Migration, human capital and selection patterns of university scholars in Medieval and Early Modern Europe (1088-1685)

David de la Croix Frédéric Docquier Alice Fabre Robert Stelter

September 2018

Universities

Universities are one of the most original creations of the Western civilization during the Middle-Ages, from 1088 CE onwards

Universitas meant community (of masters and/or of students)

3 features (from Rahsdall's Medieval Universities)

1. higher education, i.e. has at least one of the higher faculties: theology, law, medicine
2. the school invited students from all parts
3. such subjects were taught by a plurality of masters.

Europe: Political fragmentation but intellectual unity (use of latin) which helped mobility.

Universities & Corporations

European Universities are original because they are corporations: "intentionally created, voluntary, interest-based, and self-governed permanent associations." (Greif, AER 2006)

Knowledge is diffused faster in a world made of corporations (de la Croix, Doepke & Mokyr, QJE 2018)

Questions in this paper

- Is the proclaimed openness of universities reflected in the mobility of professors?
- Is mobility associated with individual quality? (positive selection)
- Are better scholars attracted by better places? (positive sorting)
- What are the gains in human capital from *positive selection* and/or *sorting* of the scholars

What we do

Build a database of thousands of scholars from university sources

Includes both well known and obscure scholars

Map the academic market in the medieval and early modern periods in Europe

Study *positive selection* and/or *sorting* in a migration choice model

Study how they impact the agglomeration of human capital and simulate effects on quality of universities.

Positive selection

In biology: Positive natural selection is the force that drives the increase in prevalence of advantageous traits

In migration literature: Better people migrate more often

Here: Better people are less sensitive to distance

Sorting

In common sense: Sorting is any process of arranging items systematically, and has two common, yet distinct meanings:

- ordering: arranging items in a sequence ordered by some criterion;
- categorizing: grouping items with similar properties.

In migration literature: households with better attributes are concentrated in the region where returns are higher

Here: Better people are more likely to settle in more prestigious universities and/or in more attractive cities

Literature - Our project speaks to:

The "stagnation-to-growth" literature in which Upper Tail Human Capital may play a role (Mokyr, 2005, Squicciarini & Voigtländer, QJE 2015)

The "institution and growth" literature in which independent institutions characterized Western Europe (Greif and Tabellini, JCE 2007. De la Croix, Doepke, Mokyr, QJE 2018)

But also to the migration literature in general and in historical contexts in particular:

- Well-educated people exhibit greater propensity to emigrate (Deuster and Docquier, UNESCO 2018)
- Positive or negative selection in the Age of Mass Migration (1850-1920) (Abramitsky, Boustan, Eriksson, AER 2012)
- Scholars are less sensitive to distance (patent inventors, ..., (Fink et al. (WIPO, 2013) Appelt et al. (OECD,2015))

The big Project

This paper belongs to a bigger project

Building a database of a large sample of scholars in Europe over 1088 CE-1800 CE.

Originality:
– Starts as much as possible from institutions data, and match them with biographical dictionaries & encyclopedia
– European scope – includes both university professors and members of academies

The size of the big Project

184 universities. 46888 years of existence. $\approx$ 134000 scholars (based on Heidelberg)
+
113 academies. 6154 years of existence. $\approx$ 42000 members (based on Leopoldina) + other higher education institutions

mean number of activities (memberships) per person: 1.20

Advancement so far: 18630*1.2/176000 = 12.7%

Subset used here: Before 1685, only university prof. 7612 persons, incl. 5791 with known birth place

Types of sources

Electronic catalogues of professors (ex: Catalogus Professorum Rostochiensium)

Printed catalogues of professors

Various Encyclopedia incl. Wikipedia

Thematic biographies (ex: prof. of canon law in Medieval times)

Repertorium Academicum Germanicum (1250-1550)

Books on history of university matched with bio dictionaries

Example of web-catalogues of professors

ex: Catalogus Professorum Rostochiensium

Brekewold, Werner

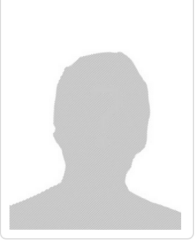
Lebensdaten:	* ? (um 1400) in Lübeck † zwischen 1432 und 1440 in Lübeck
Prof. in Rostock:	1419-um 1428
zuletzt:	Rektor
zuletzt:	Juristische Fakultät

Krantz, Albert(us)

Lebensdaten:	* 1448 in Hamburg † 07.12.1517 in Hamburg
Prof. in Rostock:	1481-1486
zuletzt:	Philosophische Fakultät

Stenbeke, Petrus

Lebensdaten:	* ? (um 1380) in ? † ? (nach 1421) in ?
Prof. in Rostock:	1419-1421(?)
zuletzt:	Dekan der Artistenfakultät
zuletzt:	Philosophische Fakultät



Example of printed catalogues of professors

Lebensskizzen

der

Professoren der Universität Jena

seit 1558 bis 1858.

Eine Festgabe

zur dreihundertjährigen Säcularfeier der Universität

am 15., 16. und 17. August 1858

von

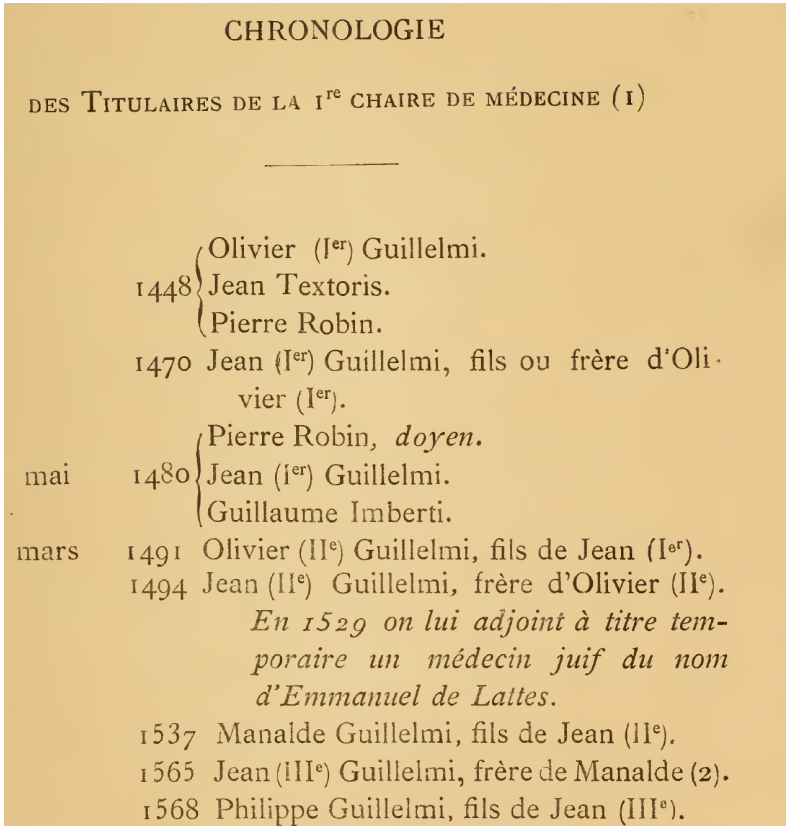
Dr. Johannes Günther.

Martin Mirus,

geboren zu Weida 1532, wurde vom Kurfürsten Christian I. als Hofprediger nach Dresden berufen, erhielt aber bald seine Entlassung. Er ging nun 1588 als Superintendent und Professor der Theologie nach Jena, blieb aber auch hier nur kurze Zeit, worauf er sich nach Helmstädt wendete, bis ihn die Wittwe des Kurfürsten Christian I. wieder zurückrief und zum Kirchenvisitator des meißener Kreises ernannte. Er starb auf dem Schlosse Caverdiz (Karditz) bei Oschatz am 14. August 1593.

Seine Schriften sind in Chr. G. Jöcher, Allg. Gel.-Ler. 3. Th. S. 554 aufgezählt. Vgl. Adr. Beier, Syll. rect. et prof. Jenae etc. p. 470.

Example of list of professors



CHRONOLOGIE

DES TITULAIRES DE LA I^re^ CHAIRE DE MÉDECINE (1)

1448 Olivier (I^er^) Guillelmi. / Jean Textoris. / Pierre Robin.
1470 Jean (I^er^) Guillelmi, fils ou frère d'Olivier (I^er^).
mai 1480 Pierre Robin, *doyen*. / Jean (I^er^) Guillelmi. / Guillaume Imberti.
mars 1491 Olivier (II^e^) Guillelmi, fils de Jean (I^er^).
1494 Jean (II^e^) Guillelmi, frère d'Olivier (II^e^).
En 1529 on lui adjoint à titre temporaire un médecin juif du nom d'Emmanuel de Lattes.
1537 Manalde Guillelmi, fils de Jean (II^e^).
1565 Jean (III^e^) Guillelmi, frère de Manalde (2).
1568 Philippe Guillelmi, fils de Jean (III^e^).

To be completed with entries from biographical dictionaries:

+Jean Guilhelmi [Guilhermi, Guillelmi, Guillermi]. — **Originaire du diocèse de Cahors, bachelier en médecine de Montpellier, il était, dès 1442, établi à Avignon, où il fut reçu maître en médecine, 1452 [1]. Il habitait près du Vieux Sextier.**

from Ernest WICKERSHEIMER, Dictionnaire biographique des médecins en France au Moyen Age

Example of *chartularia*

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PAR

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(1) Me Biçais fut nommé médecin du Roi le 23 mai 1641. Voir « Provision de l'office de médecin du Roy pour Me Honoré Biccays, docteur et professeur en médecine en l'Université d'Aix ». (*Archives des Bouches-du-Rhône*, série B, Reg. 98, fo 371 vo). — Son fils Michel Biçais, comme lui « professeur en médecine » dans l'Université d'Aix, a laissé un ouvrage curieux, aujourd'hui rare, intitulé : « *La manière de régler la santé par ce qui nous environne, par ce que nous recevons, et par les exercices ou par la gymnastique moderne* », et imprimé à Aix en 1669.

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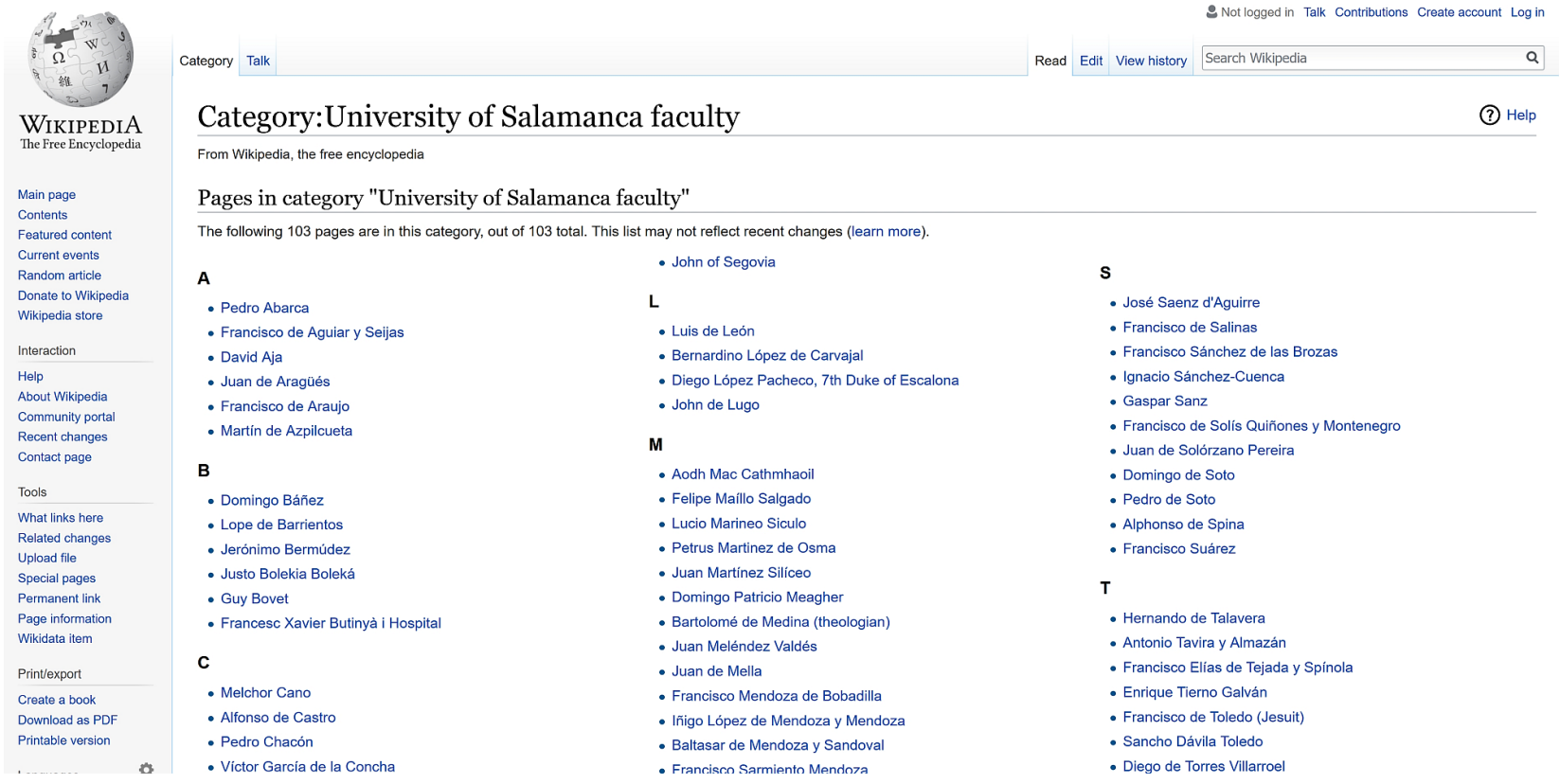
Bicaïs (Honoré), né à Oraison (Basses-Alpes) vers 1590, mort à Aix, régent en médecine à l'Université d'Aix, se distingua pendant les pestes de 1629 et de 1649. Père de Michel Bicaïs, qui lui succéda dans sa chaire et dans sa réputation.

