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FROM BAGHDAD TO LONDON: THE DYNAMICS OF URBAN GROWTH IN EUROPE AND THE ARAB WORLD, 800-1800

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ABSTRACT

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JEL Classification: economic history, long term urban development, Europe and Arab world
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Submitted 09 April 2008

Abstract

On the basis of a large (new) dataset of cities in Europe, North Africa and the Middle East in the millennium between 800 and 1800, we try to provide an answer to the question why, during this millennium, the urban center of gravity moved from Iraq (or more generally the Arab world) to Western Europe and to the shores of the Atlantic (during the 17th and 18th century) in particular. We study the characteristics of the European and Arab urban systems involved, amongst others focusing on the interaction between cities, and explain why one system was much more dynamic in the long run than the other. Also we assess the importance of various geographical, religious and institutional factors as the driving forces of urban expansion. Overall, we provide a better understanding of the dynamics of urban growth in the centuries leading up to the Industrial Revolution and an answer to the question why London, an economic backwater in 800, was able to overtake Baghdad, in 800 the thriving capital of the Abbasid caliphate, as the largest city in this part of the world.

Introduction

Why did the Industrial Revolution begin in North-Western Europe, and not in China, Japan, India or the Middle East? At about 1000, the latter regions were clearly more advanced than Western Europe, which was still a rather backward part of the world economy with low levels of urbanization and income. Understanding why between 1000 and 1800 Western Europe developed from a backwater of the world economy into its most dynamic region, is a major challenge for economists and economic historians. The question is not only academic, as it deals with the preconditions for the genesis 'modern economic growth', a process that since the early 19th century has spread to large parts of the world, but not quite to all corners.

This paper focuses on the divergent development of the Arab World and Western Europe (or the Latin West) in the millennium between 800 and 1800.[1] On the basis of a large (new) dataset of cities in Europe, North Africa and the Middle East we provide empirically founded explanations to the question why in the course of this millennium the urban center of gravity in this part of the world moved from Iraq (or more generally the Arab World) to Western Europe and the shores of the Atlantic in particular (see also Acemoglu, Johnson and Robinson (AJR) 2005).

One of the key issues is: was it geography or institutions that caused the divergence between the Arab world and the Latin West? Or more specifically, was the relative decline of the Middle East caused by the overseas expansion of Western Europe, which, after Portugal found the 'direct' route to India and China, side-tracked the main trading routes which had been the engine of the economies of the Middle East? Or was it the inability of this part of the world to develop more efficient institutions, and was this inability linked to 'cultural' and 'religious' factors, to Islamic institutions perhaps, as for example Kuran (2003) and Greif (2006) argue?

[1] Arab World is North Africa and the Middle East, inclusive of Iraq, but excluding Iran and other countries to the east; Western Europe is Europe excluding the area of the former Soviet Union; the terms Western Europe and Latin West refer to the same region.

A related debate is about the origins of Europe's dynamic development. Is it the Industrial Revolution of the late 18th century that made the difference between the west and 'the rest', as for example has been argued by a number of scholars working on comparative Chinese economic history (Pomeranz 2000; Bin Wong 1997)? Or are the roots of Europe's advance to be sought in the gains it made after the Great Discoveries of about 1500, leading to the development of the Atlantic economy (AJR 2005: 549-50)? Or should we follow Weber (1922, 1958), or more recently Landes (1998) and Greif (2006), who find the roots of European modernity in the specific institutions that emerged in the Middle Ages?

Our contribution to these debates is threefold. Firstly, we present a new dataset that can be used to study the urban development in both Europe and the Arab world covering the period 800-1800. Besides having information on city sizes, we also enriched the data set with information on cities' (relative) geographic location (e.g. their coordinates, are they near the sea, a Roman road, a caravan route etc.) and on their institutional development (which are the capital cities, have a university, have an important religious function, which cities have a form of local political organisation, etc.?). This allows us not only to chart the long term development of the urban systems of Europe and the Arab World, but also to analyse the spatial and institutional developments of the urban system. Secondly, using this dataset, we demonstrate empirically that the Latin West and the Arab World were two largely separate urban systems, each with different special features (such as different dominant modes of transport: the sea versus caravan routes) and very different dynamics (growth versus long-term stagnation). Moreover, by analyzing the interaction between cities we demonstrate that there were strong positive feedbacks within the two urban systems, but almost no interaction between them. In other words, cities in the Latin West and in the Arab World profited from the existence of other (large) cities within their own urban system (as markets or hubs of trade), but we find no evidence of a positive (and sometimes even a negative) feedback across the borders of the two systems. Finally, we test a number of hypotheses about the importance of different institutions for long-term economic development, using the distinction made by Acemoglu and Johnson (2005) between political (or property right) and economic (or contracting) institutions. Greif (2006) has argued that the dynamic commercial (and urban) development of Western Europe compared to the Arab World was based on the superiority of its institutions regulating market exchange. His views differ from those of North (1981), who has maintained that it were mainly the political institutions constraining the predatory behavior of states that made Western Europe exceptionally successful. We attempt to measure the efficiency of both different types of institutions for the Latin West and the Arab World more or less independently. By assessing the efficiency of the interactions between cities we measure the quality of the economic institutions that govern exchange (testing Greif's (2006) hypothesis). And by studying the structural features of the urban system (such as its density, capitol city shadow, and urban primacy), we try to get a grip on the quality of the political institutions. It has for example been demonstrated that the share of the primate city in total urban population is related to the quality of the political institutions (Ades and Glaeser 1995). We will use a number of ways to verify the importance of the (local) political institutions in which cities are embedded and show that there were several interesting differences between the Latin West and the Arab World in this respect.

Why compare the development of Europe to that of the Arab World and not to that of China or India? For a number of reasons the comparison between the development of the urban systems of Western Europe and the Arab World is as an

ideal experiment: both regions shared the same institutional heritage of the Hellenistic and Roman world; the two urban systems developed more or less independent from each other; and there were no colonial relationships between them, making it possible to exclude this cause of their reversal of fortune (AJR 2001).[2] Their starting point was quite different, however: the Arab world was highly urbanized, inheriting the ancient centers of urbanization in Egypt, Mesopotamia and the Levant, whereas the Latin West was – with the exception of Italy – relatively backward. Moreover, whereas the Arab world could build upon the state structures of the Levant, Western Europe went through an extended period of weak or non-existent states, in particular after the desintegration of the Carolingian Empire in the 10th century (Van Zanden 2007). Another important difference between the two regions was religion: Islam versus Christianity (or to be more precise, we defined the Latin West in such a way that it coincides with the region dominated by the Catholic Church; see also Findlay and O'Rourke, 2008). Islam was from the start a 'modern religion' which imposed a set of institutions favorable to exchange (perhaps because Mohammed had started his career as a caravan trader). It has been argued that the 'identity' of Christendom only emerged as a result of its confrontation with the Islam in the 9th/10th centuries (Glick 1979: 21), and it is from this period onwards that the Catholic Church developed a set of 'worldly' institutions it tried to impose on society at large, a process that culminated into the Papal Revolution of the 11th/12th centuries (Van Zanden 2007).

The structure of the paper is as follows. First we explore the theoretical ideas that allow us to look into the black box of the urbanisation process, and analyse the links between institutions and urban growth. Next, we present the dataset and provide a broad outline of the process of urban growth in the two regions on the basis of the evolution of several of the characteristics of their urban system. In the following sections we relate the observed pattern in urban development to different kinds of city-specific (geographical, religious and institutional) characteristics, testing the relevance of different hypotheses that have been put forward as explaining differences in the size of cities. We begin with a baseline model, and gradually introduce additional variables and study the evolution in the importance of different variables over time. This results in various interesting results by which we can assess the relevance of the various hypotheses outlined in the next section.

Theoretical framework

Much of the recent work done on long-term trends in economic performance in the pre industrial era has used estimates of the number and size of cities and/or the urbanization ratio as indicators of the economic success of regions and countries (Acemoglu, Johnson and Robinson 2005; De Long and Shleifer 1993). These figures are indeed among the few more or less reliable data available for the pre industrial age, making it possible to chart and analyse long-term trends and spatial structures (see De Vries 1984 for a seminal example). Data on city growth are therefore

[2] Although they did fight many a war against each other and regularly (tried to) conquered each other's territory; the Islamic Jihad in this respect was not really different from the Christian crusades, and both had periods in which they were on the offensive alternating with periods in which they were mainly defensive (Islam was on the rise between 632 to about 1000, Christianity was on the attack between 1095 and about 1300, followed by a new expansion of Islam in the form of the Ottoman Empire between 1300 and 1683, after which the Ottoman Empire was again on the defensive).

arguably the best starting point of an inquiry into the determinants of economic change in the pre industrial era. Given the scarcity of other data, it is however difficult to explain the trends found in urbanization processes in the pre 1800 period. Recent work has attempted to use certain proxies of the quality or the character of institutions as independent variables. Dummies of the type of state (a Free Republic or an Absolutist Monarchy, see De Long and Shleifer 1993), or proxies of the strength of constraints on the executive and the degree of protection of 'capital' are used to explain growth in terms of the increase of the size of cities and/or the urbanization ratio (AJR 2005). Both the above papers construct these proxies at the country level, and relate them to the urban development of these countries. We also use these proxies in our regressions explaining city size, but we aim to move beyond these country-regressions[3] and measure the impact of the quality of institutions by focusing at the individual cities of the urban systems in Europe and the Arab World. Our approach thus differs from the two above-mentioned papers in that our newly collected data at the individual city level allows us to move beyond explaining the urban development (e.g. urbanisation rate or the development of the number of cities) of the countries in our sample and focus entirely on the individual cities in our sample (hereby offering a peek inside the 'black box' of individual cities' development).

Our investigation is, firstly, based on Weber's typology of 'producer' and 'consumer' cities. Weber contrasted the 'industrial' or 'producer' cities of Medieval Europe with the 'consumer' cities of Antiquity, a distinction that has been rather fruitful, both for understanding the economic history of Antiquity and that of the Middle Ages (Finley 1985). The classical *consumer city* is a center of government and military protection (or occupation), which supplies services – administration, protection – in return for taxes and land rent (or more in general: non-market transactions). This kind of city is intimately linked to the state it is in embedded in – the flowering of the state, the expansion of its territory and population, will lead to urban growth, in particular of the capital city, which is the consumer city par excellence. Moreover, the most efficient location of such a city is in the middle of the territory it controls; capital cities such as Damascus, Madrid, Agra/Delhi (the center of the Moghul Empire), Moscow or Beijing, can be considered typical examples. Closeness to the sea, or to rivers, is not a necessity, as the underlying rationale of such a city is not to exchange goods at relatively low transaction costs. Commercial activity will of course take place – for the feeding of the city and the supply of other consumption goods it has to resort to its surroundings – but this function is secondary, derived from its political and military role.

The economic basis of the *producer city*, on the other hand, is the production and exchange of goods and commercial/marketed services for and with a/ its immediate hinterland and b/ other (producer) cities at a greater distance. Its links with the state are typically much less close, and its fate can to some extent be more or less independent of the political entity it is part of because it has an economic basis of its own. There is clearly no reason to be in the spatial center of this state, in fact a

[3] AJR (2005) also show results of regressions at the city-level. However, the bulk of the results provided in their paper are based on regressions at the country-level. Also, we note that both AJR (2005) and De Long and Shleifer (1993) use countries as defined by their 1990 boundaries as the unit of observation. We think that extending this country classification back to our sample period is somewhat problematic as these 1990 boundaries do hardly ever correspond to countries existing in the 9th up to the 19th century (e.g. Italy and Belgium only came into existence in 1861 and 1831 respectively). Taking individual cities as the unit of observation overcomes this problem of having to define countries.

strategic position on important trade routes (e.g. on the border of two states) – profiting from trade flows there - is more likely to be a good location for such a city. Given the importance of access to long-distance markets, the ideal producer city will therefore be either located near the sea or at a navigable river, or at a hub of overland routes.

