciardini	1483	1540	Florence	Historian
Ridolfo Ghirlandajo	1483	1561	Florence	Painter
Antonio da Sangallo the Younger	1484	1546	Terni	Architect
Jacopo Sansovino	1486	1570	Venezia	Sculptor
Girolamo della Robbia	1488	1566	Paris	Potter
Pietro Aron	1489	1550	Florence	Composer
Lorenzetto	1490	1541	Rome	Sculptor
Agnolo Firenzuola	1493	1543	Prato	Poet
Rosso Fiorentino	1494	1540	Paris	Painter
Benedetto Accolti jr	1497	1549	Florence	Cardinal and Writer

Note: Souce is Freebase. If an individual is born or dies in a small city not included in the Bairoch et al. (1988) sample, we assign it to the closest city in the sample, within a threshold of 71 Km (corresponding to the 95th percentile of the distance distribution).

Table A.4: Born in Amsterdam (1200-1699)

Name	Year of Birth	Year of Death	Place of Death	Occupation
Pieter Aertsen	1508	1575	Amsterdam	Painter
Lambert Sustris	1515	1584	Venezia	Painter
Dirck Volckertszoon Coornhert	1522	1590	Gouda	Writer
Hendrik Laurenszoon Spiegel	1549	1612	Alkmaar	Writer
Jan Pieterszoon Sweelinck	1562	1621	Amsterdam	Composer
Jacob van Heemskerk	1567	1607	Gibraltar	Explorer
Pieter Corneliszoon Hooft	1581	1647	Denhaag	Historian
Laurens Reael	1583	1637	Amsterdam	Admiral
Simon Episcopius	1583	1643	Amsterdam	Theologian
Gerbrand Adriaensz Bredero	1585	1618	Amsterdam	Poet
Hendrick Avercamp	1585	1634	Kampen	Painter
Andries Bicker	1586	1652	Amsterdam	Merchant
Esaias van de Velde	1587	1630	Denhaag	Painter
Nicolaes Tulp	1593	1674	Denhaag	Surgeon
Pauwels van Hillegaert	1596	1640	Amsterdam	Painter
Thomas de Keyser	1596	1667	Amsterdam	Painter
Salomon de Bray	1597	1664	Haarlem	Architect
Isaac Commelin	1598	1676	Amsterdam	Historian
Michael van Langren	1598	1675	Bruxelles	Astronomer
Cornelis de Graeff	1599	1664	Amsterdam	Merchant
Pieter Codde	1599	1678	Amsterdam	Painter
Philip Vingboons	1607	1678	Amsterdam	Architect
Salomon Koninck	1609	1656	Amsterdam	Painter
Jan Asselijn	1610	1652	Amsterdam	Painter
Andries de Graeff	1611	1678	Amsterdam	Merchant
Philip de Koninck	1619	1688	Amsterdam	Painter
Gerbrand van den Eeckhout	1621	1674	Amsterdam	Painter
Jan Baptist Weenix	1621	1660	Utrecht	Painter
Jan Abrahamsz Beerstraten	1622	1666	Amsterdam	Painter
Reinier Nooms	1623	1667	Amsterdam	Painter
Lambert Doomer	1624	1700	Amsterdam	Painter
Willem Schellinks	1627	1678	Amsterdam	Painter
Jan Hackaert	1628	1685	Amsterdam	Painter
Jan de Bisschop	1628	1671	Denhaag	Painter
Johann van Waveren Hudde	1628	1704	Amsterdam	Mathematician
Adriaan Koerbagh	1632	1669	Amsterdam	Philosoper
Baruch Spinoza	1632	1677	Denhaag	Philosoper
Willem Drost	1633	1659	Venezia	Painter
Frederik de Moucheron	1633	1686	Amsterdam	Painter