Example of Encyclopedia & Wikipedia

"Summary" pages providing links related to a given university



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Category:University of Salamanca faculty

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Pages in category "University of Salamanca faculty"

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- Francisco de Araujo
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B
- Domingo Báñez
- Lope de Barrientos
- Jerónimo Bermúdez
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- Guy Bovet
- Francesc Xavier Butinyà i Hospital

C
- Melchor Cano
- Alfonso de Castro
- Pedro Chacón
- Víctor García de la Concha
- John of Segovia

L
- Luis de León
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- Diego López Pacheco, 7th Duke of Escalona
- John de Lugo

M
- Aodh Mac Cathmhaoil
- Felipe Maíllo Salgado
- Lucio Marineo Siculo
- Petrus Martinez de Osma
- Juan Martínez Silíceo
- Domingo Patricio Meagher
- Bartolomé de Medina (theologian)
- Juan Meléndez Valdés
- Juan de Mella
- Francisco Mendoza de Bobadilla
- Iñigo López de Mendoza y Mendoza
- Baltasar de Mendoza y Sandoval
- Francisco Sarmiento Mendoza

S
- José Saenz d'Aguirre
- Francisco de Salinas
- Francisco Sánchez de las Brozas
- Ignacio Sánchez-Cuenca
- Gaspar Sanz
- Francisco de Solís Quiñones y Montenegro
- Juan de Solórzano Pereira
- Domingo de Soto
- Pedro de Soto
- Alphonso de Spina
- Francisco Suárez

T
- Hernando de Talavera
- Antonio Tavira y Almazán
- Francisco Elías de Tejada y Spínola
- Enrique Tierno Galván
- Francisco de Toledo (Jesuit)
- Sancho Dávila Toledo
- Diego de Torres Villarroel

Example of thematic biographies

Medieval and Early Modern Jurists: A Bio-Bibliographical Listing

Detail from Tomb of Mondino de' Liuzzi († 1326),
sculpted by Roso (Boso) da Parma,
Church of San Vitale, Bologna

With the support of the Ames Foundation (http://amesfoundation.law.harvard.edu/), this site is being completely revamped during this academic year (2011 to the present). The results are now available at the link above. We are expanding the chronological coverage to 1750 and will (slowly) include civilian jurists in our data base. This site was first put online in 1993 and was compiled for the History of Medieval Canon Law project with the support of the National Endowment for the Humanities (1989-1996), the Gerda Henkel Stiftung (1988-1992), the Werner Reimers Stiftung (1990-1991), and the Alexander von Humboldt Stiftung (1993-1996). It now continues with the generous support of the Ames Foundation.

The entries are still being up-dated regularly. If you have additions or corrections, please send them to Ken Pennington pennington@cua.edu

The listings are divided into two parts, 1140-1298 and 1298-1500. Collections are listed by their most common title and the canonists are alphabetized by their first names. The abbreviations are those used by the Bulletin of Medieval Canon Law and can be found in the List of Abbreviations of that journal.

Collections and Jurists: 1140-1298	Collections and Jurists: 1298-1500
A-Z	A-Z

Repertorium Academicum Germanicum (1250-1550)

Stephan Australis

Stephan Australis; Stephanus; Stephanus Australis; Stephanus de Austria; Stephanus de Enczendorff; Stephanus de Enczensdorf; Steph

Persönliche Daten:

	Herkunft geographisch		1377	Region: Österreich
wahrsch.	Herkunft geographisch		1385	Gross Enzersdorf
	Geburt	zwischen	1351-05-28 und 1352-05-28	
	Tod		1405	

Studium:

	Promotion		1374-10-03	Prag, bacc. art.
wahrsch.	Immatrikulation		1377	Wien
wahrsch.	Immatrikulation		1377	Immatrikulationsgrad: mag.
wahrsch.	Immatrikulation		1377	Fakultät: Jus
	Promotion		1377-02-05	Prag, lic. art.
	Promotion		1377-04-19	Prag, mag. art.
wahrsch.	Promotion	vor	1391-04-14	bacc. sacr. pag.
	Promotion	vor	1403	lic. theol.

Tätigkeiten:

wahrsch.	Kanoniker	1. Nachweis	1377	Preßburg
wahrsch.	Dekan		1385 Sommer	Wien, Fakultät: Artes
wahrsch.	Professor		1385	Wien, Fakultät: Artes
wahrsch.	Professor		1391	
wahrsch.			1397	
wahrsch.	Rektor		1391 Sommer	Wien, Universität
wahrsch.			1397/1398 Winter	
wahrsch.	Rector ecclesiae		1397-10-13	Atzbach
wahrsch.	Kanoniker	1. Nachweis	1397-10-13	Wien, St. Stephan

Quellen und Literatur:

Uiblein, Acta Facultatis Artium Wien, S. 563, Bd. 1, S. 1
Liber Decanorum Prag, Bd. 1, S. 161, 174, 176
Szaivert et al., M Wien, Bd. 1, S. 36, 5, 51

Matching history books with dictionaries

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Bicaïs (Honoré), né à Oraison (Basses-Alpes) vers 1590, mort à Aix, régent en médecine à l'Université d'Aix, se distingua pendant les pestes de 1629 et de 1649. Père de Michel Bicaïs, qui lui succéda dans sa chaire et dans sa réputation.

Include quite unknown people

Tomb of Bonandrea de Bonandreis, doctor decretorum, lectured on canon law at Bologna in 1321-22

Summary statistics for the whole projet

	nb. obs	% with known birth place	% with Wikipedia	% with Worldcat
Periods				
1088–1347	674	58.8	32.6	33.1
1347–1452	1644	56.7	13.2	13.5
1453–1535	2014	62.7	23.2	28.1
1536–1617	2303	75.2	43.3	62.6
1618–1684	2619	73.4	47.1	66.0
1685–1739	3577	70.9	41.5	65.8
1740–1800	5726	70.8	47.0	67.1
total	18557	69.2	39.3	55.2

The analysis here is limited to the first five periods

Descriptive statistics

Universities included and mean/median distance from birth place

University	# obs	E d_{ij}	Med d_{ij}	University	# obs
Uheidelberg-1386	941	160	115	Ugiessen-1607	129
Ubologna-1088	397	250	63	Uwurzburg-1402	99
Uperugia-1308	276	90	51	Uwittenberg-1502	99
Ulouvain-1425	271	126	78	Usiena-1246	98
Uparis-1200	234	432	344	Umontpellier-1289	97
Utubingen-1476	214	134	63	CollegeFr-1530	93
Upadua-1222	205	271	129	Ubasel-1460	92
Umarburg-1527	200	156	95	Ufreiburg-1457	91
Urostock-1419	189	176	98	Uaix-1409	86
Ucologne-1388	177	143	107	Uuppsala-1477	86
Ujena-1558	174	153	88	Urinteln-1620	83
Ustrasbourg-1621	162	190	89	Ufraneker-1585	76
Uleiden-1575	158	192	106	Usalamanca-1218	70
Uhelmstedt-1575	152	172	134	Utoulouse-1229	69
Ugreifswald-1456	134	186	136	Uprague-1348	68

and 62 other places

Plotting mobility

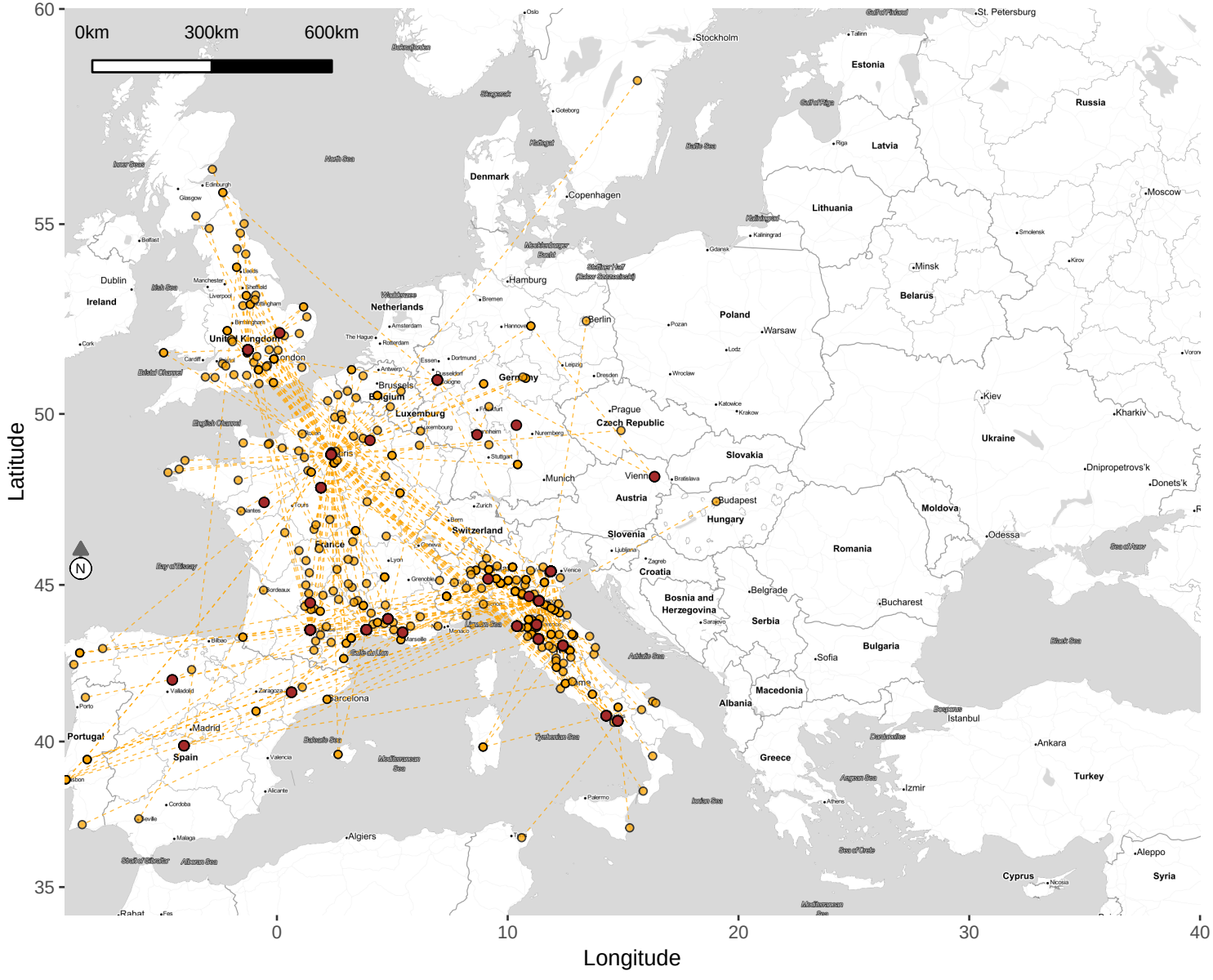
We now show maps per period where:

