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The Cycle of Medieval Cathedrals – Explaining the Construction of Iberian Cathedrals through Economic Development

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Iberian cathedrals are some of the most impressive religious buildings in Europe. Mostly erected between the twelfth and fifteenth centuries, they are also the outcome of regional phases of growth and development. This article discusses this period favourable to the building of religious structures in the Iberian Peninsula, considering local dynamism, the religiosity of adherents and stimuli from the economic development of the surrounding areas. Using models of spatial autocorrelation, we observed different results for the Portuguese dioceses and for the Spanish ones. Spanish dioceses, in particular, exerted competitive effects on surrounding dioceses, making the erection of new cathedrals close to a diocese with an old or a valued cathedral less probable. It was also observed that the dynamism of cathedral construction in a given diocese tended to be replicated in the closest dioceses between the twelfth and fifteenth centuries.

Introduction

The construction of temples, especially involving considerable monumentality, is only possible when there is a combination of several factors. The next sections of this article will detail the main reasons behind the construction of medieval cathedrals in the Iberian Peninsula. However, these sections will also advance to two dimensions that have not been properly studied in this field. On the one hand, there is the importance of the local dynamics where we will test the hypothesis that places with an accumulation of religious buildings tend to preserve these buildings even in their

expansion, depending on the interaction of cycles of local development and religious fervour. On the other hand, the dynamics of the neighbouring dioceses also have an observable influence. Basically, we intend to analyse whether the construction or expansion of cathedrals in a given diocese of the Iberian Peninsula motivated neighbouring dioceses to also build or expand their own cathedrals.

Historically, a cycle of cathedral construction existed in Galicia in approximately the twelfth and thirteenth centuries. The concentration of the main buildings on the northern coast of Portugal around the same period and the observation that most cathedrals in Catalonia had their starts separated by less than a century seem to suggest the importance of local dynamics in stimulating the emergence of large-scale religious centres.

This study is thus clearly innovative by bringing the advantages of spatial autocorrelation analysis to fields as diverse as economic history, the history of religion, the economics of public works and the economics of religion itself.

The first intention is therefore to test an innovative hypothesis: the construction of large religious buildings in the Iberian Peninsula between the twelfth and fifteenth centuries was the result of contagion effects from neighbouring regions in addition to local economic dynamics. In essence, we can consider that the combined presence of the three classic vectors – peaks in regional economic growth, a more intensely lived religiosity, and availability of materials and labour in nearby spaces – stimulated these communities to raise engineering works of this scope. However, as a result of these dynamics on the whole territory under observation, the presence of efforts to build these larger cathedrals in neighbouring communities/dioceses has not been tested with the detail here until now.

Several studies, such as those by Klotz (1999) or Mourao (2019), have found statistical significance in the 'neighbourhood effect' in real-world examples that range from the budgeting of public expenditures to the development of cultural and sports infrastructures. Obviously, such studies have concentrated on recent historical periods. Thus, the novelty of this article is twofold – both in terms of the historical period analysed and in the methodological resources used.

As a detailed examination of a period with relatively few approaches (the so-called 'Late Middle Ages' in the Iberian Peninsula), this investigation aims to contribute to the development of knowledge in three main areas:

- To recognize how economic development in the Iberian Peninsula allowed the construction of religious centres with recognized monumentality.
- To show how the presence of the three combined vectors (financial resources, religious fervour, and construction resources) throughout the various regions of the Iberian Peninsula motivated the construction of cathedrals.
- To test how the 'neighbourhood effect', that is, the planning and construction of sees/cathedrals in a given diocese, was also a reflex of the spread of episcopal headquarters in the surrounding space.

The remaining work is structured as follows. The next section reviews the literature on the issue raised here. We revisit not only the cycles of development in the Iberian Peninsula but also cycles of accumulation of essential resources for building

cathedrals. We also discuss the role of three effects subsequently tested: the relevance of the local dynamics, the religiosity of the residents and the influence coming from neighbouring dioceses. The third section empirically tests these hypotheses and the fourth section draws conclusions.