Adriaen Backer	1635	1684	Amsterdam	Painter
Olfert Dapper	1635	1689	Amsterdam	Writer and Physician
Jan Swammerdam	1637	1680	Amsterdam	Biologist
Meindert Hobbema	1638	1709	Amsterdam	Painter
Jan Weenix	1640	1719	Amsterdam	Painter
Karel Dujardin	1640	1678	Venezia	Painter
Johann Ludwig Hannemann	1640	1724	Kiel	Chemist
Nicolaes Witsen	1641	1717	Amsterdam	Writer and Diplomat
Burchard de Volder	1643	1709	Leiden	Philosoper
Abraham Storck	1644	1708	Amsterdam	Painter
Albert Meijeringh	1645	1714	Amsterdam	Painter
Romeyn de Hooghe	1645	1708	Haarlem	Sculptor
Nicolaes de Vree	1645	1702	Alkmaar	Painter
Johannes Voorhout	1647	1723	Amsterdam	Painter
Petrus Houttuyn	1648	1709	Leiden	Botanist
Govert Bidloo	1649	1713	Leiden	Poet, Physician and Playwright
Johannes Verkolje	1650	1693	Delft	Painter
Johannes van der Bent	1650	1690	Amsterdam	Painter
Jan Griffier	1652	1718	London	Painter
Jan Hoogsaat	1654	1730	Amsterdam	Painter
Dirk Dalens	1657	1687	Amsterdam	Painter
Johannes Schenck	1660	1712	Duesseldorf	Composer
Abraham Alewijn	1664	1721	Jakarta	Poet and Jurist
Rachel Ruysch	1664	1750	Amsterdam	Painter
Caspar Commelijn	1668	1731	Amsterdam	Botanist
Cornelis de Graeff II.	1671	1719	Monnikendam	Banker
Jan van Huysum	1682	1749	Amsterdam	Painter

Note: Souce is Freebase. If an individual is born or dies in a small city not included in the Bairoch et al. (1988) sample, we assign it to the closest city in the sample, within a threshold of 71 Km (corresponding to the 95th percentile of the distance distribution).

Table A.5: Born in Antwerp (1200-1599)

Name	Year of Birth	Year of Death	Place of Death	Occupation
Jacobus Barbireau	1455	1491	Antwerp	Composer
Anna Bijns	1493	1575	Antwerp	Writer
Jan Sanders van Hemessen	1500	1566	Haarlem	Painter
Hieronymus Cock	1510	1570	Antwerp	Painter
Cornelis Floris de Vriendt	1514	1575	Antwerp	Sculptor
Hubert Waelrant	1517	1595	Antwerp	Composer
Abraham Ortelius	1527	1598	Antwerp	Cartographer
Matthew Wesenbeck	1531	1586	Wittenberg	Jurist
Denis Calvaert	1540	1619	Bologna	Painter
Joris Hoefnagel	1542	1601	Vienna	Painter
Gillis van Coninxloo	1544	1607	Amsterdam	Painter
Bartholomeus Spranger	1546	1611	Prag	Painter
Martin Delrio	1551	1608	Leuven	Theologian
Leonardus Lessius	1554	1623	Leuven	Theologian
Hans Jordaens	1555	1630	Delft	Painter
Jan de Wael I	1558	1633	Antwerp	Painter
Jan Gruter	1560	1627	Heidelberg	Philologist
Joos de Momper	1564	1635	Antwerp	Painter
Jacob de Gheyn II	1565	1629	Denhaag	Painter
Abraham Janssens	1567	1632	Antwerp	Painter
Sebald de Weert	1567	1603	Sri Lanka	Explorer
Joris van Spilbergen	1568	1620	Bergen-Op-Zoom	Explorer
Frans Pourbus the younger	1569	1622	Paris	Painter
Ambrosius Bosschaert	1573	1621	Denhaag	Painter
Jacobus Boonen	1573	1655	Bruxelles	Bishop
Sebastian Vrancx	1573	1647	Antwerp	Painter
Hendrick van Balen	1575	1632	Antwerp	Painter
Pieter Neeffs I	1578	1656	Antwerp	Painter
Frans Hals	1580	1666	Haarlem	Painter
Artus Wolffort	1581	1641	Antwerp	Painter
Caspar de Crayer	1582	1669	Ghent	Painter
David Teniers the Elder	1582	1649	Antwerp	Painter
Jacques l'Hermite	1582	1624	Callao	Merchant
Caspar Barlaeus	1584	1648	Amsterdam	Poet
Willem van Nieulandt II	1584	1635	Amsterdam	Painter
Gijsbrecht Leytens	1586	1656	Antwerp	Painter
Jan Wildens	1586	1653	Antwerp	Painter
Andries van Eertvelt	1590	1652	Antwerp	Painter
Daniel Seghers	1590	1661	Antwerp	Painter