On the basis of this distinction the North hypothesis that the rapid economic development of Western Europe is linked to its favorable political economy, can be reformulated; it implies that we expect the cities of Western Europe to be more producer-oriented and therefore less dependent on a predatory state, and vice versa, that cities in the Arab World are more consumer-oriented.[4] This difference between consumer and producer cities may also express itself in the structure of the urban system. Capital cities are typical consumer cities: when they dominate the urban landscape (as Rome with its million inhabitants dominated Ancient Italy) the degree of 'consumerism' of the urban system is probably quite high. Ades and Glaeser (1995) for example demonstrate that high levels of urban concentration are not only linked to low levels of international trade and an inward looking economy (high tariffs), but also to political instability and lack of democracy: 'Urban giants ultimately stem from the concentration of power in the hands of a small cadre of agents living in the capital. This power allows the leaders to extract wealth out of the hinterland and distribute it in the capital' (Ades and Glaeser 1995: 224). By contrast, we expect producer cities are more likely part of a more balanced urban system. The positive interactions between producer cities (on which more below) will ideally lead to a dense urban system, whereas consumer cities compete for the same scarce resources – basically taxes and other forms of surplus extraction from the surrounding countryside – and will therefore tend to keep a certain distance from each other. By analyzing the location of cities (in particular their ease of access to important trade routes), the structure of the urban system (the share of the largest and/or the capital city in total urban population), the polity they are part of (Republics versus Monarchies), and using information on the local political organisation, we can find out what kind of forces are driving the urbanization process, whether we are dealing with producer or consumer cities, and therefore whether market forces or non-market transactions are behind urban expansion.

A second way of linking the structure of the urban system to the underlying institutional framework is via the analysis of the interactions between cities. The idea is that one city is the market for another, and that therefore urban growth is, to some extent, self-reinforcing. The hypothesis is that when institutions governing transactions between cities are efficient and transaction costs are low, the interaction effect between cities will be positive (growth of the surrounding urban system stimulates city growth). Conversely, if, as a result of poor institutions transaction costs are high, the growth of one city will not have a big effect on another city because it is very costly to carry out transactions between them. Whereas the locational structure of the cities tells us something about the political institutions in which they are embedded, the feedbacks between cities are indicative of the efficiency of their interaction, and therefore of the efficiency of the institutions regulating exchange; this will make it possible to test the Greif hypothesis that the strong economic

[4] There is an obvious link here to the distinction between Republics (which developed out of the city-states of Medieval Europe) and Monarchies used by DeLong and Shleifer 1993; for a discussion of the historical literature about city types in Arab World and Latin West see the online data Appendix, available at http://maartenbosker.googlepages.com.

development of Western Europe was the result of its more favorable economic institutions regulating exchange.[5]

Looking at these interaction effects can also answer the question to what extend a group of cities functions as an integrated urban system. When we find a positive (and significant) interaction effect, feedbacks between cities are strong, pointing to the existence of such a system. When instead this interaction coefficient is zero or negative, the cities apparently do not interact to such a degree that one can speak of the existence of such a system. In other words, this approach allows us to find out whether Muslim and Christian cities formed one integrated system, or separate sub-systems, and how these evolved in time: when they came into existence as a system, and how strong their interaction was.

Summing up, we try to understand why the Arab World, which in 800 had reached a much higher level of economic development than Western Europe, was gradually overtaken by the latter region. We try to test two hypotheses concerning the divergent development of Western Europe versus the Arab World. Firstly, the Greif hypothesis focuses on the differences in the efficiency of institutions regulating exchange, predicting that interaction between cities in Western Europe was more efficient than between similar cities in the Arab World. Secondly, the North hypothesis on the role of institutions constraining the behavior of the state implies that the explanation is that political institutions in Western Europe were more efficient than in the Middle East. Thirdly, North's and others have also assumed that political institutions are closely related to economic institutions (Acemoglu and Johnson 2005), and that there is a positive correlation between the quality of political and that of economic institutions; measuring both aspects of the institutional framework independently of one other, also makes it possible to test this hypothesis.

Dataset of cities in Europe and the Middle East 800-1800

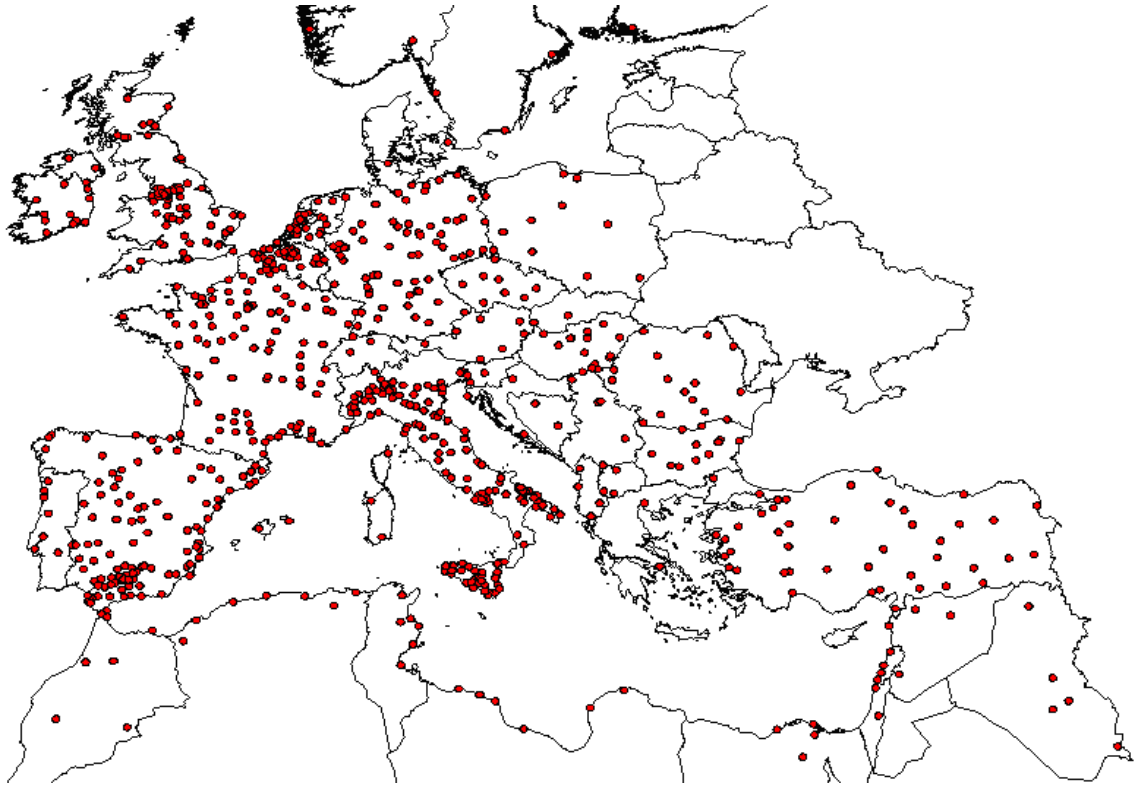
In order to do our empirical analysis we have constructed a large dataset consisting of city-specific information about all cities in the Arab World and Europe that at some point during our sample period, 800-1800, were larger than 10,000 inhabitants[6]. In the medieval period a criterion of ten thousand inhabitants to characterize a residential area as a city is a rather hefty one. Towns often had not more than a few thousand, and sometimes only a few hundred, inhabitants, but it is impossible to trace and quantify the development of these minor towns in the period under review. Therefore, only the really large centres of population pass our criterion (Ennen 1972, 199). For European cities with 10,000 inhabitants or more we used the dataset published by Bairoch *et al* (1988). To update it, we scanned recent literature concerning the major cities covered by the dataset, in particular all cities which during some point in time

[5] Theoretically agglomeration effects may work the other way around: the growth of a certain city – in particular when it surpasses a certain threshold – may have a negative effect on other cities as it because more attractive to concentrate activities in the metropolis. This may occur independent of the type of city (consumer versus producer). For instance, in 18th century Holland, a typical example of an urban system dominated by producer cities, a process of ' internal contraction' occurred as more and more commercial activity was concentrated in the largest city, Amsterdam (and other cities saw their trading activities shrink relatively) (De Vries 1959; De Vries 1974).

[6] In the online data Appendix we explain in detail how we constructed this dataset. It is available at http://maartenbosker.googlepages.com; the reliability of the dataset of also discussed there.

were larger than 60.000 inhabitants. This led to a number of important revisions concerning Cordoba and the other Muslim cities in medieval Spain (estimates were corrected downwards on the basis of Glick (1979)), and Palermo and London in the same period.[7] For cities in the Arab World we used a wide variety of sources, and sometimes had to infer population sizes from their surface area, the numbers of mosques, *hammans*, and other indirect indicators; useful starting points were Chandler and Fox (1974) and Behar (1996). Because of the gradually increasing population and urbanization, the number of cities included in the analysis, which starts from 54 in the year 800, grows continually to 615 cities in 1800 (in total the sample comprises 729 cities that are ever larger than 10,000). The map below shows all the cities that are at some point included in our sample.

Map 1. All cities in our sample



Additional city-specific data – geography, religion and institutions[8]

Apart from population data we also collected administrative information concerning the functions of the various cities. For instance, was it a capital city, a bishopric or archbishopric, and did it have a university; what is the religious orientation of its inhabitants or that of the state it is part of: was it predominantly Muslim or Christian? Also we collected information about each city's local political

[7] Bairoch et.al. (1988) estimates were corrected for a number of extreme outliers, Cordoba (on the basis of Glick 1979) and Palermo (email exchanges with Jeremy Johns and S.R. Epstein); according to Bairoch et.al.(1988), Cordoba was supposed to have 450,000 inhabitants at about 1000 (but only 110,000 according to Glick), Palermo's size was 350,000 according to Bairoch et.al. (1988), whereas our estimate (following Epstein and Johns) is 60,000; London was the only city for which estimates were revised upwards following Campbell 2000.

[8] Again, we refer to the online data Appendix for a much more detailed exposition of these data.

organisation, i.e. the presence of a local commune or city council, capturing the extent to which a city had local authority.

Additionally we collected data concerning the precise geographical location of the different cities (its coordinates), the location of previous Roman roads leading to the city, the availability of navigable waterways, caravan routes or location at the sea.

Foreign Urban Potential and distances

To analyze the importance of interaction effects between cities, we constructed each city's so-called 'foreign urban potential' (FUP) and include this variable as one of the explanatory variables in our regressions. The foreign urban potential of city *i* is defined as the distance weighted sum of the size of all other cities, where we measure distance in terms of relative transport costs. Following De Vries (1984), and Bosker et al. (2008), we calculate a city's foreign urban potential at time *t* as follows:

$$FUP_{it} = \sum_{j \neq i}^{n} \frac{pop_{jt}}{w_{ij} D_{ij}} \tag{1}$$

where pop_{jt} is the population of city *j* at time *t*, D_{ij} is the great-circle distance between city *i* and city *j*, calculated on the basis of each city's coordinates[9], and w_{ij} is a distance weight that we use to take a city's ease of access, depending on a city's geographical conditions, into account. Hereby we distinguish between three different modes of transport – via the sea, river or road – and use the estimate of Masschaele (1993) for the differences in relative transport costs, i.e. 1:4:8 (i.e. road transport is 8 times as expensive, and river transport 4 times as expensive as sea transport). This results in the following definition of w_{ij}:

$$w_{ij} = \begin{cases} 0.125 & if \quad city\ i\ and\ city\ j\ located\ at\ sea \\ 0.25 & if \quad city\ i\ and\ city\ j\ on\ a\ river \\ 0.375 & if \quad city\ i\ located\ at\ sea\ and\ city\ j\ on\ a\ river\ or\ vice\ versa \\ 0.75 & if \quad city\ i\ located\ at\ sea\ and\ city\ j\ not\ at\ sea\ nor\ on\ a\ river\ or\ vice\ versa \\ 0.875 & if \quad city\ i\ on\ a\ river\ and\ city\ j\ not\ at\ sea\ nor\ on\ a\ river\ or\ vice\ versa \\ 1 & if \quad city\ i\ and\ city\ j\ not\ at\ sea\ nor\ on\ a\ river \end{cases} \tag{2}$$

Regarding our choice of distance weights, we are well aware that the data of Masschaele apply to the situation around the 14th century, more or less in the middle of our period of analysis. Naturally it is highly unlikely for transport costs to have remained exactly the same over a period of a millennium and we may assume that the various modes of transport will not have all developed equally in this period. For instance Austen (1990, 341) indicates that for caravan transport by camel the relative efficiency has remained rather constant between 850 and 1830. On the other hand we may expect quite some gains in efficiency in transport by sea between 800 and 1800, where technological innovations have played a considerably larger role than in the caravan transport.[10]

[9] To calculate the (great-circle) distance between all pairs of cities, we collected each city coordinates, i.e. its degrees of longitude and latitude, from www.heavens-above.com, a website that provides the coordinates of over 2 million places in the world.