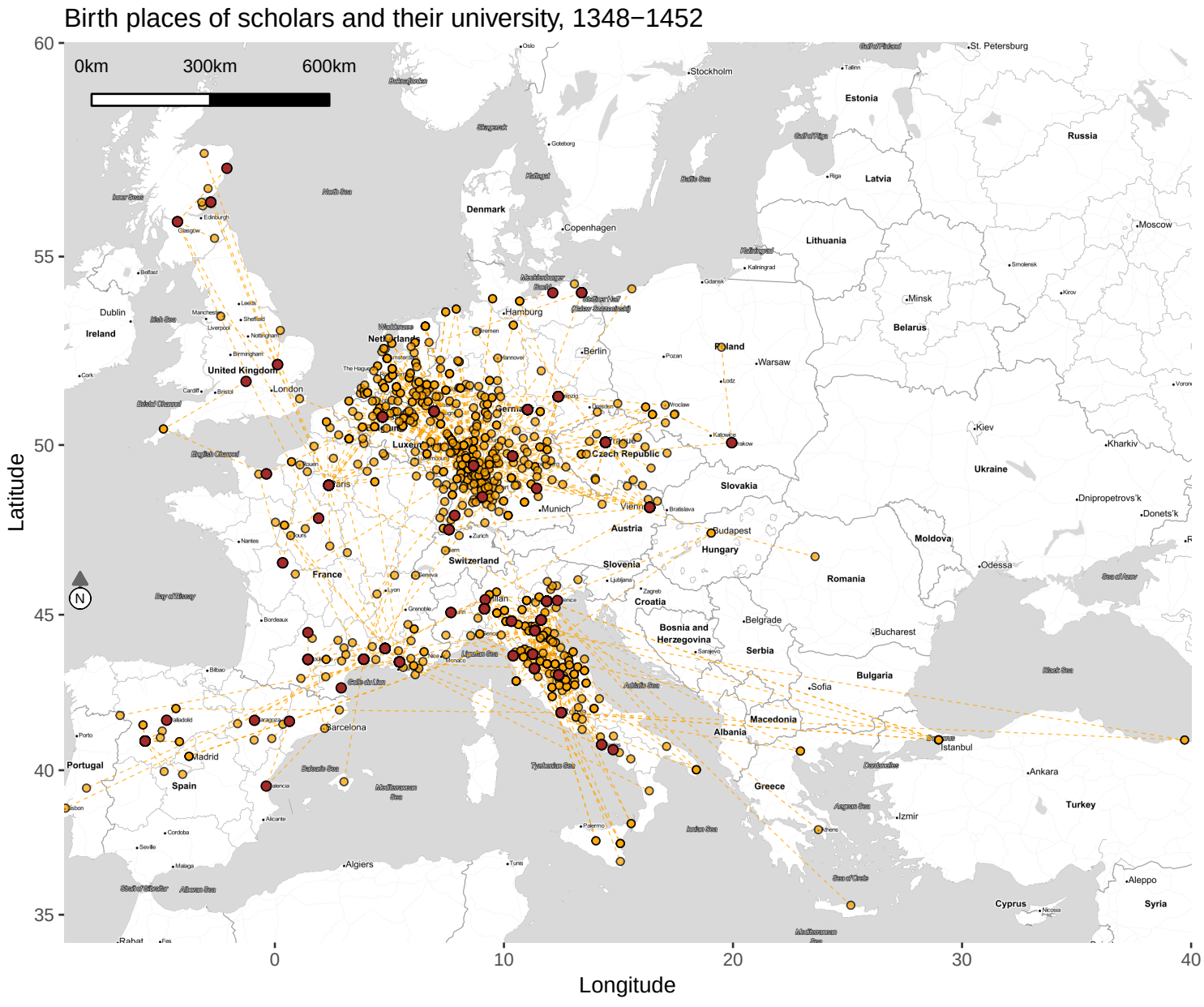
red dots are universities included so far

orange dots are birth places of scholars

dashed lines link scholars to the university for which they taught

Birth places of scholars and their university, 1088−1347




Birth places of scholars and their university, 1348−1452
0km
300km
600km
Latitude
Longitude
60
55
50
45
40
35
0
10
20
30
40
Ireland
United Kingdom
France
Spain
Portugal
Netherlands
Germany
Denmark
Poland
Czech Republic
Slovakia
Austria
Hungary
Switzerland
Slovenia
Croatia
Bosnia and Herzegovina
Serbia
Albania
Macedonia
Greece
Bulgaria
Romania
Moldova
Ukraine
Belarus
Lithuania
Latvia
Estonia
Russia
Turkey
Syria
Cyprus
Dublin
London
Paris
Madrid
Barcelona
Hamburg
Berlin
Munich
Prague
Vienna
Budapest
Warsaw
Copenhagen
Stockholm
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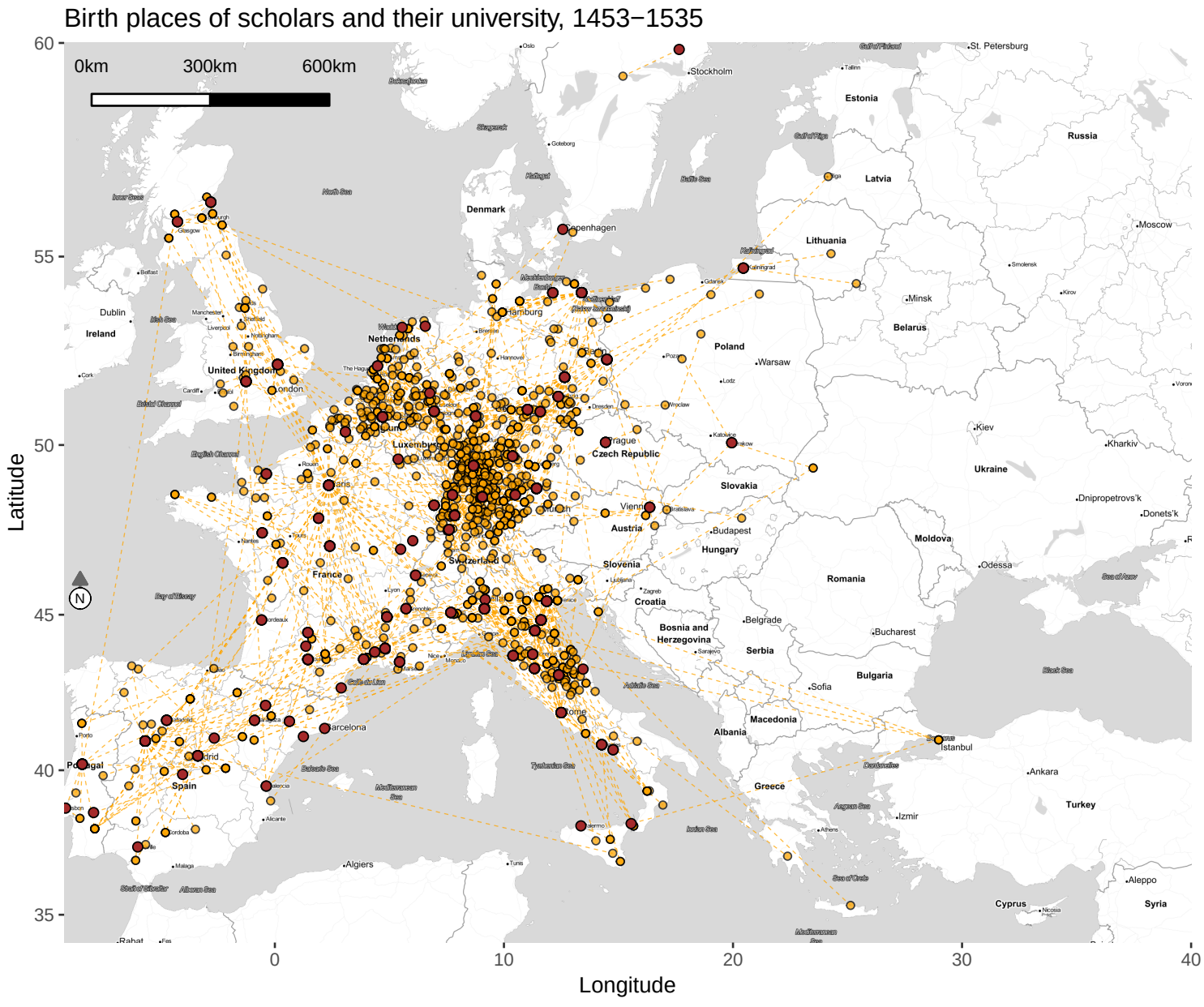
Kiev
Minsk
Istanbul
Ankara
Izmir
Sofia
Belgrade
Bucharest
Odessa
Algiers


Birth places of scholars and their university, 1453−1535
0km
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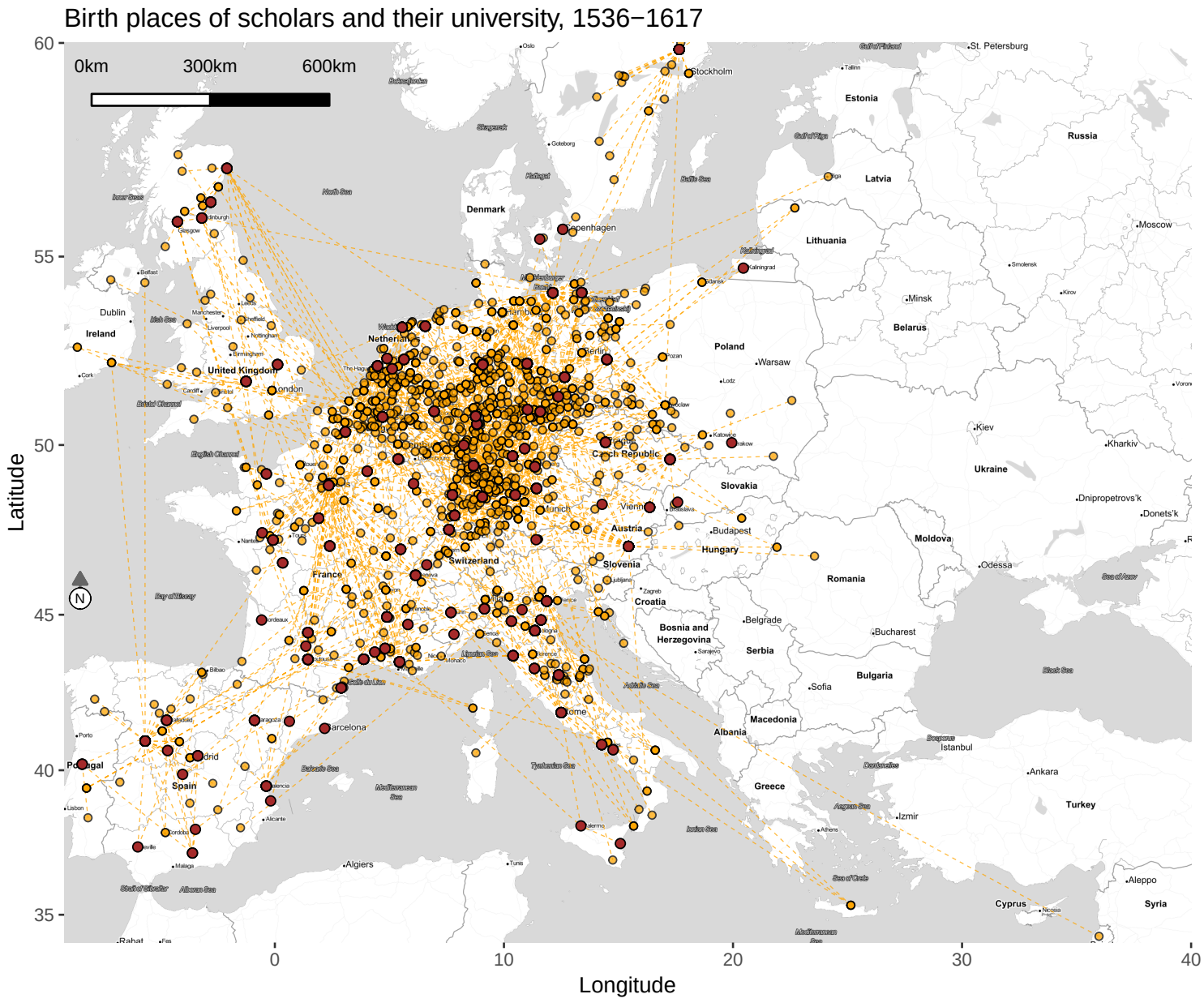
Ireland
United Kingdom
Netherlands
Denmark
Estonia
Latvia
Lithuania
Russia
Belarus
Poland
Czech Republic
Slovakia
Austria
Hungary
Slovenia
Croatia
Bosnia and Herzegovina
Serbia
Romania
Bulgaria
Albania
Macedonia
Greece
Turkey
Ukraine
Moldova
Cyprus
Syria
France
Spain
Portugal
Switzerland
Luxembourg
Stockholm
Copenhagen
Hamburg
London
Dublin
Paris
Vienna
Budapest
Warsaw
Prague
Minsk
Moscow
St. Petersburg
Kiev
Kharkiv
Odessa
Belgrade
Bucharest
Sofia
Istanbul
Ankara
Izmir
Aleppo
Barcelona
Madrid
Algiers
Rome