Francisco Pelsaert	1590	1630	Jakarta	Merchant
Lucas de Wael	1591	1661	Antwerp	Painter
Cornelis de Wael	1592	1667	Rome	Painter
Jacob Jordaens	1593	1678	Antwerp	Painter
Dirk van Hoogstraten	1596	1640	Dordrecht	Painter
Jacob van Es	1596	1666	Antwerp	Painter
Cornelis Schut	1597	1655	Antwerp	Painter
Justus Sustermans	1597	1681	Florence	Painter
Pieter Claesz	1597	1660	Haarlem	Painter
Adriaen van Utrecht	1599	1652	Antwerp	Painter
Anthony van Dyck	1599	1641	London	Painter

Note: Souce is Freebase. If an individual is born or dies in a small city not included in the Bairoch et al. (1988) sample, we assign it to the closest city in the sample, within a threshold of 71 Km (corresponding to the 95th percentile of the distance distribution).

Table A.6: Born in Paris (1700-1899)

Name	Year of Birth	Occupation
Francois Boucher	1703	Painter
Emilie du Chatelet	1706	Mathematician
Alexis Clairault	1713	Mathematician
Claude-Adrien Helvetius	1715	Philosopher
Jean le Rond d'Alembert	1717	Mathematician
Anne Robert Jacques Turgot, Baron de Laune	1727	Economist
Louis Antoine de Bougainville	1729	Explorer
Pierre de Beaumarchais	1732	Writer
Donatien-Alphonse-Francois de Sade, Marquis de Sade	1740	Writer
Antoine Lavoisier	1743	Chemist
Jacques-Louis David	1748	Painter
Adrien-Marie Legendre	1752	Mathematician
Elisabeth Louise Vigee Le Brun	1755	Artist
Claude Henri de Rouvroy, comte de Saint-Simon	1760	Philosopher
Anne Louise Germaine de Stael	1766	Writer
Antoine-Jean Gros	1771	Artist
Jean-Baptiste Biot	1774	Physicist
Sophie Germain	1776	Mathematician
Augustin Louis Cauchy	1789	Mathematician
Gaspard-Gustave Coriolis	1792	Physicist
Jean-Baptiste Camille Corot	1796	Painter
Nicolas Leonard Sadi Carnot	1796	Engineer
Jules Michelet	1798	Writer
Adolphe-Charles Adam	1803	Composer
Charles Lucien Bonaparte	1803	Biologist
Prosper Merimee	1803	Writer
George Sand	1804	Writer
Alexis de Tocqueville	1805	Historian
Gerard de Nerval	1808	Writer
Baron Haussmann	1809	Architect
Alfred de Musset	1810	Writer
Eliphas Levi	1810	Writer
Theodore Rousseau	1812	Painter
Charles-Valentin Alkan	1813	Musician
Eugene Viollet-le-Duc	1814	Architect
Charles Gounod	1818	Composer
Hippolyte Fizeau	1819	Physicist
Leon Foucault	1819	Physicist
Nadar	1820	Photographer