[10] We will come back to the issue of choosing these distance weights in the next sections. Our main results are qualitatively robust to using other specifications of these weights. See the online results

Finally, note that we do not include own city population when calculating FUP. This is different from de Vries (1984) who does include own city population in his measure of urban potential. We do not do this here, because we are interested in the effect of developments in the urban system around a city on the development of the city itself.

Descriptive statistics

The different dynamics of the two main regions distinguished here is immediately clear from the Tables 1 and 2 (see pp.33-34). Table 1 shows that between 800 and 1800 the urban population of Western Europe increased more than twentyfold, whereas it is grew by only 50% in the Arab world.[11] The differences in terms of rates of urbanization[12] (see Table 2) are equally striking: in Western Europe this ratio went up from 3% to 11%, in the Arab world it remains stable at about 8%, with only a modest increase at the end of the period under study. At the beginning of our period Iraq is by far the most urbanized 'country' with a 25 to 30 percent share of people living in cities with more than 10,000 inhabitants; in the 10th and again in the 14th century it loses part of its urban population (to a large extent the results of the Mongol incursions); within the Arab World, the center of urbanization eventually moves to Istanbul. In Western Europe, by contrast, before 1100 levels of urbanization are very low, with the exception of (Islamic) Spain, which is the most urban region between 800 and 1100. It is overtaken by Italy (in 1200) and the Low Countries (in 1300). Only late in the period under study, after 1700, does Great Britain become an important center or urbanization.

Underlying trends in the total population (urban and non-urban combined) are also quite different: the total population of the Arab world increases 'only' from 19 to 22 million. In Western Europe, which in 800 has about the same population as the Arab World (22 million), it increases dramatically to 130 million in 1800; already in 1200 the Latin West has a population that is more than double that of 'the East'. The Balkan, where the population increased from about 5 million in 800 to almost 25 million in 1800, shows similar trends as Western Europe. In all these respects, trends in Western Europe and the Arab World are quite different from the 9th/10th century onwards. The Latin West shows a continuous, steady increase in its urbanization rate – in fact, it is difficult to find a 'decisive' acceleration in either urban or population growth in the estimates about Western Europe -, whereas the Arab world shows a stagnating, hardly changing pattern over the whole period we are considering. Note however also that despite these two different patterns, the steady increase in the Latin West only results in the Latin West overtaking the Arab World in terms of overall urbanization rate in the final 100 years of our sample period.

More particularly, during the 800-1000 period the urban core of the whole region was in Iraq, where the rate of urbanization was a staggering 20 to 30%; the biggest cities in 800 were Baghdad, Constantinople and Antiochia (Ashtor 1976: 89-

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Appendix, also available at http://maartenbosker.googlepages.com for robustness checks regarding the choice of weights to measure the relative transport efficiency.

[11] This is consistent with the detailed discussion of demographic trends in the Middle East between 800 and 1500 in Ashtor 1976.

[12] The numbers of inhabitants in millions of persons in the different countries for the eleven time periods of our analysis, that are needed to be able to calculate urbanisation ratios, have been obtained from McEvedy and Jones (1979) either directly from their figures or by interpolation (when no data was provided).

91 for a discussion of the high level of urbanization in 9th/10th century Iraq). Iraq continues to be the most urbanized region until 1400, when the Low Countries take over this position. The Latin West in this period did not produce the giant cities characteristic of the Middle East, however; after the decline of Baghdad (between 1100 and 1300), Cairo takes over its position as biggest city (during the period 1200-1500), followed after 1500 by Constantinople. In between we witness the flowering or urban centers in Spain (between 1000 and 1200) and Italy (1200-1500). Then urban core then moves to the North Sea area, where, in 1800, Great Britain becomes the most densely urbanized country in this part of the world economy – at the end of our period London has become the largest city in the region, a thousand years after Baghdad.

As a first indication of the institutional setup of the urban systems in Europe and the Arab World, we calculate the share of the largest city in the total urban population, a measure of the degree of balance within the urban system (see Ades and Glaeser, 1995)[13]. Trends in the two parts of Eurasia distinguished here are very different: in Western Europe this share declines from 12% in 800 to 4% in 1200, after which a slight increase begins (6% in 1400, 7% in 1700 and 1800). In the Arab world the trend is downward initially as well, but from a much higher level: from 25% in 800 and 900 it declines to 13% in 1200, after which it again increases to 19% in 1500 and as high as 33% in 1600 (due to the rapid growth of Istanbul in the 16th century). These large differences in the share of the primate city point to persistent differences in the structures of the two urban systems: in the Arab World the system is dominated by a few very large cities, in Western Europe the system is much more balanced. There are similar differences in the density of the urban system (see Map 1): already in 800 the average distance from a city to the nearest city in the Latin West was half that of the Arab World (46 km versus 100 km), and this difference persisted (in 1800 it was 40 km versus 101 km). Similarly, the average distance of a Christian city to all other ones, was twice the average distance of a Muslim city to all other Muslim cities (in 800 the values are 1134 km and 2281 km). This implies that on a certain geographical area in Western Europe there were on average more than 4 times the number of cities than could be found in the Arab World. Already at the start of our period, the Western European urban system was more dense than that of the Arab World, which was dominated by a few very big cities located at relatively large distances from eachother.

This review of the main features of the two systems already points to large differences between them in terms of the share of the primate city in total urban population and the density of the system, which seem to confirm the hypothesis that Muslim cities came closer to the typical 'consumer city', and cities in the Latin West were more like 'producer cities'. This section however only gives (preliminary) descriptive evidence. The aim of the next section is to go a bit further and tries to uncover the city-specific drivers of urban expansion using panel data techniques.

Baseline Results: Two Urban Systems

As our dataset contains not only information on cities' population size but also on several of their geographical, religious and institutional features, we aim to uncover the (un)importance of these city-specific features as drivers of the observed urban

[13] See Table 5 in the online results Appendix available at http://maartenbosker.googlepages.com.

developments discussed in the previous section. To do this, we estimate the following regression equation:

$$\ln pop_{it} = \alpha_i + X_i'\beta + X_{it}'\gamma + \varepsilon_{it} \quad (3)$$

where pop_{it} is the population of city i at period t, X_i are city specific variables that do not change over time, X_{it} are city specific variables that do vary over time and ε_{it} is a disturbance term that we allow to exhibit both autocorrelation and heteroscedasticity. Also, in our baseline specifications the α_i denote a city-specific random effect that is uncorrelated with the regressors (in subsequent robustness tests we also allow α_i to be a city-specific fixed effect but this comes at the cost of being unable to say anything about the time-invariant city-specific variables in our regressions). The estimated coefficients on the included city specific variables, β and γ are our main point of interest.

We operationalize the Weberian approach sketched in our theoretical framework by analyzing the relative importance of different factors that in principle could leave their effect on city growth. These factors can grosso modo be classified in three groups: geographic variables unchanging in time (location), specific institutional and religious features of cities that can change over time (being a capital city, an (arch)bishopric, religious orientation, having a university), and our measure of FUP that aims to capture the strength and direction of cities' interaction. More in detail the different variables are:

Geography

- location at the sea (also distinguished in being located at the Atlantic, the Mediterranean or the Baltic or North Sea coast[14]), at a navigable river, at a hub of roman roads, at a roman road, at a caravan route, or at a hub of caravan routes.

Religious and institutional

- their status as the seat of a bishop or an archbishop, or the capital of a large territory
- the presence of a university
- their religious denomination: dummies have been included for all Muslim cities, and for cities with a predominantly protestant population (from 1600 onwards)

Cities' interaction

- the 'foreign urban potential' measuring the size of the urban market to which they had access (taking into account transport costs), a variable that is split in the Muslim and Christian 'foreign urban potential'.[15]

Table 3 shows our baseline results obtained using the unbalanced panel of all cities larger than 10,000 inhabitants. It captures the most important underlying forces causing cities to growth. Besides showing the results when considering all cities in the sample, we also discerned a number of larger subsamples of cities: one divides the sample along religious lines, i.e. in Christian cities and Muslim cities and the other

[14] Note that we use location at sea, and not the actual presence of a seaport. It can thus be viewed as capturing the potential for being a seaport which is arguably less plagued by endogeneity issues than considering only those cities with an actual seaport (see AJR 2005).

[15] For each city in the sample we calculate the part of its foreign urban potential that can be ascribed to other Christian and to other Muslim cities respectively.

divides them according to their geographical location, i.e. those cities in the Latin West versus cities in the non-Latin West (The Latin West comprises the region under influence of the Medieval Catholic Church, or Western Europe to the west of the line between Triest and Petersburg.[16] The non-Latin West comprises the rest of the studied area.[17]).

Table 3. The baseline results

	all cities	muslim	christian	latin west	non latin west
Sea	0.108*	-0.047	0.138**	0.133**	0.016
	[0.080]	[0.721]	[0.035]	[0.043]	[0.911]
River	0.052	0.141	-0.01	0.019	-0.023
	[0.203]	[0.224]	[0.808]	[0.649]	[0.805]
hub_3rr	0.051	0.023	0.096*	0.112*	-0.067
	[0.348]	[0.840]	[0.080]	[0.058]	[0.541]
rom_road	-0.013	-0.169	0.048	0.044	-0.129
	[0.759]	[0.208]	[0.242]	[0.320]	[0.290]
Caravan	-0.035	0.083	-0.026	-	0.026
	[0.757]	[0.551]	[0.881]	-	[0.830]
Caravanhub	0.526***	0.463***	0.303	-	0.506***
	[0.002]	[0.008]	[0.163]	-	[0.001]
Bishop	0.177***	0.270**	0.139***	0.139***	0.310***
	[0.000]	[0.012]	[0.000]	[0.000]	[0.001]
Archbishop	0.388***	0.217	0.438***	0.463***	0.259*
	[0.000]	[0.175]	[0.000]	[0.000]	[0.083]
Capitol	0.815***	0.766***	0.817***	0.822***	0.767***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
University	0.322***	0.107	0.301***	0.265***	0.347
	[0.000]	[0.743]	[0.000]	[0.000]	[0.170]
Muslim	0.292***	-	-	0.583***	0.084
	[0.000]	-	-	[0.000]	[0.301]
ln_mus_fup	0.048	0.332***	-0.055	-0.053	0.264***
	[0.242]	[0.001]	[0.156]	[0.226]	[0.002]
ln_chr_fup	0.093***	-0.04	0.161***	0.176***	-0.072
	[0.000]	[0.508]	[0.000]	[0.000]	[0.237]
Prot	0.094	-	0.076	0.07	-
	[0.102]	-	[0.187]	[0.226]	-
Observations	2376	481	1895	1831	545

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not change the results whereas the dummies themselves are insignificant. Results obtained using a panel data estimator allowing for random city-specific effects.

[16] This line is well known from the literature on the European Marriage Pattern (see Hajnal 1965) and is arguably the best approximation of the historical border of Western Europe/the Latin West; it coincides with the border of the Catholic Church during the Middle Ages; Latin West comprises Scandinavia (Norway, Sweden and Finland), Poland, Germany, Czech Republic, the Low Countries (Belgium, Luxembourg and the Netherlands), France, Great Britain, Ireland, Switzerland, Austria, Italy and those located on the Iberian Peninsula (Portugal and Spain).