Birth places of scholars and their university, 1536−1617
0km
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Latvia
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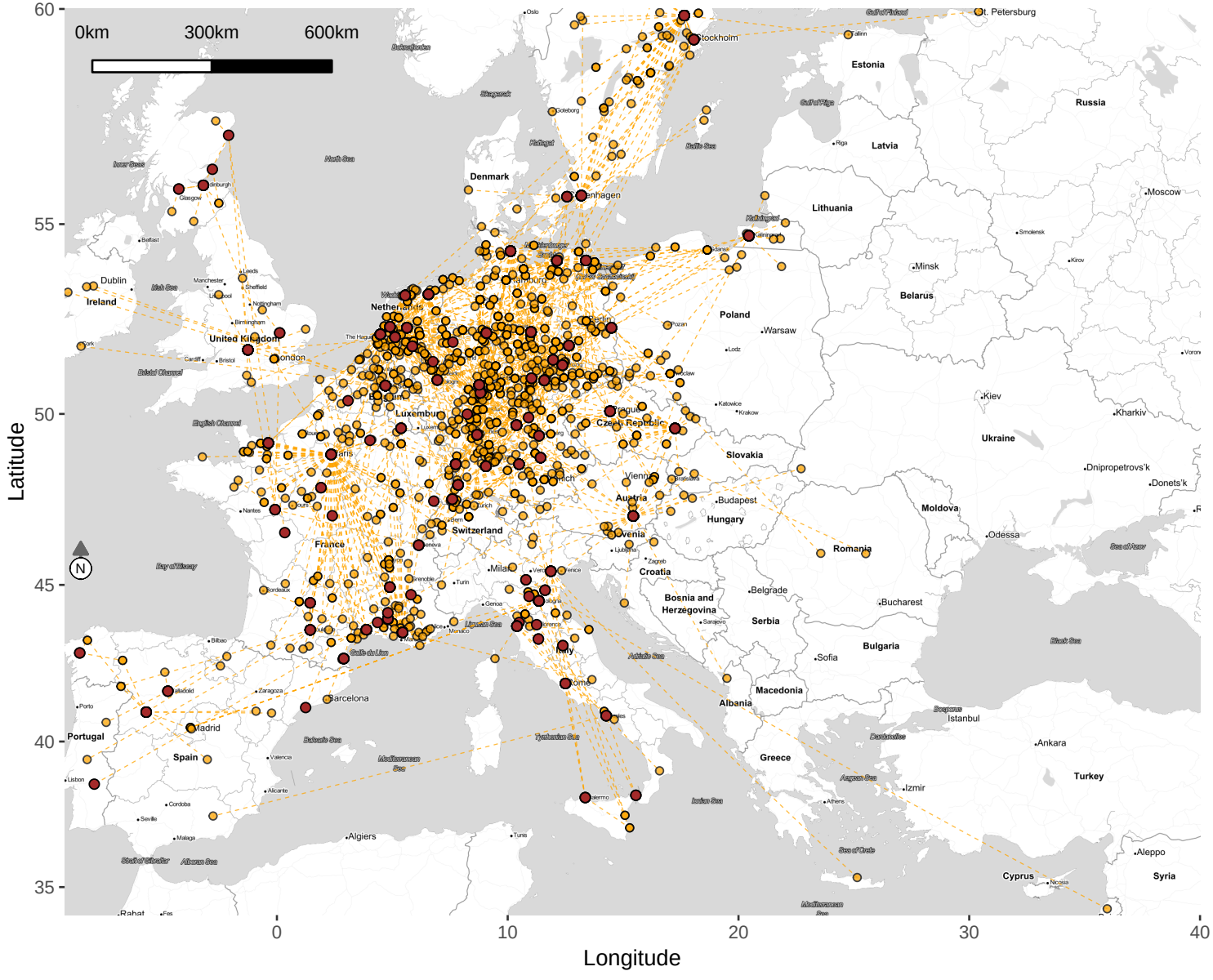
Belarus
Poland
Czech Republic
Slovakia
Ukraine
Austria
Hungary
Switzerland
France
Slovenia
Croatia
Bosnia and Herzegovina
Serbia
Romania
Moldova
Bulgaria
Albania
Macedonia
Greece
Turkey
Spain
Portugal
Cyprus
Syria
Dublin
London
Amsterdam
Copenhagen
Stockholm
St. Petersburg
Moscow
Minsk
Warsaw
Kiev
Kharkiv
Budapest
Vienna
Munich
Berlin
Prague
Barcelona
Madrid
Rome
Belgrade
Bucharest
Sofia
Istanbul
Ankara
Izmir
Algiers
Aleppo

Birth places of scholars and their university, 1618−1684



Notoriety: Individuals

We measure the notoriety of an individual (as seen as today) by taking the first principal component of

1. an index $\in \{1, 2, 3, 4, 5\}$ on whether we know the basic vital information
2. the number of characters $\in (10000, 797846)$ of the longest wikipedia page
3. the number of languages $\in (1, 211)$ in which a Wikipedia page exists
4. the number of works (by or about) in Worldcat, $\in (1, 61153)$
5. the number of publication languages in Worldcat, $\in (1, 51)$
6. the number of library holdings in Worldcat, $\in (1, 930650)$

Taken on the full sample

Individuals

The first Principal Component explains 3/4 of the total variations in the variables.

Top Individuals:

Martin Luther, Desiderius Erasmus, Thomas Aquinas, Isaac Newton, Galileo Galilei, Francis Bacon, Giovanni Boccaccio, Johannes Calvin, Giordano Bruno, Ramon Llull, Nicolas de Cusa, Philipp Melanchthon, Pierre Abélard, William of Ockham, John Duns Scotus, Tycho Brahe

Notoriety: Institutions

Given that sampling varies from one institution to the other, we cannot take means, medians, ...

For a given period t, We define the quality of an institution k as a function of the notoriety of the top 4 individuals i having spend time there:

$$Q_{k,t} = f(q_{1,k,t}, q_{2,k,t}, q_{3,k,t}, q_{4,k,t}) + (1 - \delta)Q_{k,t-1}$$

We allow for some persistency of past notoriety with a depreciation rate δ of 1% per year

For $f(\cdot)$, we require $f(a, b, c, 0) > 0$, and $f(a, b, 0, 0) + f(0, 0, c, d) < f(a, b, c, d)$

In practice, we use a CES production function with high substitution ($\sigma = 2$)

Results for 1088-1618

Top institutions (<1347): Paris, Cologne (cathedral school), Oxford, Bologna, Toulouse, Montpellier

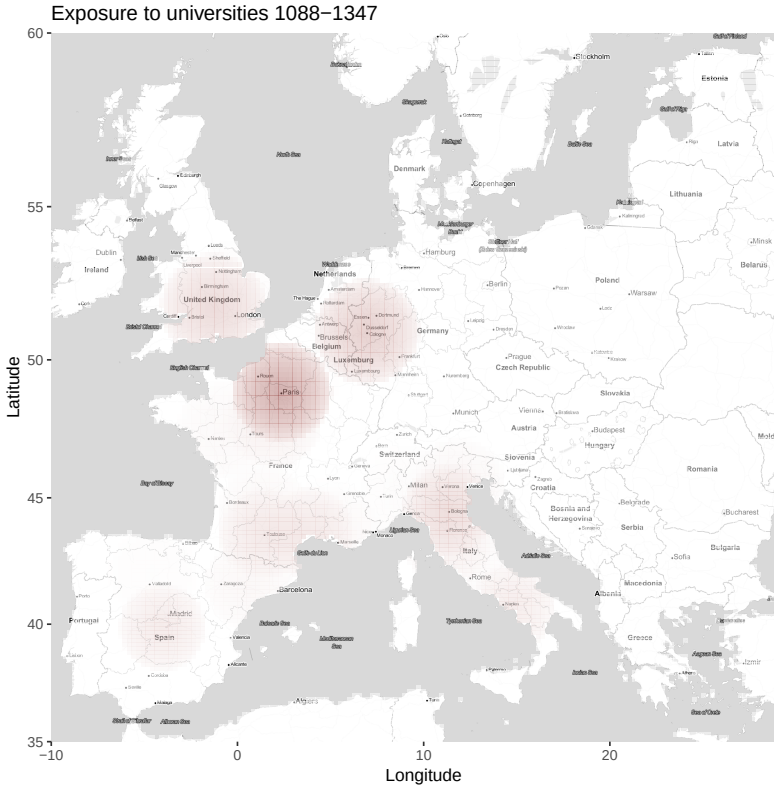
Top institutions (1348-1452): Florence (Studium generale), Paris, Toulouse, Montpellier, Prague, Oxford, Padua

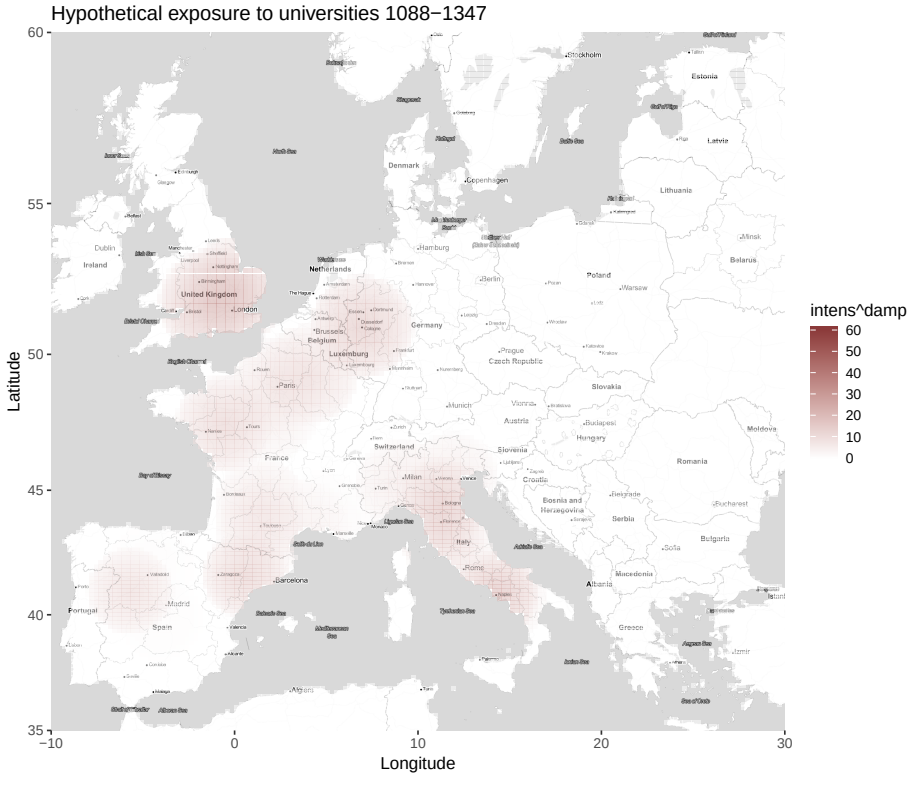
Top institutions (1453-1535): Roma, Cologne, Perugia, Florence, Padua, Tübingen, Louvain