Charles Baudelaire	1821	Writer
Frederic Passy	1822	Economist
Alexandre Dumas	1824	Writer
Pierre Jules Cesar Janssen	1824	Astronomer
Jean-Martin Charcot	1825	Physician
Gustave Moreau	1826	Artist
Marcellin Berthelot	1827	Chemist
Edouard Manet	1832	Painter
Edgar Degas	1834	Painter
Camille Saint-Saens	1835	Composer
Georges Bizet	1838	Composer
Alfred Sisley	1839	Artist
Sully Prudhomme	1839	Writer
Emile Zola	1840	Writer
Auguste Rodin	1840	Sculptor
Claude Monet	1840	Painter
Stephane Mallarme	1842	Writer
Anatole France	1844	Writer
Sarah Bernhardt	1844	Actor
Charles Louis Alphonse Laveran	1845	Physician
Gustave Caillebotte	1848	Painter
Joris-Karl Huysmans	1848	Writer
Paul Gauguin	1848	Painter
Vilfredo Pareto	1848	Economist
Charles Robert Richet	1850	Biologist
Henri Louis Le Chatelier	1850	Chemist
Antoine Henri Becquerel	1852	Physicist
Henri Moissan	1852	Chemist
Rudolf Diesel	1858	Inventor
Georges-Pierre Seurat	1859	Artist
Henri Bergson	1859	Philosopher
Pierre Curie	1859	Physicist
Georges Melies	1861	Film Director
Paul Signac	1863	Painter
Pierre de Coubertin	1863	Historian
Paul Dukas	1865	Composer
Gaston Leroux	1868	Writer
Andre Gide	1869	Writer
Paul Langevin	1872	Physicist
W. Somerset Maugham	1874	Writer
Maurice de Vlaminck	1876	Artist
Louis Renault	1877	Inventor
Andre Citroen	1878	Engineer

Francis Picabia	1879	Painter
Roger Martin du Gard	1881	Writer
Jacques Maritain	1882	Philosopher
Maurice Utrillo	1883	Artist
Robert Delaunay	1885	Painter
Nadia Boulanger	1887	Musician
Maurice Chevalier	1888	Actor
Gabriel Marcel	1889	Philosopher
Jacques Ibert	1890	Composer
Marcel Dassault	1892	Engineer
Jean Renoir	1894	Actor
Andre Frederic Cournand	1895	Physician
Basil Liddell Hart	1895	Writer
Frederic Joliot-Curie	1897	Chemist
Louis Aragon	1897	Writer
Georges Dumezil	1898	Linguist
Francis Poulenc	1899	Composer

Note: Souce is Yu et al., (2016). If an individual is born or dies in a small city not included in the Bairoch et al. (1988) sample, we assign it to the closest city in the sample, within a threshold of 71 Km (corresponding to the 95th percentile of the distance distribution).

Table A.7: Born in Vienna (1800-1899)

Name	**Year of Birth**	**Occupation**
Johann Strauss I	1804	Composer
Johann Strauss II	1825	Composer
Otto Wagner	1841	Architect
Ludwig Boltzmann	1844	Physicist
Arthur Schnitzler	1862	Writer
Gustav Klimt	1862	Painter
Richard Adolf Zsigmondy	1865	Chemist
Gustav Meyrink	1868	Writer
Karl Landsteiner	1868	Biologist
Alfred Adler	1870	Psychologist
Arnold Schoenberg	1874	Composer
Hugo von Hofmannsthal	1874	Writer
Fritz Kreisler	1875	Musician
Robert Barany	1876	Physician
Lise Meitner	1878	Physicist
Martin Buber	1878	Philosopher
Otto Weininger	1880	Philosopher
Stefan Zweig	1881	Writer
Melanie Klein	1882	Psychologist
Anton Webern	1883	Composer
Alban Berg	1885	Composer
Erich von Stroheim	1885	Film Director
Karl von Frisch	1886	Biologist
Erwin Schrodinger	1887	Physicist
Ludwig Wittgenstein	1889	Philosopher
Egon Schiele	1890	Painter
Fritz Lang	1890	Film Director
Anna Freud	1895	Psychologist
Friedrich Hayek	1899	Economist

Note: Souce is Yu et al., (2016). If an individual is born or dies in a small city not included in the Bairoch et al. (1988) sample, we assign it to the closest city in the sample, within a threshold of 71 Km (corresponding to the 95th percentile of the distance distribution).