[17] The Balkans (Hungary, Slovakia, former Yugoslavia, Albania, Rumania, Bulgaria and Greece), Turkey, and the Middle East (Lebanon, Israel, Syria and Iraq) and North Africa (Egypt, Libya, Tunisia, Algeria and Morocco, all above 30 degrees latitude).

We distinguish these two partly overlapping divisions of our sample as we want to allow for a comparison between splitting the sample in two on the basis of on the one hand the geographical location of cities (Latin West vs. non-Latin West), which does not change over time, and on the basis of their main religious orientation, which may have changed during this millennium[18], on the other hand.

The results of the baseline model are shown in Table 3. Theoretically we expect producer cities to profit from having a port and being on a hub of roman roads: cities in the Latin West are like this (both coefficients are positive and significant). Cities in the Muslim world are the opposite though: the sea coefficient is negative (but not significant), implying that location at sea does not give cities a clear advantage over their landlocked counterparts; indeed, the really big Muslim cities such as Baghdad, Damascus, Cairo and Cordoba are inland (Istanbul is the exception here, but it became a Muslim city only in 1453). Being on a hub of caravan roads has a strong positive effect; but being on a hub of Roman roads, or at a river, does not seem to have an effect on Muslim cities – in contrast to cities in the Latin West. These differences are related to a number of underlying factors: there appears to be more continuity between the Roman past and the urban system in Western Europe: this is clear from the effect a hub (of roman roads) has on city size, it is also clear from the positive effect of (arch)bishoprics on city size.[19] The governance structure of the Catholic Church was rather immobile, and (arch)bishops were almost always seated in towns that had been important urban centers in Roman times. These coefficients therefore tend to confirm the Verhulst-hypothesis that there was a large degree of continuity in the structure of the urban system between the Roman Empire and the Middle Ages (Verhulst 1999).

This appears to have been less the case in the Arab world, where the effect of Roman roads and of archbishops was much smaller (and insignificant), and we see a strong influence of caravan hubs. Caravan roads are however not exogenous as location factors (as in a way Roman roads were), but at least to some extent endogenous: one would expect caravan trails, which may have come into existence after the Islamic conquest, to link the big cities that grew up at the same time. Housing a university spurs city growth in Western Europe, but not so in the three cities in the Arab World that we classified as having a university (Baghdad, Fez and Cairo)[20].

Being a capital city has a huge impact on cities in all regions, and it is striking that this impact seems to be almost exactly the same in the Middle East and the Latin West; a coefficient of .80 points to an increase of the size of the city by about 130% as a result of being the capital of a large state.[21] Furthermore, Muslim cities appear to be

[18] Especially in the Iberian Peninsula, Italy (Sicily), in the Balkans and Turkey (former Byzantine Empire) and during the crusades the religious affiliation in a number of cities shifted between Muslim and Christian or vice versa (the main source was Jédin *et al* 1980).

[19] Glick 1979: 23 gives examples of policies by medieval Spanish states and cities to maintain the system of Roman roads. The significant positive bishop effect found for the muslim / non latin west samples is totally due to a large number of bishoprics in Byzantine Anatolia, if country fixed effects or city fixed effects (see Table 4) are included this is immediately gone.

[20] We do not want to stress this result too much though, as we think that especially our university variable may be plagued by endogeneity issues (i.e. it were oftentimes the larger cities where universities were founded).

[21] We understand that there may be endogeneity problems here, because cities may have been selected as capitals because they were big; however in many cases – Baghdad is perhaps the most striking one, but one can also think of Madrid – they were set by a powerful state outside the existing urban system, and became large because they were capital cities; other examples of relatively small cities that owed their rise to the capital city effect are Vienna, Berlin, Turin and Brussels.

on average larger than non-Muslim cities, a factor that is probably linked to the less balanced structure of the urban system that was already noticed before (big cities form a much higher share of the total urban population). This does not seem to apply to protestant cities.

The most remarkable finding concerns the interaction between cities: Muslim cities have a strong positive impact on other Muslim cities and the interaction between Christian cities is also positive and significant, but interaction across religious borders is consistently non-significant or significantly negative (see Table 5 and 6 in the next section). In the neighbourhood of (big) Muslim cities, Christian cities appear to be smaller than they would be under other circumstances, and the same, negative interaction effect applies to Muslim cities close to Christian cities. Moreover, this effect is robust to using different specifications of the FUP-variables (see the online results Appendix) or to including proxy variables such as the distance to the nearest Muslim or Christian city.[22] Our interpretation of this is that trade across the borders of religions seems to be a problem – it is constrained by high transaction costs – and that Muslim and Christian cities seem to be crowding out each other, perhaps because these border regions are war zones in which cities do not flourish well. The Balkan with its low urbanization ratio – in between two regions with a much higher level of urbanization – is a clear example. The low or even negative interaction between the two urban systems may be explained in a number of ways. Bernard Lewis (1982) has drawn attention to the lack of interest of the Muslim World for what was going on in Western Europe in this period (exemplified by the fact that virtually all famous Arab travellers, such as Ibn Battuta travelled from Al-Andalus to Morocco to East Africa to India, but hardly any accounts are known of them visiting the Latin West).[23] In this the two cultures really differed from each other, because Europe did develop a keen interest in the Muslim World (adopting several Arab technologies, such as the use of paper, the Arabic numerals and later the habit of drinking coffee). But they also had some institutions in common: slaves could not be recruited from their 'own' population: Christians could not enslave Christians and neither were Muslims allowed to enslave their brethrens in faith. As a result, the demand for slaves had to be satisfied by raiding others, which had negative consequences for people living near the borders of the two religious systems (these slave raids could however extend deep into each other's territory – the south coast of England fell a few times victim to them, and the Saracens even reached as far as Iceland on one occasion).[24]

The positive feedbacks between Christian cities and between Muslim cities combined with the absence of significant interaction across the borders of the two religions are strong evidence that Muslim and Christian cities formed two separate urban systems, which did not really interact with each other (and this interaction, when it occurred, was probably even negative), but which did indeed interact quite strongly with cities of the same religious denomination. It demonstrates that the

[22] When, for example, transport costs per km on all routes (sea, land and river) are taken as identical, (i.e. $w_{ij} = 1$ in (2)), the same patterns emerges; also when we assume that the relationship between transport costs and distance is not to linear but that transport costs vary with the root of distance, we get again very similar results.

[23] A number of authors also suggest that Arab merchants generally lacked the knowledge to trade with the West (Ashton 1976: 105; Inalcik 1994: 188); but it is also suggested that these information problems were to some extent solved by intermediaries such as Jews and Christian minorities living in the Arab world.

[24] Davis 2003; the Ottomans for example recruited a large part of their slaves from the Balkans (see Erdem 1996).

literature suggesting the importance of culture – even religion - for the kind of institutions that were used for regulating international trade is probably correct.

An important objection to our baseline results is that we, by employing a random effects panel data estimator, only allow for a city-specific random effect that is uncorrelated with the variables of interest. It can be argued that by doing this we are not adequately controlling for unobserved time-invariant city-specific variables that are *correlated* with some of the variables of interest (an example would be being located in the mountains or being surrounded by a fertile agricultural hinterland). If this were the case, our estimates could be misleading. A complication with allowing for such city-specific fixed effects is however that it would leave us unable to say something about the relevance of our variables of interest that are not changing over time (basically all the geographical variables) for cities' development. To be complete, Table 4 below shows the results of allowing for such city-specific fixed effects. Except for our results regarding the two bishop variables (that become insignificant[25]), the main results are qualitatively robust to the inclusion of city-specific fixed effects[26].

Table 4. Fixed effect estimation results

	all cities	muslim	christian	latin west	non latin west
Geography	-	-	-	-	-
Bishop	-0.166*	0.104	-0.109	-0.078	-0.009
	[0.057]	[0.479]	[0.364]	[0.480]	[0.940]
Archbishop	0.149	0.113	0.275	0.329**	-0.086
	[0.287]	[0.713]	[0.105]	[0.028]	[0.773]
Capitol	0.581***	0.611***	0.470***	0.540***	0.574***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
University	0.169*	-0.224	0.172**	0.184**	-0.284
	[0.052]	[0.586]	[0.036]	[0.024]	[0.305]
Muslim	0.081	-	-	0.472***	-0.116
	[0.332]	-	-	[0.000]	[0.292]
ln_mus_fup	0.165***	0.389***	0.027	0.03	0.361***
	[0.004]	[0.003]	[0.649]	[0.595]	[0.001]
ln_chr_fup	0.240***	0.057	0.332***	0.327***	0.016
	[0.000]	[0.492]	[0.000]	[0.000]	[0.845]
Prot	0.075	-	0.063	0.062	-
	[0.523]	-	[0.588]	[0.594]	-
Observations	2376	481	1895	1831	545

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not significantly change the results whereas the dummies themselves are insignificant.

[25] We think that looking at the within-city-variation only (as when controlling for city-specific fixed effects) leaves us too little variance (a city for example never loses its (arch)bishop status) to identify the effect of these two variables on city size.

[26] They are also robust to the inclusion of country-dummies, with countries defined by their 1990 boundaries (as is similarly done in AJR 2005 and De Long and Shleifer, 1993). We do not present these here as we find the use of 1990 countries somewhat problematic. Results are available upon request.

Another objection may be that we are using an unbalanced panel of cities larger than 10,000 inhabitants. This selection criterion may result in biased estimates if cities are endogenously selected into our sample, which is maybe not unlikely. However running the same regressions on an unbalanced panel of all cities larger than 5,000 inhabitants gives very similar results as those presented in Table 3 (see the online results Appendix). Another way to (partly) address this problem, see AJR (2005 and 2002b), would be to look at a balanced sample, i.e. to only look at cities that are always larger than 10,000 inhabitants over the whole sample period. In our case this would amount to considering a sample of only 33 of our 729 cities (20 in the Latin West and 13 in the Arab World). This and as using only this very specific sample would in our view provide results that are hard to generalize (indeed the selection bias may be just as large, or even larger, than when using the unbalanced sample, given the even stricter inclusion criterion), made us decide to focus on our unbalanced sample (results for the balanced sample are available upon request) instead[27].

Overall, our baseline results provide clear evidence on the important factors that are behind urban development in both Europe and the Arab world. Given the size of our dataset, the next section(s) try to establish whether the found effects of some of the variables, and that on FUP in particular, may have been of changing importance over the centuries (see also AJR 2005 who focus on the change in the coefficient of location at the Atlantic over their sample period).

Century specific impact of FUP, transport and being a capital cities

Focus on FUP only

The positive feedback between cities in the same urban sytem (Arab World or Latin West respectively), and the non-significant or even negative feedback between cities in a different urban system is in our view one of the most remarkable findings of the previous section. To see if this pattern existed during our whole sample period, or that it was only present in certain periods, we allowed the different FUP variables to have a century specific and thus possibly changing effect over time.

The results, shown in Table 5 suggest a number of important changes in the efficiency of the institutional structures regulating exchange of the urban system of both Western Europe and the Arab World. Because changes in other coefficients are quite small with respect to those presented in Table 3, we concentrate on changes in the FUP coefficient here[28].

The century specific FUP coefficients in Table 5 show remarkable changes over the centuries. During the Middle Ages the interaction effects between Muslim cities are very strong, pointing to high levels of positive feedback between cities in the Arab World. By contrast, Western European cities do not form an integrated urban

[27] AJR (2005) focus on a balanced sample of cities only. As they start in 1300 this gives them a somewhat larger balanced sample than the 33 cities that we would be able to include; also they note (in footnote 17 on p.558) that they found that the composition bias did "in practice…not seem to be important".