Top institutions (1536-1617): Wittemberg, Louvain, Strasbourg, Cambridge, Freiburg im Breslau, Toulouse

Top institutions (1618-1685): Wittenberg, Cambridge, Padua, Louvain, Leiden, Pisa, Strasbourg

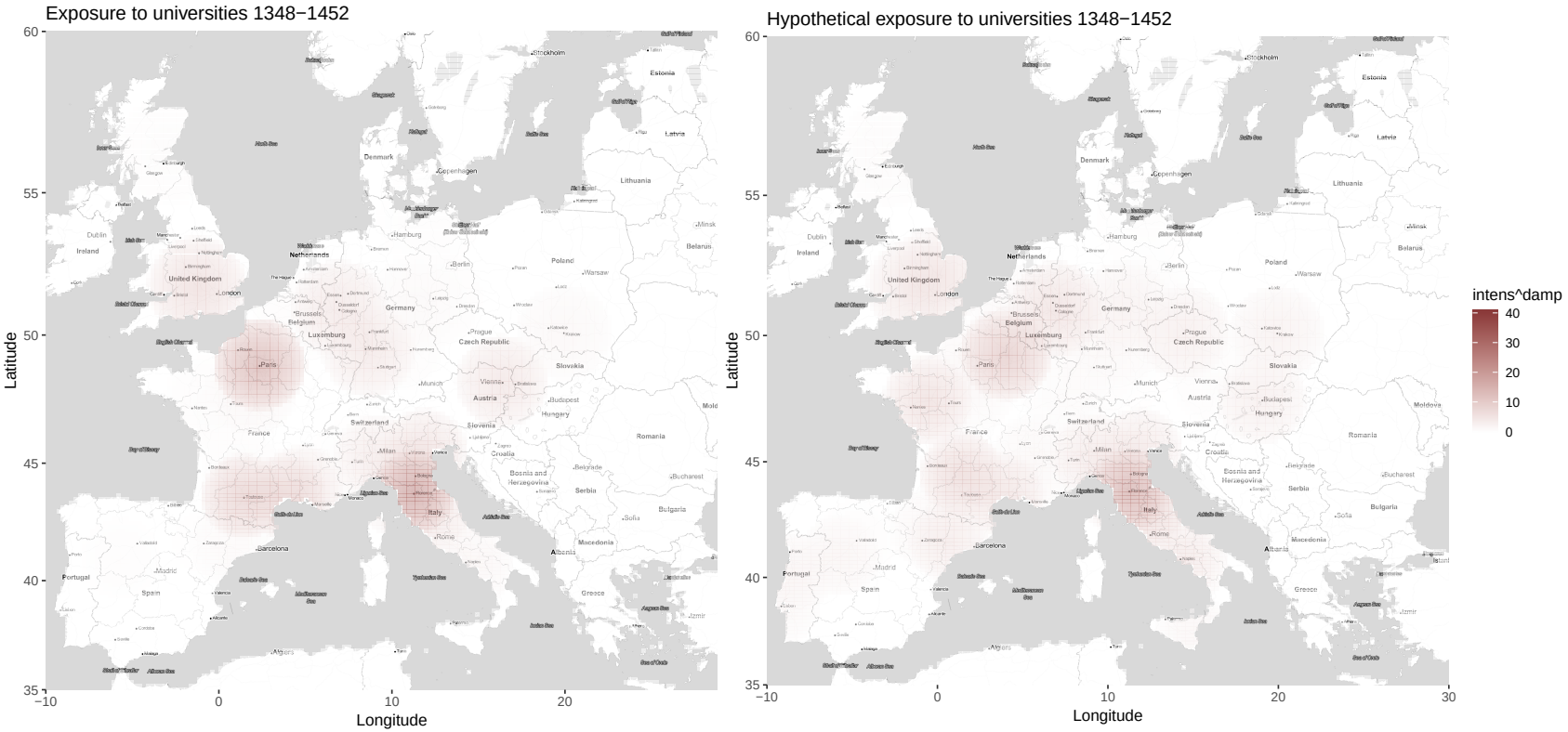
Mapping agglomeration





Actual distribution of university quality

Hypothetical distribution obtained if scholars worked at university closest to their birth place


Exposure to universities 1348−1452
Hypothetical exposure to universities 1348−1452
Latitude
Longitude
intens^damp
40
30
20
10
0
Stockholm
Estonia
Latvia
Lithuania
Denmark
Copenhagen
Ireland
Dublin
United Kingdom
London
Netherlands
Belgium
Brussels
Luxemburg
Germany
Hamburg
Berlin
Poland
Warsaw
Minsk
Belarus
Prague
Czech Republic
Slovakia
Vienna
Austria
Budapest
Hungary
Moldova
Romania
France
Paris
Switzerland
Slovenia
Croatia
Bosnia and Herzegovina
Serbia
Bulgaria
Bucharest
Italy
Milan
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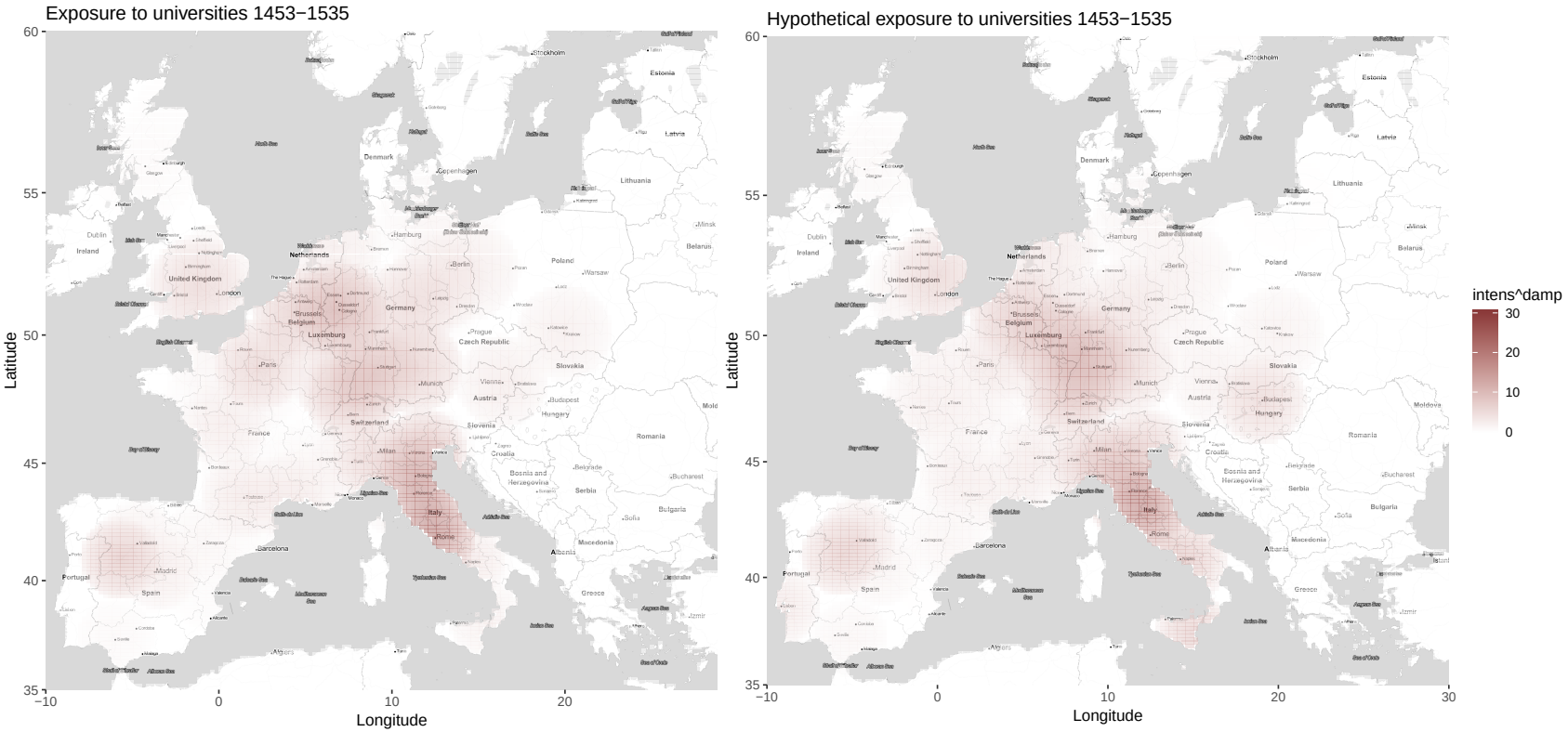
Macedonia
Albania
Greece
Spain
Madrid
Barcelona
Portugal
Izmir


Exposure to universities 1453−1535
Hypothetical exposure to universities 1453−1535
Latitude
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Ireland
United Kingdom
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Belgium
Luxemburg
Germany
Denmark
Poland
Czech Republic
Slovakia
Austria
Hungary
Switzerland
France
Spain
Portugal
Italy
Croatia
Slovenia
Bosnia and Herzegovina
Serbia
Romania
Bulgaria
Greece
Macedonia
Albania
Belarus
Lithuania
Latvia
Estonia
Moldova
Dublin
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Paris
Brussels
Amsterdam
Hamburg
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Sofia
Belgrade
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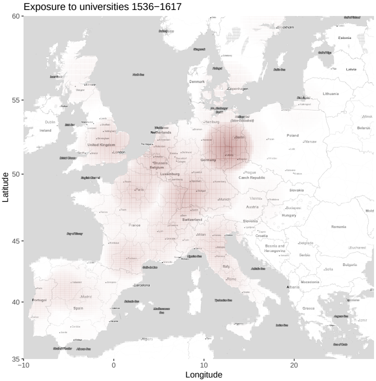
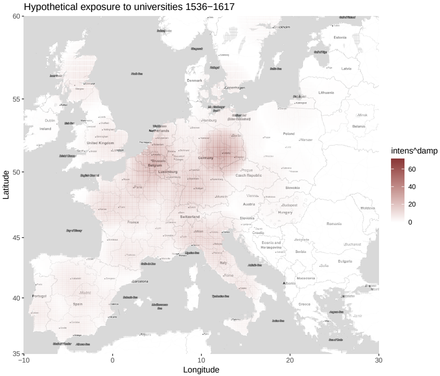