Table A.8: Correlation between Births, Immigrants, Population and Commune

	Births	Immigrants	Population	Commune
Births	1			
Immigrants	0.56	1		
Population	-0.03	0	1	
Commune	0.13	0.11	0.1	1

Table A.9: Real Wage of Skilled Workers and Population

Log(Population) intervals:	100 years	50 years (from 1700)
L1.Wage	0.188	0.065*
L2.Wage	0.003*	0.080*
L3.Wage	-0.175	0.019*
L4.Wage	0.180	0.067*
L5.Wage	0.107	-0.121*
$F^{L.Wage}, pv$	0.0353	0.0001

In each column we include 5 lags of the variable Wage (10 years intervals). The variable Wage represents the average real wage of skilled workers over the decade. The dependent variable is Log(Population). Its frequency of observation is 100 years in the first column and 50 years in the second column, where we consider only observations from 1700 onwards, when Population is observed every 50 years. $F^{L.Wage}, pv$ is the p-value of the F-test of joint significance of the lags of the variable Wage. Period dummies always included.

Table A.10: Commune, First Stage

	(1)	(2)	(3)	(4)
Regional Commune	1.450***	1.381***	1.446***	1.434***
	(0.207)	(0.205)	(0.338)	(0.337)
Large state		-0.053***	-0.020	-0.015
		(0.019)	(0.032)	(0.032)
Bishop		0.126***	-0.016	-0.012
		(0.037)	(0.054)	(0.054)
Archbishop		0.077	-0.109*	-0.107
		(0.048)	(0.065)	(0.065)
Capital		0.080	-0.005	-0.004
		(0.050)	(0.055)	(0.055)
Plundered		-0.032	-0.025	-0.024
		(0.024)	(0.033)	(0.033)
Log (Population)			0.051***	0.049***
			(0.012)	(0.012)
University			-0.012	-0.012
			(0.054)	(0.054)
Spatial Lag of Log (1 + Births)				0.185**
				(0.094)
Observations	7,227	7,227	3,110	3,110
Number of ID	657	657	657	657
Adjusted R-squared	0.446	0.454	0.427	0.427

Dependent Variable is Commune. Standard errors (clustered at the NUTS 2 region level) in parentheses. Period Dummies and City FE always included. * p<0.1, ** p<0.05, *** p<0.01.

Table A.11: Commune and Births, 2SLS Regressions, using the Yu et al. data

	(1)	(2)	(3)	(4)
Commune	0.229**	0.259**	0.260**	0.237*
	(0.113)	(0.116)	(0.123)	(0.122)
Spatial Lag of Log (1 + Births)				0.473**
				(0.209)
Observations	2,961	2,961	2,961	2,961
Adjusted R-squared	-0.171	-0.170	-0.171	-0.164
Fstat, instrum., 1st stage	21.60	19.04	17.03	16.96
Baseline Controls	NO	YES	YES	YES
Additional Controls	NO	NO	YES	YES

Dependent Variable is Log (1 + Births Yu et al.). Standard errors (clustered at the NUTS 2 region level) in parentheses. Period Dummies and City FE always included.

Table A.12: Commune and Births: Distinguishing Positive and Negative Transitions

	(1)	(2)	(3)	(4)
	Positive		Negative	
	OLS	2SLS	OLS	2SLS
Commune	0.049***	0.171*	0.066***	0.118
	(0.017)	(0.098)	(0.022)	(0.117)
Fstat, instrum., 1st stage		13.56		8.57
Observations	2,812	2,717	2,665	2,569
Adjusted R-squared	0.380	0.203	0.363	0.173

In this Table we estimate the effect of institutional transitions in the two directions separately. When estimating the effect of entry into Commune, we drop the city-century observations following a negative transition (from Commune=1 back to Commune=0). When studying the effect of exits, we drop the city-year observations prior to a positive transition (from Commune=0 to Commune=1). Dependent Variable is Log (1 + Births). Standard errors (clustered at the NUTS 2 region level) in parentheses. Period Dummies, City FE and full set of city-level controls always included. *p<0.1, ** p<0.05, *** p<0.01.

Table A.13: Summary Statistics for the Dependent Variable in the Gravity Model

Variable	**Mean**	**(Std. Dev.)**	**Min.**	**Max.**	**Percent of Zeros**	**N**
Immigrants (dyadic obs.)	0.008	(0.13)	0	14	99.42	366763

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