[28] To save space we only show the results for each of the four subsamples, the results obtained using the whole sample show a very similar picture (Christian FUP being significantly positive from about 1200 onwards and Muslim FUP being significantly positive only at the beginning of the sample period). See the online results Appendix for the full results.

system before 1100. The high level of the FUP-coefficient for the Muslim world in the Middle Ages is perhaps one of the most striking results[29]: it demonstrates that the institutions regulating exchange there were much more efficient than those of the Latin West. But the trends in the two series are also quite

Table 5. Century specific FUP

sample	muslim		christian		latin west		non latin west	
geography	similar to baseline							
institutions / religion	similar to baseline							
year	ln_chr_fup	ln_mus_fup	ln_chr_fup	ln_mus_fup	ln_chr_fup	ln_mus_fup	ln_chr_fup	ln_mus_fup
800	-0.045	0.765***	0.038	0.025	0.183	-0.064	-0.234	0.571***
900	-0.277	0.605***	0.065	-0.062	0.09	-0.203	-0.166	0.363**
1000	-0.13	0.579***	-0.03	0.108	0.024	0.027	-0.124	0.360**
1100	-0.288	0.617***	0.178***	-0.235**	0.187**	-0.148	-0.143	0.222
1200	0.127	0.378*	0.167***	-0.314***	0.181***	-0.232**	-0.071	0.224
1300	0.079	0.438*	0.133***	-0.185**	0.155***	-0.123	0.012	0.103
1400	0.078	0.356	0.118**	-0.159	0.139**	-0.078	-0.08	0.131
1500	0.258*	0.047	0.135***	-0.197**	0.168***	-0.203**	0.059	0.014
1600	0.246*	0.133	0.125***	-0.084	0.160***	-0.117	0.139	0.057
1700	0.238	0.121	0.113**	-0.026	0.131***	-0.009	0.063	0.13
1800	0.134	0.175	0.114***	-0.036	0.127***	-0.011	-0.035	0.184
nr. obs.	481		1895		1831		545	

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not change the results significantly whereas the dummies themselves are insignificant. Results obtained using a panel data estimator allowing for random city-specific effects.

significant: there is an almost constant decline in the FUP-coefficient in the Arab World, pointing to a gradual loss of feedbacks between these cities, resulting in the effect becoming insignificant after 1300. What was before 1300 a well functioning urban system, seems to be disintegrating rapidly. The immediate cause may have been the conquests by the Mongols in the 13th century; they conquered large parts of the Muslim world in a short period (1206-1258), destroyed Baghdad, but also created a free zone for trade between Europe and Asia (China, India) which side tracked the Arab world (Abu Lughod 1989; Findlay and O' Rourke, 2008). The rise of the Ottoman Empire, with Istanbul as the primate city after 1453, did not result in the return of strong positive feedbacks within the system. One therefore finds the gradual disintegration and loss of dynamism of the urban system of the Arab World reflected in decline of the FUP-coefficient, a trend that clearly precedes the 16th century discoveries.

[29] The size of the Christian FUP coefficient is (if significant) usually lower than the size of the Muslim-Muslim interaction coefficient (if significant). This does not immediately show that the effect of a 1% population increase in a Muslim city will always have a larger effect on another Muslim city, compared to the effect of a 1% population increase in a Christian city on another Christian city. Instead, the interpretation of the coefficient on a FUP variable is somewhat more nuanced: as explained in detail in Appendix A, it is also affected by the density of the urban system (which was much higher in the Latin West), and by the appearance of new cities (which occurred more often in Western Europe than in the Arab world). Here we focus exclusively on (the time trends in) the significance and sign of the coefficient.

By these standards, the urban system of Western Europe comes into being in the 11th century, and shows in terms of the efficiency of its interaction, remarkable stability in the 1100-1800 period (the FUP-coefficient remains basically unchanged). At the same time, during the 11th century, the negative interaction between Muslim and Christian cities becomes quite strong and significant (and continues to be so until 1500). This all suggests that the typical Western-European (or perhaps even Christian) institutions that governed exchange, made possible the rapid urban expansion of Western Europe in the centuries after 1000, and seem to have functioned as a barrier to trade with the Arab World, came into being during the period between 900 and 1200 (and most clearly the 11th century), consistent with the interpretations by Greif (2006) and Van Zanden (2007).

How plausible are these results? That the Arab World had an efficient system of exchange is well known, although it has so far not been possible to estimate its efficiency in one way or another. Until 750 the whole region – from Cordoba in Spain to Baghdad in Iraq (and beyond) – was united in one state, which guaranteed peace and order and imposed similar institutions for exchange. The ruling class spoke one language, and there existed hardly any barriers to trade in this vast empire. By contrast, Europe after the disintegration of the Carolingian Empire went through a process of political fragmentation, resulting in a complex patchwork of (small) political entities, which were developing their own institutions (independent cities, counties, regions), and it knew many different languages and systems of common law. But out of this rather chaotic situation new institutions emerged that were increasingly able to regulate exchange in an efficient way (Greif 2006; Van Zanden 2007). At the same time, in the Arab World, the Umayyad Dynasty was succeeded by the Abbasid Caliphate (750-1258), which did not include Spain and West-Africa, and gradually began to lose its control over other parts of the Arab World as well, leading to a process of political fragmentation that must have harmed trade (as is evident from the decline of the FUP-coefficient). It is significant that the cities and the urban system of Western Europe emerged in a situation of weak states and political fragmentation, and found ways to overcome these problems. No such 'bottom up' process of institution building followed the disintegration of the Abbasid Caliphate in the 13th and 14th centuries – instead a new empire, the Ottoman, emerged which to some extend took over the role of its predecessor, without, however, recreating a similar urban system.

Changes in locational and institutional factors in time

To check whether the pattern in the two FUP-variants is robust to allowing other variables to have a century specific effect, we now also allow the coefficients of specific transport cost variables (the sea in case of the Latin West, following AJR (2005) and location on a caravan route or a Roman road in case of the Arab World) and being a capitol city to vary over the centuries. Tables 6 and 7 show the results for each of the four sub-samples (again focussing only on the time-varying variables to save space – see the online Appendix for the full results).

We look at the Muslim and non Latin west samples first (Tables 6a and 6b), concentrating on those factors which were significant in the baseline model. The radical change in the transport infrastructure in the Arab World is evident from Table 5; whereas in the Latin West we found evidence of positive effects of roman roads and hubs, in the Arab world cities outside this network, and linked via caravan routes instead, are larger than the other cities, pointing to a clear discontinuity in the urban

system: camels have taken over the role of horse-drawn carts.[30] It is reassuring that adding the time-dimension to the locational factors, does not change the development of the FUP coefficient.

Table 6: FUP and transport + capitol over time: Muslim and non Latin West cities

a. MUSLIM					
year	rom_road	caravan_hub	capitol	ln_mus_fup	ln_chr_fup
800	-0.814***	0.351	1.049***	0.743***	-0.067
900	-0.564***	0.437*	1.149***	0.444***	-0.315
1000	-0.442***	0.237	1.080***	0.456***	-0.211
1100	-0.289	0.294	0.557***	0.461***	-0.351
1200	-0.337*	0.339*	0.727***	0.213	0.072
1300	-0.261	0.426**	0.825***	0.311	-0.07
1400	-0.179	0.382*	0.604***	0.082	0.031
1500	0.038	0.454**	0.807***	-0.177	0.056
1600	0.317	0.31	0.781*	-0.105	0.074
1700	0.396	0.433*	0.807**	-0.145	0.06
1800	0.074	0.418*	0.843**	0.064	-0.021
other variables			see baseline		
Observations			481		

b. NON LATIN WEST					
year	rom_road	caravan_hub	capitol	ln_mus_fup	ln_chr_fup
800	-0.931***	0.458**	1.430***	0.618***	-0.054
900	-0.565***	0.514**	1.386***	0.267*	-0.1
1000	-0.295*	0.361**	0.907***	0.309**	-0.198
1100	-0.434*	0.508***	0.536**	0.164	-0.122
1200	-0.333*	0.451***	0.498***	0.179	-0.103
1300	-0.149	0.544***	0.560***	0.021	-0.085
1400	-0.077	0.439**	0.713***	-0.036	-0.123
1500	0.075	0.379*	0.989***	-0.089	-0.101
1600	0.313	0.263	1.152***	-0.074	-0.005
1700	0.438**	0.433*	1.235***	-0.036	-0.108
1800	0.133	0.430**	1.111***	0.132	-0.155
other variables			see baseline		
Observations			545		

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not significantly change the results whereas the dummies themselves are insignificant.

The other effect that dominates here is the capital dummy: its size is quite large during the flowering of the Umayyad and Abbasid Caliphates (661-1258),

[30] Hourani 2002: 44: 'In the greater part of the Near East wheeled transport disappeared after the rise of the Muslim Empire, not to come back until the nineteenth century, and various reasons have been suggested for this: Roman roads decayed, the new Arab ruling groups had an interest in the rearing of camels, and transport on camel-back was more economical than by cart'; according to Glick 1979: 24 the disappearance of wheeled transport antedated the Arabic expansion by several centuries, but he also stresses the link with the military use of the camel.

declines with the gradual fragmentation of the latter state in the 12th/13th century, and returned to previous high level with the rise of Istanbul as the new urban center of the Arab World after 1453. But as noticed before, the capital city effect is not significantly larger in the Muslim world than in Western Europe, which is a bit surprising given the differences in urban structures evident from the share of the primate city in the total urban population[31].

Table 7: FUP, seas and capitol over time: Christian and Latin West cities

a. CHRISTIAN

year	atlantic	mediterrenean	baltic / northsea	capitol	ln_mus_fup	ln_chr_fup
800	-	0.74	-	1.574***	-0.428	-0.108
900	-0.447	0.902**	-	0.617*	-0.184	-0.055
1000	-0.17	0.409	-	0.400*	0.184	-0.107
1100	0.056	0.286	-	0.482**	-0.114	0.088
1200	0.03	0.248	-	0.423***	-0.183	0.106*
1300	0.007	0.052	0.209	0.702***	-0.045	0.089*
1400	0.399	0.151	0.225*	0.564***	-0.034	0.063
1500	0.272*	0.403*	-0.035	0.635***	-0.197	0.097*
1600	0.252*	0.042	0.325	1.050***	-0.002	0.059
1700	0.414***	0.352*	0.145	1.367***	-0.128	0.094**
1800	0.436***	0.327**	-0.073	1.566***	-0.099	0.088**
other variables			see baseline			
Observations			1895			

b. LATIN WEST

year	atlantic	mediterrenean	baltic / northsea	capitol	ln_mus_fup	ln_chr_fup
800	-0.283	-0.132	-	1.032***	0.263	0.255
900	-0.479*	-0.331	-	0.332	0.156	0.174
1000	-0.188	-0.068	-	0.331*	0.218	0.059
1100	-0.123	-0.162	-	0.471***	0.107	0.193**
1200	-0.068	-0.021	-	0.527***	-0.028	0.192***
1300	-0.135	-0.237	0.082	0.815***	0.119	0.170***
1400	0.299	0.042	0.158	0.590***	0.089	0.151**
1500	0.373**	0.600**	0.092	0.631***	-0.388**	0.220***
1600	0.300**	0.158	0.443	1.051***	-0.162	0.182***
1700	0.386**	0.36	0.157	1.325***	-0.164	0.177***
1800	0.372***	0.266*	-0.121	1.593***	-0.092	0.147***
other variables			see baseline			
Observations			1831			

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not significantly change the results whereas the dummies themselves are insignificant.

Table 7a and 7b present the century-specific estimates for the Christian and Latin West samples, allowing for the effect of being a located at different seas and being a capitol city to change over our sample period. Being located at the Atlantic

[31] The chronology of the capital city effect is however quite different (see the discussion after Table 7).

was not an asset before 1500; in fact, during the 9th and 10th century the Atlantic effect is negative, exactly in the years that the Vikings were a constant threat to cities in North West Europe, and some bishoprics (such as Utrecht) were even relocated inland in order to cope with this (Weiler 2003). This changes from 1500 onwards, exactly in the period of the Great Discoveries when trade over the Atlantic is booming (confirming hereby the results of AJR 2005); for the 1600-1800 period we find the same strong positive correlation between being an Atlantic seaport and urban growth identified by AJR (2005). The Hansa-sea dummy (covering the cities of the Hansa-league near the Baltic and the North Sea) tells another story: here trade boomed during the period of the Hansa (1300-1500), but after 1500 this trade was increasingly dominated by Dutch merchants and ships (and its size became less significant in terms of the overall expansion of international trade), leading to a decline of the coefficient. Being on the shores of the Mediterranean had a strong positive effect on Christian cities, which is however only significant in 900 and during the Early Modern Period (1500-1800).[32] This is very much in contrast to the Arab World where the 'sea' variable is almost always non-significant (and negative); in Western Europe from about 1500 onwards being close to the sea is a big bonus (when the three sea-variables are lumped together, the sea variable for the cities in the Latin West is positive, and significant, from 1500 onwards). This different relationship with the sea is a fundamental difference between the two urban systems and stresses the importance of the differential impact of the Great Discoveries in explaining their different development paths after 1500.