Exposure to universities 1536−1617
Latitude
Longitude


Hypothetical exposure to universities 1536−1617
Latitude
Longitude
intens^damp
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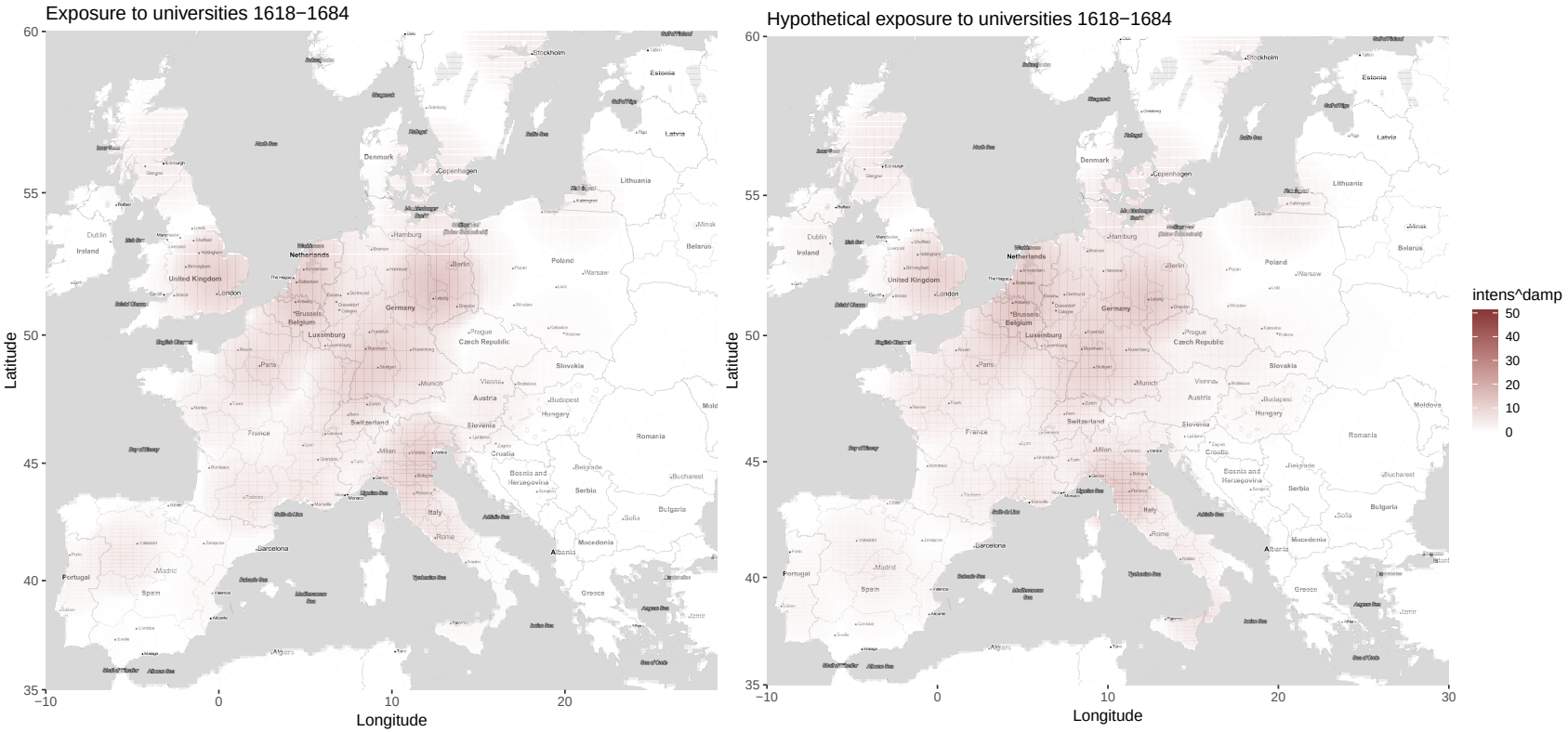
Exposure to universities 1618−1684
Hypothetical exposure to universities 1618−1684
Latitude
Longitude
intens^damp
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Ireland
United Kingdom
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Luxemburg
Germany
Denmark
Poland
Czech Republic
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Austria
Hungary
Switzerland
France
Spain
Portugal
Italy
Croatia
Slovenia
Bosnia and Herzegovina
Serbia
Romania
Bulgaria
Macedonia
Albania
Greece
Belarus
Lithuania
Latvia
Estonia
Moldova
Dublin
London
Brussels
Paris
Munich
Vienna
Budapest
Prague
Warsaw
Stockholm
Copenhagen
Hamburg
Berlin
Milan
Rome
Barcelona
Madrid
Bucharest
Sofia
Belgrade
Izmir

Individual location choice - Specificities

Consider a discrete choice model where potential professors decide where to go.

Compared to literature on migration, we have two specificities

Varying choice set. As new universities are created (or abandoned) over time, the options faced by individuals are time dependent.

Unbalanced panel dimension. Some individuals make multiple choices / repeated choices. We do not necessarily know the timing of choices. (ex: Jean de Corras (1513-1572) taught in Orléans, Paris, Angers, Padua, Toulouse, Ferrara, Valence)

Model

The utility that a professor i living in period t would obtain from locating in university $k \in K_t$ at the stage s of her career is given by:

$$U_{itks} = V_{itk} + \epsilon_{iks} = \beta \mathbf{x}_{itk} + \epsilon_{iks}, \tag{1}$$

$V_{itk} = \beta \mathbf{x}_{itk}$ represents the deterministic component of utility, which depends on a vector of observable variables $\mathbf{x}_{itk}$

ϵ_{iks} captures random taste shocks.

Persons having been at more than one place have had several career spells with different ϵ_{iks}

Multinomial logit

The random term ϵ_{iks} is assumed to follow an independently and identically distributed Extreme Value Type-1 distribution.

The probability that university k represents the utility-maximizing choice for professor i at the stage s of her career as the outcome of a standard multinomial model (McFadden, 1974):

$$p_{itks} \equiv \text{Prob}\left[U_{itks} = \underset{k' \in K_t}{\text{Max}}\, U_{itk's}\right] = \frac{\exp(\beta \mathbf{x}_{itk})}{\sum_{k'} \exp(\beta \mathbf{x}_{itk'})}. \quad (2)$$

$\rightarrow$ Property of independence of irrelevant alternatives (IIA).
For example, the relative probabilities of going to Louvain vs Bologna does not depend on whether Paris exists

Components of utility

$$\mathbf{x}_{itk} = (f_k,\ d_{ik},\ d_{ik}q_i,\ q_i Q_{kt},\ q_i Y_{kt})$$

Universities fixed effect f_k: control for many unobserved features

Distance from birth to university: d_{ik}. Travel cost, but also distance from family etc.

Selection: Interaction between own notoriety and distance: $d_{ik}q_i$. Are better people less sensitive to distance?

Sorting I: Interaction between own notoriety and of university (subtracting effect of famous individuals from university measure): $q_i Q_{kt}$.

Sorting II: Interaction between own notoriety and quality of the city in which university is located: $q_i Y_{kt}$ (like city size)

Parameter Estimates for Multinomial Logit Model

	(1)	(2)	(3)	(4)	(5)
d_{ik}	-1.126***	-1.239***	-1.126***	-1.124***	-1.238***
	(0.011)	(0.017)	(0.011)	(0.011)	(0.017)
$d_{ik}\,q_i$		0.072***			0.072***
		(0.007)			(0.007)
$q_i\,Q_{kt}$			0.023***		0.008
			(0.006)		(0.006)
$q_i\,Y_{kt}$(city size)				0.046***	0.044***
				(0.007)	(0.007)
incl. Q_{kt}, Y_{kt}(city size)	yes	yes	yes	yes	yes
k Fixed E.	yes	yes	yes	yes	yes
N. Obs.	6,728	6,728	6,728	6,728	6,728
R2	0.392	0.394	0.392	0.393	0.395

Note: Number of persons i: 5791. Maximum number of destinations k: 92. Mean number of destinations per person: 1.146. Maximum number t of destinations for one person: 7. Number of dyads: 444270.

Size of effects

Measuring the strength of self-selection for two persons

–**Thomas Aquinas** (1225-1274), born in Roccasecca, taught theology at Paris (1252-1272), ranked 3/5154

–**Jakob Wimpfeling** (1450-1528), born in Sélestat, taught rhetoric and poetry at Heildelberg (1473-1501), ranked 168/5154

We compare predictions of:
– model (1) (no self-selection)
– model (2) (+high q_i less sensitive to remoteness - selection)
– model (5) (+high q_i more attracted by big cities & good universties - selection & sorting)

Thomas Aquinas

	(0) gravity	(2) +selection	(5) +sorting
Aix-en-Provence	5%	6%	5%
Bologna	23%	20%	23%
Cologne	3%	5%	6%
Montpellier	5%	6%	5%
Napoli	10%	5%	4%
Padova	9%	9%	7%
Paris	10%	15%	26%
Salerno	10%	6%	5%
Siena	11%	9%	7%

painting by Carlo Crivelli - 1476

(2): ↘ prob of short distance destinations
(5): increases attractiveness of big cities & famous universities

Jakob Wimpfeling

	(0) gravity	(2) +selection	(5) +sorting
Basel	4%	4%	4%
Cologne	2%	3%	3%
Freiburg	16%	12%	12%
Heidelberg	17%	16%	15%
Louvain	4%	5%	6%
Padua	2%	3%	3%
Paris	2%	3%	4%
Saint-Dié	3%	2%	2%
Strasbourg	13%	10%	11%
Tübingen	10%	9%	9%

Portrait by Heinrich Pantaleon, 1578

Econometric issues

- Robustness of selection and sorting ?
  $\rightarrow$ run estimates by periods, fields, and country of origin
- Our sample might not be random. Biased estimation of positive selection?
  $\rightarrow$ provide bounds on the coefficient of $d_{ik} q_i$
- Panel dimension not taken into account (repeated choices)
  $\rightarrow$ estimate a mixed logit in panel and check if it is different
- Individual quality can be endogenous to location choice
  $\rightarrow$ model quality as a function of location choice, and show that endogeneity bias is mitigated in a nested logit model. Estimate such a model and check if it is different

Heterogeneity in Selection and Sorting ? (model (5))

	pos. selection	Sorting		
	$d_{ik} q_i$	$q_i Q_{kt}$	$q_i Y_{kt}$(city size)	n. obs
Benchmark	0.072***	0.008	0.044***	6,728
Period 1 & 2	0.047***	-0.021	0.115***	1,554
Period 3, 4 & 5	0.089***	0.020**	0.032***	5,174
Theology	0.070***	0.026**	0.008	1,458
Law	0.101***	-0.006	0.018	1,934
Medicine	0.037*	0.010	0.070***	872
France	0.124***	0.007	0.050***	1,014
Low Countries	0.085***	-0.023	0.114***	745
Germany	0.080***	0.038***	-0.010	2,763
Italy	0.079***	-0.008	0.069***	1,206

Some heterogeneity remains to be explored but positive selection appears in all subsamples

Sample not random

Sampling depends on availability of information for each university and where we put our effort

Build an interval for the positive selection effect:

- Make sample less selective: Add the persons from unknown origin assuming they are locals
- Make sample more selective: Remove the scholars who do not have a Worldcat entry

What do we gain by taking all the "unknown" professors into account beyond the big names ?
Short answer: precision in the measurement of the importance of positive selection

Parameter Estimates for Different Samples

	benchmark	adding scholars with unknown birthplace = destination	removing scholars without Worldcat entry
d_{ik}	-1.238***	-1.344***	-1.224***
	(0.017)	(0.016)	(0.024)
$d_{ik} q_i$	**0.072****	**0.104****	**0.073****
	(0.007)	(0.007)	(0.009)
$q_i Q_{kt}$	0.008	0.013**	0.026***
	(0.006)	(0.007)	(0.008)
$q_i Y_{kt}$(city size)	0.044***	0.046***	0.047***
	(0.007)	(0.007)	(0.008)
k Fixed E.	yes	yes	yes
N. obs	6,728	9,505	4,260
N. diads	444,270	567,032	295,773
R2	0.395	0.579	0.352

Making the sample less selective reinforce the coef of $q_i d_{ik}$.
We find upper and lower bounds on the effects.

Panel Dimension due to Repeated Choices

Assume coefficients β_i vary in the population (mixed logit) rather than being fixed (multinomial logit).

In such a set-up we can assume that individuals with several career spells keep the same β_i.

$\rightarrow$ accounts for individual unobserved preference factors common to all career spells.