Another important result is the development in the coefficient of the capital city, which is quite different from that in the Arab World: it is quite high in 800 (mainly caused by the size of Byzantium and Cordoba), collapses between 800 and 1000 (when Western Europe underwent a process of political fragmentation), and afterwards slowly increases to a level which was similar to that observed in the Arab World during the heydays of the Ummayad and Abbasid Caliphates and again during that of the Ottoman Empire. This clearly reflects the process of state formation that began in Europe around 1000 and resulted in the formation of new and strong territorial states (France, Germany, Spain and Britain) afterwards (Tilly 1990).

Focus on institutions: city specific institutions, country specific institutions and capitol city shadow

So far we have mainly focused on the development and efficiency of the *economic* institutions regulating exchange. In this section we will switch to the effect of the quality of the *political* institutions on urban development. Previous work by AJR (2005), De Long and Shleifer (1993) and also more recently Bosker et al. (2008) have analysed in more detail the importance of the political institutions for the development of cities and/or the rate of urbanisation. All three papers point to an important positive effect of the quality of political institutions on urban development, indicating that the more "free" a city is, i.e. the greater the degree of local authority and the fewer the constraints on economic activity imposed by the national ruler, the better the incentives and opportunities for economic and urban expansion.

[32] Remarkably, it was not significant in 1300 and 1400, at the height of the flowering of the Italian economy, perhaps as a result of the impact of large 'industrial' cities such as Florence and Milan.

City specific institutions

The above-three papers rely largely on country- or region-specific variables measuring the quality if political institutions. We try to go beyond these nationwide measures and have constructed a variable, we call "commune", that gives information on the local, city-specific political organization, in particular during the period 800-1500 when these institutions for local governance emerged. To be more specific, we have classified each of the cities in our sample in the period up to 1500 on the basis of whether or not it had a local commune, a number of consuls or a city council exercising local authority *(Rat, raad, vroedschap, conseil, consejo, conselho, commune)*. The first occurrences of such local city authority shows up in our benchmark year 1100 in cities in Italy and France, spreading to more cities and over the rest of Western Europe in the following centuries (in 1500 about 36% of the cities in the Latin West have some form of local authority).

To see whether having local authority is beneficial to a city's development, we added our commune-variable to our baseline regression. Table 8 below shows the results, we only show the christian and latin west sub-sample as none of the muslim or non latin west cities have a form of local authority during our sample period:

Table 8. Focus on city-specific institutions, 800-1500:

	all cities	christian	latin west		continued	all cities	christian	latin west
sea	-0.088	0.024	-0.061		capitol	0.651***	0.583***	0.598***
	[0.467]	[0.869]	[0.622]			[0.000]	[0.000]	[0.000]
river	-0.042	-0.091	-0.065		university	0.254***	0.232***	0.172**
	[0.499]	[0.159]	[0.292]			[0.001]	[0.008]	[0.041]
hub_3rr	0.091	0.135**	0.150**		muslim	0.181**	-	0.549***
	[0.154]	[0.032]	[0.033]			[0.020]	-	[0.000]
rom_road	-0.093	0.041	0.025		ln_mus_fup	0.181***	-0.004	0.016
	[0.168]	[0.480]	[0.696]			[0.009]	[0.956]	[0.813]
caravan	-0.077	-0.018	-		ln_chr_fup	0.048	0.130***	0.173***
	[0.528]	[0.923]	-			[0.268]	[0.004]	[0.000]
caravanhub	0.565***	0.299	-		prot	-	-	-
	[0.001]	[0.126]	-			-	-	-
bishop	0.082	0.037	0.05		**commune**	**0.172*** **	**0.103** **	**0.102** **
	[0.164]	[0.474]	[0.382]			**[0.001]**	**[0.027]**	**[0.046]**
archbishop	0.199***	0.253***	0.287***					
	[0.003]	[0.001]	[0.000]		Observations	1130	826	780

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not significantly change the results whereas the dummies themselves are insignificant. Results obtained using panel data estimator allowing for random city-specific effects. Results are also robust to the inclusion of city-specific or country-specific fixed effects.

Table 8 clearly shows that having local political authority positively affects a city's urban expansion, confirming the earlier evidence provided on the basis of (sometimes artificial) country-specific measures of the quality of political institutions.[33] Note also

[33] One may be worried about reverse causality here, however it does not seem to be the case that the larger cities are those that get local authority. Conditional on not having a form of local authority, cities in our sample that do get local authority have on average 22375 inhabitant versus 31073 inhabitants of

that including this measure of political institutional quality does not undo the positive effect of economic institutional quality (as captured by the FUP variables), indicating that both institutions regulating exchange as well as a city's political organisation are important determinants of a city's prosperity.

Country specific institutions

In contrast to focusing on the city-specific institutional variable as we have done in the previous section, two influential papers in the literature (DeLong and Shleifer (1993) and AJR (2005)) suggest that city growth is to a large degree caused by the institutional environment of the ***countries*** cities are part of. On the basis of various indicators that they have constructed for the quality of these institutions, these two papers show o.a. that the better a country's institutions, the higher the urbanization rate and the number of cities in such **a country.** In this section, and complementary to the evidence in the previous subsection[34], we study whether these country specific institutional variables help to understand the dynamics of the urban systems in Western Europe and the Arab world. In order to do that, we extended the DeLong and Shleifer classification to also cover Western Europe between 800 and 1300 (their classification begins in 1300). Between 1100 and 1500 Western European countries were almost always classified as 'free' feudal states (that is, states with more or less autonomous cities and with institutions for consultation and negotiations such as estates or parliaments); the literature suggests that these feudal socio-political structure emerged in the $10^{th}/12^{th}$ centuries (we choose the year 1100 as the break point (a review in Van Zanden 2007)).

Table 9. Focus on country-specific institutional variables:

	all cities	latin west	christian
Geography		see baseline + text	
religion / institutions		see baseline	
FUP		see baseline	
free_prince_dls_pre1500	0.137***	0.118***	0.122***
	[0.001]	[0.003]	[0.003]
free_prince_dls_post1500	0.082*	0.073*	0.069*
	[0.056]	[0.079]	[0.100]
Observations	2376	1831	1895

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not significantly change the results whereas the dummies themselves are insignificant. Results obtained using panel data estimator allowing for random city-specific effects and including country dummies.

Although there is some discussion on the emergence of feudal institutions in the Arab world as well, their character is so different – and they in particular lack the dimension of fragmented sovereignty that is characteristic for the Latin West in the

cities that do not get local authority. When restricting the sample to latin west or christian cities only, this becomes 22447 vs. 22076 and 22375 vs. 23138 respectively.

[34] The correlation between the free/prince variable and our commune variable is 0.5 in the period before 1500.

Middle Ages - that we assume that the Arab world was continually 'unfree' in the meaning of DeLong and Shleifer (1993) (see the discussions in Ashtor 1976 and Inalcik 1994). After 1500 only two 'free' states remain: the Dutch Republic and (after 1688) England; the rest of Western Europe then consists of unfree 'monarchies' (see De Long and Shleifer 1993). Two sets of dummies were entered in the baseline model representing 1/ before 1500 'feudal' socio-political institutions, and 2/ after 1500: the two Republics.[35]

Table 9 shows that the 'free dummy' is clearly significant, in particular in the period before 1500. Since the free/prince variable is defined at the country level, the results in Table 9 are obtained including also country specific fixed effects (they also hold up to the inclusion of city specific fixed effects). Not shown is that including this free/prince variable has a strong effect on the 'sea' variable, which becomes insignificant. Apparently there is a strong correlation between 'free' and 'sea' as determining factors of urban growth – in particular after 1500 (when only the Netherlands and after 1688 England are free). However, when subdividing the sea-variable into location on the Atlantic, Mediterranean or Baltic-North Sea coast, being located on the Atlantic still has a significant positive impact on population size (results shown in the online results Appendix).[36]

Capitol city shadow

It has been argued in the literature that cities near the seat of power, usually the capitol city, suffer from being located close to such a city as the capital city is oftentimes a consumer city 'par excellence'. To see whether or not we can find statistical evidence of such a 'capital city shadow' in case of our sample(s), we (as in Bosker et al., 2008) calculated each city's distance to the nearest capital city.

Figure 1: Capital city shadow – distance to the nearest capital city

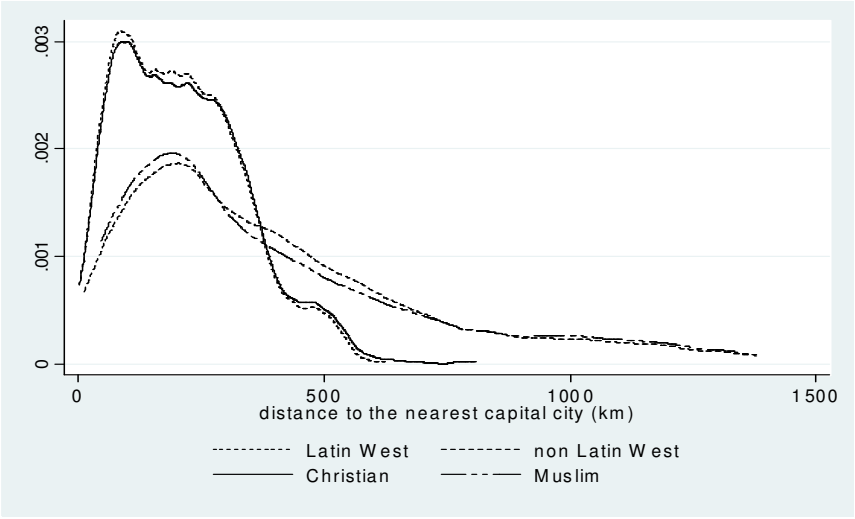

Figure 1 shows the distribution of this nearest distance to the capital city over cities in the four different subsamples that we considered in the previous sections. It shows

[35] It was assumed that states outside Western Europe were never' free' but always governed by a 'prince'.

[36] The results of adding the proxies developed by AJR (2002; 2005) for the quality of institutions (either 'constraints of the executive' or 'protection of capital') to the model were disappointing; coefficients were generally insignificant, although most of the time they had the right sign; again they 'conflict' with the sea variable appears (results not shown here).

clearly that in the Latin West many more cities (larger than 10,000) exist at closer distance to the capitol city compared to cities in the Arab World[37]. Suggesting that not only were the primate cities in the Arab World much larger, they also did not tolerate the development of other urban centers in their close vicinity. Besides the evidence provided by Figure 1, we also included the (natural logarithm of the) distance to the nearest capitol city as an additional variable to our baseline specification. Table 10 below shows the results.

Table 10. Capital city shadow

	all cities	non latin west	latin west	christian	Muslim
geography	see baseline and text				
other religion / institutions	see baseline				
capitol	0.810***	0.767***	0.812***	0.808***	0.767***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
ln_dcap	0.036	0.054	0.048**	0.056**	-0.024
	[0.116]	[0.342]	[0.036]	[0.015]	[0.714]
ln_mus_fup	0.052	0.280***	-0.047	-0.05	0.327***
	[0.199]	[0.001]	[0.277]	[0.195]	[0.001]
ln_chr_fup	0.097***	-0.078	0.186***	0.174***	-0.034
	[0.000]	[0.178]	[0.000]	[0.000]	[0.529]
Observations	2376	545	1831	1895	481

Notes: p-values, based on autocorrelation and heteroskedastically robust standard errors, in brackets. *, **, *** denotes significance at the 10%, 5%, 1% respectively. Without exception, the inclusion of century dummies does not significantly change the results whereas the dummies themselves are insignificant.

The results show that only in case of the Latin West and Christian sample we find significant evidence of a capitol city shadow (the further away a city is located from the nearest capitol city, the larger its size). We did not find such an effect for the Muslim world. Combining the results in Table 10 and Figure 1, we interpret this as follows. In the Arab world the large capital cities did not tolerate the existence of other large cities (at least larger than 10,000 inhabitants) in their vicinity. In the Latin West, we find many more cities (with at least 10,000 inhabitants) in close vicinity to a capitol city, however these cities are generally smaller compared to those located further away from the capitol city.

In both urban systems we thus do find some evidence of a capitol city shadow, however in the Latin West the extent of this shadow takes on a somewhat milder form (not completely crowding out the development of cities in its vicinity, as seems to be the case in the Arab World, but instead keeping a close check on the cities that develop in its vicinity). Summing up this section, we found strong evidence that 'free' political institutions – either measured at the country level (following De Long and Shleifer) or at the city level (the presence of a commune) – had a positive impact on

[37] Note that, although cities in the Arab World are in general located at greater distance from eachother than in the Latin West, the distribution of the distance to the nearest capitol city differs markedly from the distribution of the distance to the nearest city of the same religious denomination (see the online results Appendix).

city growth in the Latin West. The absence of these institutions in the Arab World must have constrained urban development to some extend there. This supplements the evidence presented in previous sections about differences in the structures of the two systems, such as the much larger share of the primate city in total urban population in the Arab World (a measure of 'bad' institutions), and the much greater density of the system in the Latin West.

Conclusion

We have developed a powerful tool for the analysis of long term economic change in the pre modern era: we presented a new dataset about the growth of cities in Europe (except for Russia) and the Arab world between 800 and 1800, and we offered new ways of analyzing those data, in particular focusing on the geographic location of these cities, their political institutions, and on the interactions between them.

A first analysis of these data demonstrated that in terms of urbanization the Arab World was much ahead of Western Europe in the first half of the millennium studied here, but also that in the long run this level of urbanization was almost stagnant. Western Europe, on the other hand, from the $9^{th}/10^{th}$ century onwards embarked on a process of urbanization that lead to the overtaking of the Arab World in the Early Modern Period, and which ultimately resulted in the emergence of an industrial society in the late 18^{th} and 19^{th} century. The aim of the paper was to explain this 'reversal of fortune'.

We distinguished a number of hypotheses explaining the divergent developments of the two urban systems. Two hypotheses were related to the links between institutions and economic performance. The first one focuses on economic institutions that determine the efficiency of exchange, which we measured by quantifying the degree of interaction between cities in the two urban systems. Firstly, it could be established that we indeed find two separate urban systems in the area under study: the interaction between Muslim and Christian cities was generally not significant and if so mostly negative (the FUP-coefficient had a negative sign), whereas within the two systems, positive feedbacks occurred. It is strong evidence that culture does matter, that these two societies had or developed different institutions that facilitated exchange amongst cities within each urban system, but to some extend hindered exchange over the borders of the two urban systems. Moreover, it also explains why the Arab world could continue to stagnate, in spite of the enormous growth of the European economy and urban system – it simply did not get the positive stimuli from Europe. On the contrary, if these regressions tell the whole story, European growth may have had negative effects on development in the Arab world.

The hypothesis that the explanation of the divergent development of the two urban systems was caused by more efficient *economic institutions* in the West compared with the Arab World, had to be modified, however. Initially, coinciding with the 'Golden Age of Islam' (see Findlay and O'Rourke, 2008), the FUP-coefficient of the Arab World was very high, which points to quite efficient institutions regulating exchange. This was probably due to the fact that the Arab world was unified by one state, which guaranteed law and order and imposed similar institutions on economy and society (and with the same language spoken throughout its domain). From 800 onwards, the FUP-coefficient declined however, parallel to the gradual disintegration of the Abbasid state, and it became insignificant after 1300. In short, efficient exchange was *dependent* on the existence of a large territorial empire,

a situation which is quite normal in world history – Ching China, the Roman World, the Moghul Empire were 'similar' empires that brought law and order and abolished previously existing trade barriers, resulting in a boom in long-distance trade (Shuie and Keller 2007 and Findlay and O'Rourke, 2008). In Western Europe no integrated urban system existed in the 9th/10th century, but it emerged in the 11th century in a period of political fragmentation (after the collapse of the Carolingian Empire); it was largely based on 'bottom up' institution building (such as independent cities and merchant guilds), and created a set of institutions that was able to cope with the existence of many borders, institutional regimes and languages (Van Zanden 2007). Overall, these institutions were not necessarily more efficient than the set of institutions governing trade in 9th century Arab world (as the FUP-coefficients demonstrates), but they were more robust and much less dependent on the states it was part of (a.o. because these states delegated authority to cities and guilds to regulate their own affairs).

This already demonstrates that the institutions regulating exchange of the Arab world and of Western Europe were in a different way embedded in the states they were part of, pointing to the importance of the second hypothesis concerning the differences between the *political institutions* of the two urban systems. We have developed this idea by introducing the Weberian concepts of consumer and producer cities, and formulated the question: were Muslim cities typical consumer cities and Christian cities typical producer cities? Looking at the structure of the urban system, the differences are indeed quite big: the share of the primate city was much higher in the Arab World than in the Latin West; the urban density of the system was much lower in the east than in the west, and the 'free', communal institutions that were characteristic of the Latin West had a positive impact on urban growth. Moreover, the growth cycles of the Islamic urban system was closely linked to the rise and decline of big territorial entities – first flourishing under the Umayyad and Abbasid Caliphates (661-1258), followed by a desintegration of the Islamic state system in the 13th-14th centuries, again followed by a reconsolidation linked to the rise of the Ottoman Empire. Big cities such as Damascus, Baghdad, Cairo and Istanbul were the centers of big states, and when the big states collapsed, the level of urbanization went down. As argued already, in Western Europe this was much less the case; in particular in the period between 900 and 1300 the rise of cities ran parallel to a collapse of the Carolingian Empire and the desintegration of its successor states, suggesting that the new cities of the Latin West were not dependent on large territorial states (which is reflected in the decline of the capital coefficient). After 1300 state formation and urban growth went hand in hand again, however, and in particular after 1500 Western Europe saw the re-appearance of typical consumer cities such as Brussels, Madrid, Naples or Vienna (De Vries 1984), which is also reflected in the rise of the capital-city effect to levels that are also usual in the Arab World.

Both factors, economic and political institutions, and the relationships between them, therefore play a role in explaining the greater dynamism of the European urban system in the very long run. Another factor that we argue has played a substantial role was the importance of different in modes of transport. In a way, the Arab world was more innovative in that it replaced the system of Roman roads by caravan routes, and the cart drawn by oxen or horses by the camel packed with goods (a rational move as camel transport was a much more efficient means of transportation – there was no need for road maintenance and the camel outperforms the horse when it comes to stamina in desert type conditions). By focusing on caravan routes, Muslim cities to some extent turned their back to the seas. Initially this may have been related to the

fact that during the Conquest of the Middle East and North Africa Christian powers – in particular Byzantium – still dominated the Mediterranean, which made sea transport more risky than overland trade.[38] But between 900 and 1100, when the Arabs controlled the Eastern, Southern and Western shores of the Mediterranean, including Sicily, Sardinia, and the Baleares, and it was almost an inner lake of the Islam, this orientation did not change fundamentally. It were traders from Italy – Pisa, Genova, Venice - who filled the gap left by the Byzantines. Part of the explanation is that the Arabs were caravan traders by origin, their conquests were conducted on the backs of camels, so the choice for this mode of transport was logical, but in the Mediterranean they somehow lacked the flexible institutions and incentives to develop large-scale sea transport when the changes for doing this emerged.[39] This choice for camels and caravans as the key mode of transport had long-term consequences. Given its stagnant technology, prospects for productivity growth were meager; in fact, the productivity of camel transport may not have changed at all during the ten centuries under study (see Austen 1990).

The West, on the other hand, was increasingly oriented towards the sea. The potential for productivity growth in sea transport proved to be very large, and one of the explanations for the increased strength of the 'sea' variable through time is the fact that transport costs overseas declined much more than via other modes of transport.[40] One of the factors explaining dynamic growth of the urban system in the West and stagnation in the East is therefore this – perhaps to some extent fortuitous – choice of the key mode of transport and its long term growth possibilities – the Muslim world became locked in into the camel-overland trade, whereas the Latin West could profit from the productivity growth of seaborn trade.

These changes all began much before 1500. In fact, the Western European urban system was most 'progressive' (or producer-oriented) during the High Middle Ages, and the FUP-coefficient did not change anymore between 1100 and 1800.[41] The disintegration of the Arab urban system occurred during the same period (between 1100 and 1300), and was possibly related to the rise of the Mongol Empire in the 13th century that gave the Europeans a direct overland trade route to China and India (avoiding the extra costs incurred by using the Arab middlemen). After the desintegration of the Mongol Empire in the 14th century which effectively ended the use of the direct overland to China by the European (see Findlay and O'Rourke 2008), the search for a direct trade route to the Eastern spice markets via the seas began, which eventually resulted in the Great Discoveries of about 1500 that greatly speeded up the divergent trends of the two systems, but these developments occurred when the real changes in institutions and urban systems had already happened. We also did find a strong 'Atlantic economy' effect in the 1500-1800 period: it is clear that cities bordering the Atlantic profited a lot of the economic consequences of Columbus, Da Gama and others.

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[38] Ashtor 1976.

[39] However, in the Indian Ocean Muslim traders and shippers did develop a strong control over sea routes, suggesting that it may have been competition with the more efficient European merchants who blocked them in the Mediterranean (Chaudhuri 1985).

[40] This may have been scale-dependent: whereas sea transport was subject to strong economies of scale, land transport (by cart and by camel) probably was much less so.

[41] We also found that the country-specific institutional variables linked to the political economy of the emerging states before 1500 pointed at a strong effect of 'feudalism' (a situation of fragmented authority, characterized by independent states, parliaments etc.) on city growth, whereas after 1500 this effect was less strong.

Summing up, the Arab world was in a way quite innovative (it adopted a new mode of transport replacing the Roman infrastructure), exchange between Muslim cities initially was highly efficient, but at the same time these 'consumer' cities remained dependent on the basic institutions of the states which were (because of their basically predatory nature) unable to generate long-term economic growth. The urban system that arose in Western Europe between 900 and 1300 was by contrast geared towards generating its own resources via market exchange; it was highly competitive, independent of large territorial states (which were quite weak between 900 and 1300, anyway) and became oriented towards long-distance trade via the sea. It was this 'new' urban system that generated the long-term economic development that was characteristic of Western Europe in the millennium after 900 and which finally, spurred on by the effect of the Great Discoveries, caused it to overtake the Arab World in terms of economic prosperity.