Mixed logit Results

	benchmark multinomial logit	mixed logit
d_{ik}	-1.238***	-1.751***
	(0.017)	(0.031)
$d_{ik} q_i$	0.072***	0.073***
	(0.007)	(0.011)
$q_i Q_{kt}$	0.008	0.013*
	(0.006)	(0.008)
$q_i Y_{kt}$ (city size)	0.044***	0.046***
	(0.007)	(0.008)
k Fixed E.	yes	yes
dist. of parameters	no	yes
N. obs	6,728	6,728
R2	0.395	0.421

$\rightarrow$ Sorting is strenghtened

Individual quality can be endogenous to location choice

E ex-post notoriety is: $q_i = \bar{q}_i + \theta Q_{k^\star t}$
with $\bar{q}_i$ innate ability, $Q_{k^\star t}$ quality of chosen university

Individual prefers k to k' if:

$$V_{itk} + \epsilon_{iks} > V_{itk'} + \epsilon_{ik's}$$

Taking

$$V_{itk} = f_k + \beta_0 d_{ik} + \beta_1 Q_{kt} + \beta_2 Y_{kt} + \beta_3 d_{ik} q_i + \beta_4 q_i Q_{kt} + \beta_5 q_i Y_{kt}$$

Replacing q_i by $\bar{q}_i + \theta Q_{k^\star t}$, and denoting $\bar{V}_{ikt}$ the V_{ikt} where q_i has been replaced by $\bar{q}_i$:

...

Individual prefers k to k' if:

$$\bar{V}_{ikt} + \epsilon_{ikt} > \bar{V}_{ik't} + \epsilon_{ikt}$$
$$+\beta_3(d_{ik'} - d_{ik})\theta Q_{k^\star t} + \beta_4\theta(Q_{k't} - Q_{kt})Q_{k^\star t} + \beta_5(Y_{k't} - Y_{kt})\theta Q_{k^\star t}$$

$\rightarrow$ endogeneity of q_i implies a violation of the IIA property, as the choice now depends on $Q_{k^\star t}$

To assess the size of this problem: estimate nested logit model, where nests group universities with similar Q, making $(Q_{k't} - Q_{kt})$ small (we also estimate the model with nests grouping university based on the size of the city and on the location).
Nested logit amounts to introduce a nest fixed effect which will capture part of the bias
$\rightarrow$ compare benchmark with nested logit to see size of bias

Nested logit Results - Periods 3, 4 & 5

	multinomial logit	nested logit		
nests based on		univ. quality	city size	location
nb. of nests		4	4	4
d_{ik}	-1.324***	-0.889***	-1.026***	-1.931***
	(0.020)	(0.019)	(0.021)	(0.032)
$d_{ik} q_i$	0.089***	0.063***	0.067***	0.105***
	(0.008)	(0.004)	(0.005)	(0.009)
$q_i Q_{kt}$	0.020***	0.009	0.015**	0.032**
	(0.008)	(0.006)	(0.006)	(0.014)
$q_i Y_{kt}$(city size)	0.032***	0.013***	0.033***	0.036***
	(0.008)	(0.005)	(0.007)	(0.013)
k Fixed E.	yes	yes	yes	yes
N. obs	5,174	5,174	5,174	5,174
R2	0.371	0.381	0.376	0.383

note: limited to periods 3,4 & 5 for nests to keep their meaning

$\rightarrow$ no sign of bias

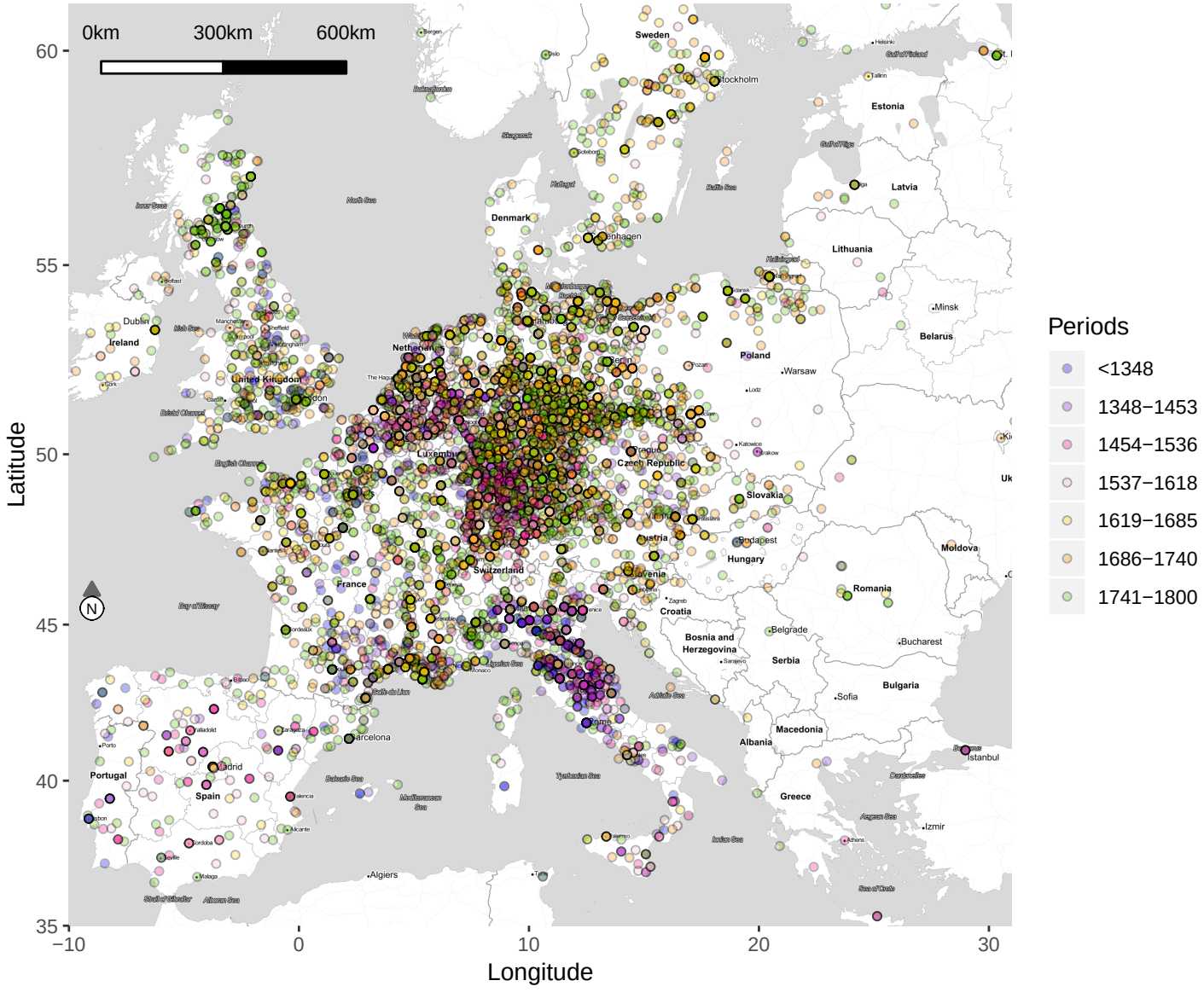
Conclusion - main result

Analysis of migration pattern of European scholars over the period 1088-1685

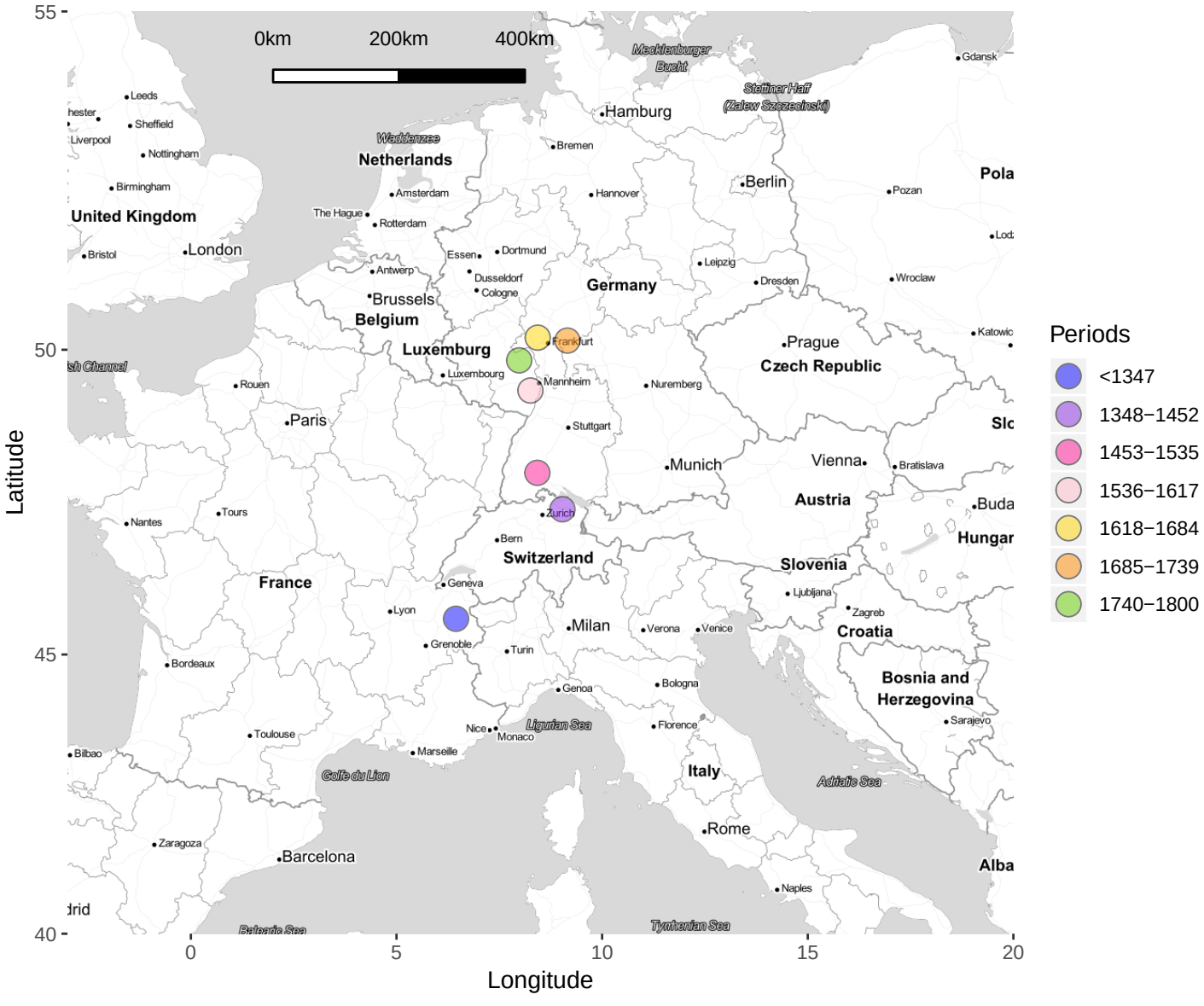
There is positive selection and sorting among them:
The more talented scientists are less sensitive to distance (positive selection) and more sensitive to pull factors (sorting)

$\rightarrow$ these properties likely to help universities to diffuse and create knowledge at the dawn of European primacy