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Table 1 **Total population in cities with more than 10,000 inhabitants (x1000)**

Total urban population	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
Scandinavia	-	-	-	-	-	-	-	10	40	115	238
Great Britain	-	10	62	72	84	133	77	88	293	764	2430
Ireland	-	-	15	-	-	24	15	-	5	96	462
Low Countries	-	-	24	34	150	252	327	421	637	1023	1034
France	152	147	249	340	610	973	696	933	1291	1903	2610
Germany	105	126	198	208	285	418	360	425	619	621	1373
Austria / Switzerland	-	-	-	-	12	20	30	42	77	182	394
Italy	150	212	413	493	766	1352	900	1281	2094	2037	3281
Iberia	240	361	602	540	567	770	635	780	1295	1060	2055
Poland	-	-	-	-	10	22	60	131	232	188	276
Czech Republic	-	-	10	10	10	50	95	94	100	92	122
Hungary / Slovakia	-	-	-	-	-	-	-	37	39	57	308
Yugoslavia / Albania	-	30	55	20	25	73	77	100	225	170	279
Bulgaria / Rumenia	30	60	70	65	95	150	103	168	164	223	444
Greece	20	60	55	53	50	75	77	29	83	53	82
Turkey	340	475	603	540	392	396	412	635	1249	1149	1140
Lebanon / Israel	30	60	73	79	59	70	35	30	20	20	46
Syria	120	110	110	115	130	130	110	144	170	190	180
Iraq	650	690	430	340	290	190	150	105	90	100	179
Egypt	195	330	358	405	395	373	370	230	270	340	263
North Africa	90	120	165	295	320	325	360	340	330	375	339
Latin – West	647	856	1573	1697	2494	4014	3195	4242	6722	8138	14583
Balkan	50	150	180	138	170	298	257	297	472	446	805
ME – NA	1425	1785	1739	1774	1586	1484	1437	1484	2129	2174	2147
Total											

Table 2 Urbanisation ratio (total population in cities >=10000 inhabitants / total population)

Urbanisation	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
Scandinavia	-	-	-	-	-	-	-	0.53	1.67	3.59	4.58
Great Britain	-	0.82	3.65	3.43	2.90	3.17	2.66	2.10	5.86	11.32	23.14
Ireland	-	-	5.00	-	-	3.00	2.50	-	0.40	3.84	8.80
Low Countries	-	-	3.43	3.40	10.00	12.29	23.36	19.58	21.23	27.28	19.70
France	3.04	2.56	3.83	4.39	5.81	6.08	6.33	6.22	6.98	8.65	9.00
Germany	3.23	3.73	5.66	5.20	4.75	4.64	5.54	4.72	5.16	4.78	7.63
Austria / Switzerland	-	-	-	-	0.69	0.71	1.62	1.50	2.20	4.85	8.29
Italy	3.75	4.71	8.26	8.57	10.57	13.52	12.86	12.81	17.45	15.67	17.27
Iberia	5.78	8.24	13.09	10.38	8.86	8.80	9.92	10.06	12.33	10.60	14.42
Poland	-	-	-	-	0.44	0.63	2.18	3.28	4.64	3.13	3.07
Czech Republic	-	-	0.80	0.67	0.50	1.67	3.80	3.13	2.22	2.04	1.81
Hungary / Slovakia	-	-	-	-	-	-	-	0.87	0.68	0.95	3.08
Yugoslavia / Albania	-	1.76	2.82	0.91	1.07	2.98	3.95	4.08	7.63	5.57	5.42
Bulgaria / Rumenia	2.31	4.14	4.38	3.69	4.92	6.00	5.28	6.00	5.05	5.95	5.92
Greece	2.50	6.67	5.50	4.82	4.17	6.00	8.56	2.90	5.53	3.53	3.64
Turkey	5.40	6.99	8.26	10.19	6.22	5.42	7.10	10.08	15.81	13.52	11.88
Lebanon / Israel	4.17	9.23	12.17	13.17	9.52	10.77	6.03	5.00	3.08	3.33	7.67
Syria	8.00	8.25	8.80	9.20	9.75	8.91	9.43	11.52	11.66	15.20	14.40
Iraq	26.00	30.67	21.50	19.43	19.33	19.00	15.00	10.50	7.20	10.00	17.90
Egypt	5.13	7.17	7.16	9.64	9.88	7.77	10.00	5.75	5.40	7.56	7.51
North Africa	2.00	2.42	3.00	5.46	6.34	5.80	7.91	7.91	5.50	7.81	5.38
Latin – West	2.83	3.32	5.49	5.00	5.47	6.06	6.68	6.54	8.06	8.62	10.65
Balkan	1.41	3.70	3.96	2.73	3.11	4.81	5.35	4.75	6.13	5.37	5.40
ME – NA	7.38	8.67	8.03	9.59	8.43	7.13	8.56	8.50	9.56	10.53	9.65
Total											

Appendix A. The interpretation of the FUP coefficient in more detail

The interpretation of the FUP coefficient is quite complex, as we demonstrate below. This immediately becomes clear when writing down the elasticity of an increase of population in (an existing) city *j* on the population in city *i*. From the formula used to calculate FUP, see (1), (where '*y*' stands for 'pop'), we can derive this effect:

$$(4) \qquad \frac{\partial \ln y_{it}}{\partial y_{jt} / y_{jt}} = \alpha \frac{\partial \ln FUP_{it}}{\partial y_{jt} / y_{jt}} = \alpha \left[\frac{\partial FUP_{it}}{\partial y_{jt}} \right] \frac{y_{jt}}{FUP_{it}} = \alpha (w_{ij} D_{ij})^{-1} \frac{y_{jt}}{FUP_{it}}$$

This immediately shows that looking at the coefficient on FUP, α, does not provide all information on the interaction between two particular cities *i* and *j*. It shows that this also depends (negatively) on the weighted distance between the cities, $w_{ij}D_{ij}$, and (positively) on the relative importance of city *j* in city *i*'s FUP. The larger city *j* compared to city *i*'s overall FUP, the larger the effect of a 1% population increase in city *j* on city *i* will be.

City *i*'s FUP can also increase because of newborn cities. Suppose that a new city *k* is 'born' that has *K* inhabitants. The effect of this on each city *i* will be[42]:

$$(5) \qquad \frac{\partial \ln y_{it}}{\partial y_{kt}} = \alpha FUP_{it}^{-1} (w_{ik} D_{ik})^{-1} \quad \Leftrightarrow \quad \partial \ln y_{it} = \alpha FUP_{it}^{-1} (w_{ik} D_{ik})^{-1} K$$

This shows that this depends (positively) on the size of the newborn city *K* (relative to city *i*'s FUP) and also (negatively) on the weigthed distance between the new city and city *i*.

Equation (4) and (5) show that, ceteris paribus, the difference between the coefficients on Muslim-Muslim and Christian-Christian interaction can be interpreted as the difference in the degree of interdependence of Muslim and Christian cities respectively. However within our sample such a ceteris paribus increase is hard to imagine given the heterogeneity in terms of cities' location, their population size and FUP at different points in time.

To address this issue, we can use (4) and (5) to offer a more intuitive interpretation of the FUP coefficient or to illustrate the (different) effect of Muslim and Christian FUP somewhat more clearly by discussing a particular example(s):

I First we show that the coefficient on FUP can be interpreted as showing the effect of a 1% increase in population in all other existing cities on a particular city *i*., irrespective of city *i*'s location, FUP or the other cities' population size. This effect of a 1% increase in the population in all other existing cities on city *i* can be calculated as follows:

$$(6) \qquad \sum_{j \neq i} \frac{\partial \ln y_{it}}{\partial y_{jt} / y_{jt}} = \alpha FUP_{it}^{-1} \sum_{j \neq i} \left[(w_{ij} D_{ij})^{-1} y_{jt} \right] = \alpha ,$$

where we use that $\sum_{j \neq i} \left[(w_{ij} D_{ij})^{-1} y_{jt} \right] = FUP_{it}$.

Again we can interpret the higher coefficient on Muslim FUP as evidence of the fact that the interdependency of the Muslim cities was quite strong during the blooming

[42] Calculating an elasticity in this case is impossible since the emergence of a new city cannot be translated into a % increase in that city's population.

period of the Arab world, even when compared to the interdependency of Christian cities during the 16th-17th centuries.

II The average effect of a 1% increase in <u>one</u> other (average) Muslim/Christian city,

$$(7) \qquad \frac{1}{n}\sum_i\left[\frac{1}{n-1}\sum_{j\neq i}\frac{\partial \ln y_{it}}{\partial y_{jt}/y_{jt}}\right]=\alpha\frac{1}{n}\frac{1}{n-1}\sum_i\left[FUP_{it}^{-1}\sum_{j\neq i}\left[(w_{ij}D_{ij})^{-1}y_{jt}\right]\right]=\frac{\alpha}{n-1}$$

where again the last equality follows by noting that $\sum_{j\neq i}\left[(w_{ij}D_{ij})^{-1}y_{jt}\right]=FUP_{it}$ and n denotes the number of cities.

This shows that combining the coefficient on FUP with the number of (other) Muslim/Christian cities gives evidence on the average importance of one other Muslim/Christian city for the average Muslim/Christian city. The higher the total number of Muslim/Christian cities, the lower the average impact of a 1% population increase in only <u>one</u> other Muslim/Christian city. Table B8 shows that during the millennium we consider, the total number of Muslim cities doubles. This may seem a lot but it is almost nothing compared to the increase in the number of Christian cities: in 1800 the number of Christian cities is twentyfold that in 800. Taking this into account shows that the average effect of a 1% increase in only <u>one</u> other average city is even higher in the Muslim urban system compared to the Christian urban system than suggested by the estimated coefficient on FUP. It also means that in an urban system comprising many cities (such as the Christian one) each city is less vulnerable to a random negative population shock in another city, than in an urban system containing only few cities. In effect, the larger number of other cities 'protects' a city from large changes in FUP when only a single (or few) cities experience a negative population shock

Table A.

	nr cities		average distance (km) to other city		average distance (km) to nearest city	
year	muslim	christian	muslim - muslim	christian - christian	muslim - muslim	christian - christian
800	25	29	100	46.4	2218	1134
900	37	40	86	59.0	2174	1227
1000	42	76	87	54.4	1863	1293
1100	43	78	104	52.3	2015	1217
1200	40	118	115	49.5	2077	1178
1300	35	177	132	45.9	2003	1163
1400	41	125	112	53.4	1761	1091
1500	41	183	116	41.9	1494	1070
1600	50	263	109	39.4	1401	1071
1700	49	269	106	42.6	1391	1057
1800	78	537	101	40.2	1346	1116

III The average effect of a 'newborn' city of size *K*. Suppose that a new city is 'born' having *K* inhabitants. The average effect of this on the existing cities will be:

$$(8) \qquad \frac{1}{n}\sum_i\partial \ln y_{it}=\frac{\alpha K}{n}\sum_i\left[FUP_{it}^{-1}(w_{ik}D_{ik})^{-1}\right]$$

This shows that the average effect of a newborn city depends on the distance of this city to all other (already existing) cities and the current size of each existing cities' FUP. Assuming each existing city's FUP the same, (8) can be further simplified to

$$(9) \qquad \frac{1}{n}\sum_i \partial \ln y_{it} = \frac{\alpha K}{FUP_{\cdot t}} \frac{1}{n}\sum_i (w_{ik} D_{ik})^{-1},$$

so that average effect depends not only the coefficient on FUP but also on the average (weighted) distance of the new city to all other existing cities. In a denser urban system a new city will thus on average have a larger impact. Assuming that the new city is founded at the current average distance between Muslim or Christian cities, the effect of a the new city would, c.p., be higher in the much denser Christian urban system, compared to the more spread out Muslim urban system (see Table A that shows the average distance between the existing Muslim and between the existing Christian cities)

IV The average effect of a 1% increase in the population of the nearest (existing) Muslim/Christian city,

$$(10) \qquad \frac{1}{n}\sum_i \frac{\partial \ln y_{it}}{\partial y^i_{near,t} / y^i_{near,t}} = \frac{\alpha}{n}\sum_i (w_{i,near} D_{i,near})^{-1} \frac{y^i_{near,t}}{FUP_{it}}$$

This shows that, for a given size of the nearest city and of a city's own FUP, the average effect of a 1% increase in the population of the nearest (existing) city depends not only on the coefficient on FUP but on the average weighted distance to the nearest city, i.e

$$(11) \qquad \frac{\alpha y^{\cdot}_{near,t}}{FUP_{\cdot t}} \frac{1}{n}\sum_i (w_{i,near} D_{i,near})^{-1}$$

Again this shows that in a denser urban system an increase in the nearest city will on average have a larger impact. Table 4 shows the average minimum (weighted) distance for the (existing) Muslim and Christian cities respectively. This is much lower for the Christian cities so that the average impact of a 1% population increase in the nearest city will c.p. have a larger impact in case of Christian cities.