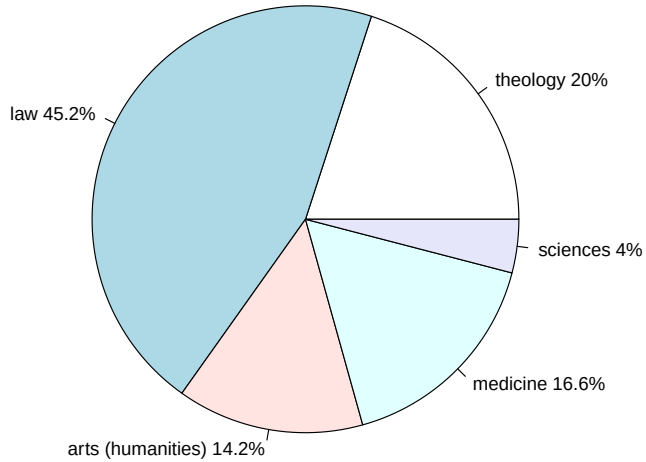
Map of the advancement of the project

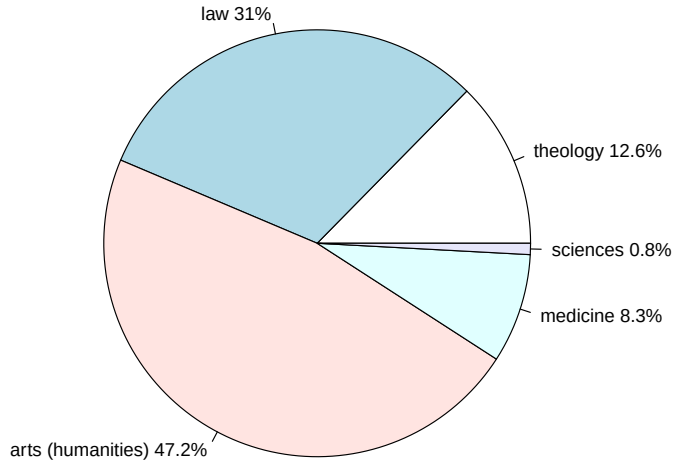


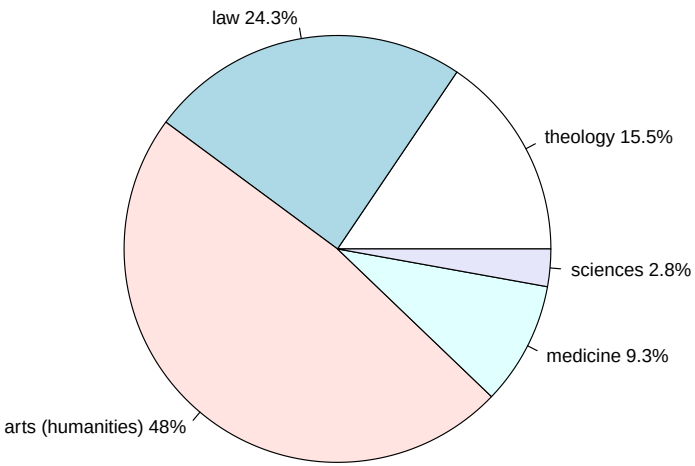
Barycenter (so far - sample not representative)



What are they teaching? Fields for the first three periods

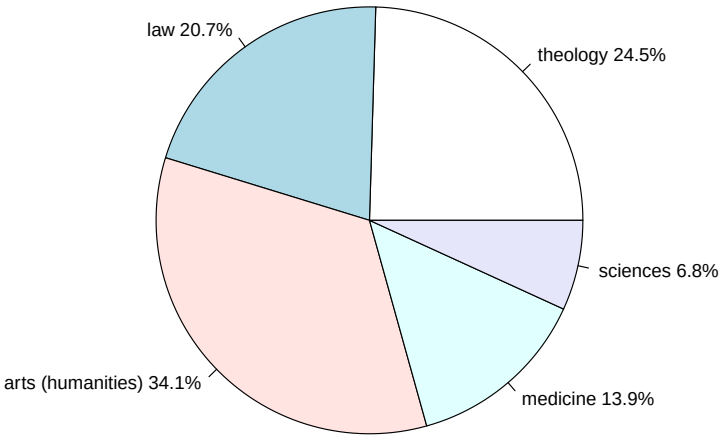


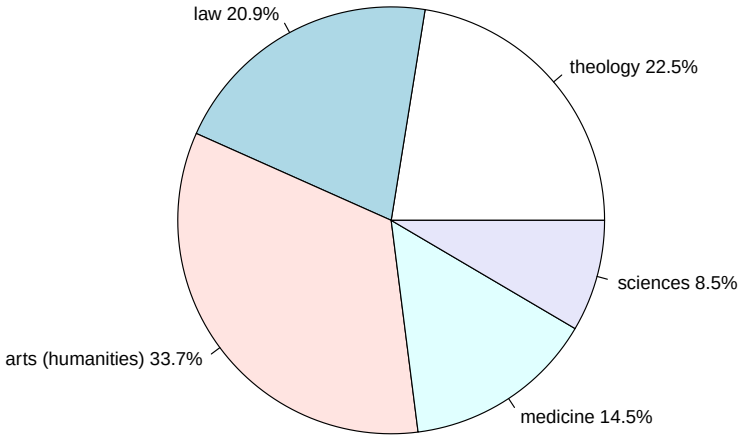




Note: Mostly based on teaching. A person may act in more than one "field".

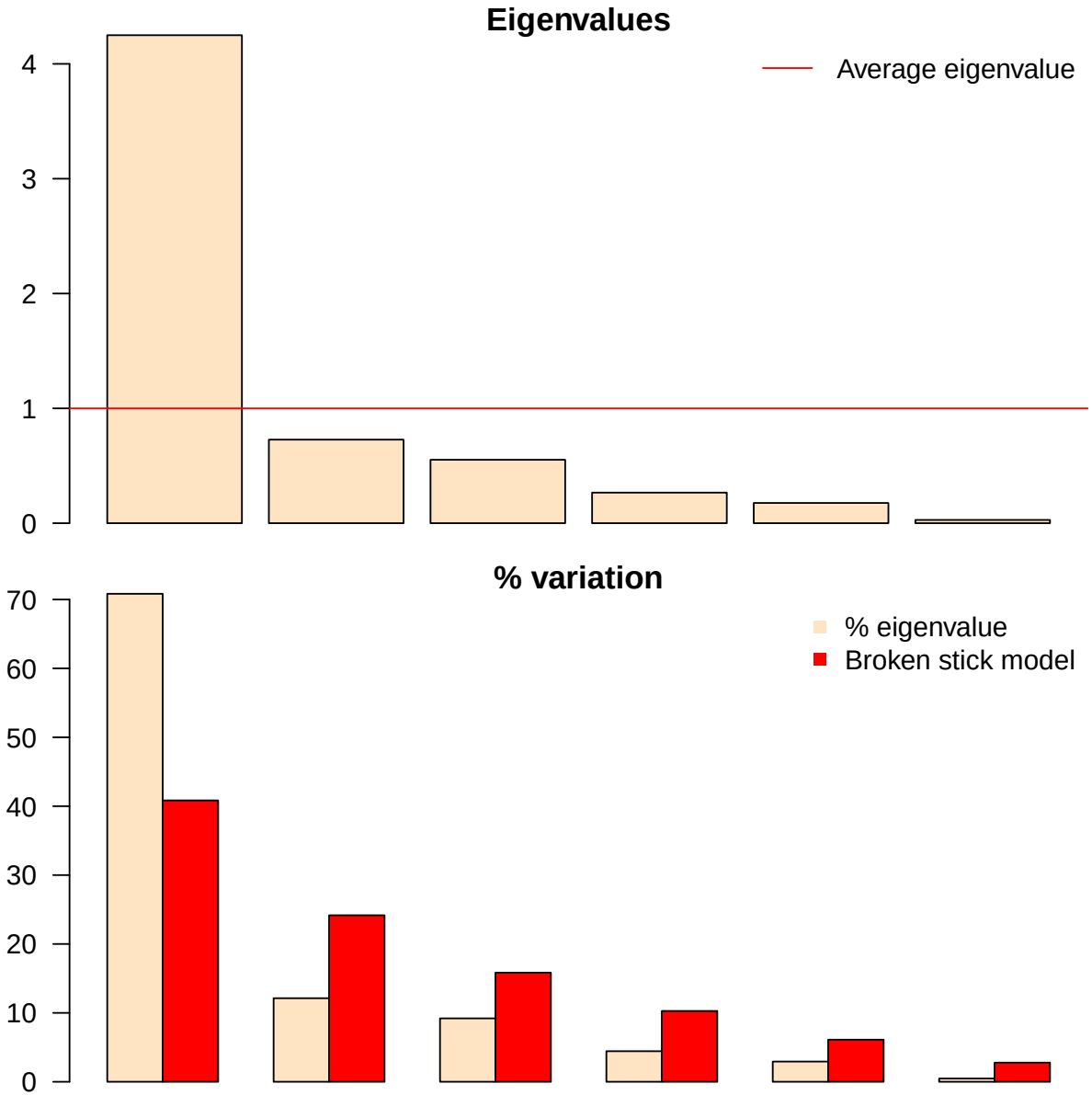
What are they teaching? Fields for the last two periods



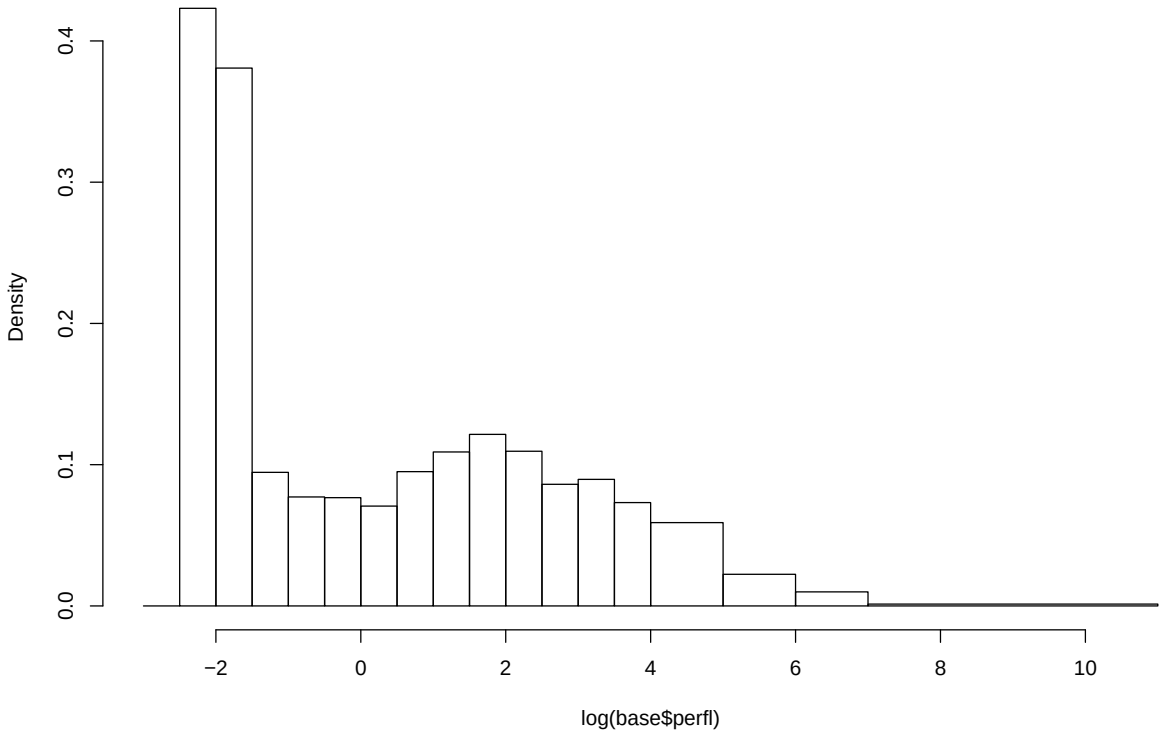


Note: Mostly based on teaching. A person may act in more than one "field".

Principal component analysis



Distribution of log notoriety for first five periods



Conclusion - broader view

Mobility and self-selection may have contributed to the greatness of Medieval Universities, which

- revival of Roman Law, better suited to regulate complex economic transactions than prevailing customary rules
- translated the philosophical and scientific works from Classical Arabic and Greek.
- initiated scientific thinking in Europe (e.g. Ockham's parcimony principle, Duns Scotus' logic, Roger Bacon's empiricism)
- promoted the nuclear family view (and the education of children, Aquinas)

Anecdotal evidence of market-based behavior

In 1583, the university of Valence was searching for a well-known scholar in law. They send a messenger to convince a famous lawyer of Grenoble, Lescure, to join the university. The latter reported that he would be willing to come for a salary of 1500 pounds, and provided his moving costs and house rental cost were covered by the university. They finally agreed on 1200 pounds plus the house, partly paid by four merchants of the city.

Later on, his colleague Josserand became jealous of Lescure's treatment, threatened to go elsewhere, and finally obtained a pay rise.

Histoire de l'Université de Valence, by Nadal, 1861, p120–122