The Building of Cathedrals in the Iberian Peninsula – an Analysis from Spatial Autocorrelation to Contagion Effect

Defining the Focus of this Work – the Construction of a Cathedral in Iberian Territories

To study the spatial autocorrelation of cathedral construction, it is important to define from the start the concept of cathedrals to understand the reason for this focus. Thus, the notion of a cathedral, or cathedral church, is associated with a church where the main figure of the diocese – the Bishop – is entitled to a chair (cathedra). Although the modern concept appeared only in the fourteenth century, in approximately 1340 (Usher 2012), our study collected observations for each diocese of the Iberian Peninsula that included the year of the construction or expansion of the most relevant church. Thus, for generalization purposes, this study will primarily observe the religious buildings – as well as the ensuing improvements – of structures considered diocesan headquarters in the Iberian Peninsula since the twelfth century.

Studies that accurately detail the differences between the expressions of Catholic religious architecture, namely, the differences between chapels, churches, basilicas, *Sés* or cathedrals, are those by authors such as Icher (1998).

Money, Religiosity and Endogenous Resources – Economic Development in the Iberian Peninsula between the Twelfth and Fifteenth Centuries as a Catalyst for the Construction of Cathedrals

The analysis of the economic and social history of the middle ages in the Iberian Peninsula has been developing at a slow pace. The works of Virginia Rau, Damião Peres, Magalhães Godinho and Oliveira Marques created a significant impulse throughout the twentieth century. Subsequently, figures such as Balard *et al*. (1994), Fourquin (1969) and Álvarez Palenzuela (2003) generated an equivalent development in a more recent period.

In invoking such works here, we do so with a sense of construction. In reality, we cannot disconnect the development of any cycle of religious construction from the cycle of surrounding economic development. Financing a religious temple has always been a complex task; this is even more so if the temple is categorized as a 'cathedral'. Regardless of the religious sect in question, in the wake of the findings by Icher (1998), Fourquin (1969) and Fonseca (1984), the construction of religious temples combines the following levels of effort/cost.

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- *Efforts toward capital accumulation*. Works for public use tend to be financially expensive, regardless of time and place. We restate here the thesis of Briscoe (1988) and Hutcheson (1993), according to whom the most 'grandiose' works of any time (sometimes identified as 'works of the regime') occur in periods of capital accumulation in the surrounding communities that, in general, coincide with peak cycles in local and regional expansion. Thus, churches and cathedrals could only be raised when communities of believers perceived that there was an accumulation of capital. Although individual currencies have had their own cycles within each kingdom of the Iberian Peninsula, we follow the thesis of Valdés (2014) that moments of greater economic development associated with the accumulation of resources were also periods with a greater dynamism in the circulation of registered money.
- *Local or regional availability of materials and labour*. If today the professionalization of the civil engineering sector makes it possible for teams to travel around the globe, in the times associated with the data analysed here, the scope of religious temples implied the use of available labour among locals from the region (Icher 1998). Such essential availability did not prevent the use of architects from other spaces or even from other countries or the use of imported architectural materials/details. However, the close (regional) availability of labour and construction materials would make any construction project of this magnitude more viable by reducing associated costs.
- *Religious efforts*. These efforts of religious intentionality, according to Alashi (2017), can be divided into three main directions: honour, worship and legacy. Thus, communities and leaders with the intention of building this type of religious space 'feel' the need to honour the divine (Lang *et al*. 2005), to manifest the robustness of their faith and to leave this space for their heirs and for other believers (Alashi 2017).

We will now detail these main aspects of the economic history of the Iberian Peninsula between the twelfth and fifteenth centuries, explaining the construction of cathedrals.

Cycles of Currency Circulation in the Iberian Peninsula throughout the Late Middle Age

The relationship between monetary flows and religious purposes is not limited to the relationship between the dynamic circulation of currencies and the construction of religious temples. Other relationships are discussed in Valdés (2014). In fact, Valdés states very explicitly that coins were used not only for alms (in response to feelings of mercy and charity) but also for donations and offerings to organizations. Thus, because ecclesiastical figures possessed both temporal rights (namely, the ability to collect taxes) and the ability to issue currency under real authorization (Olmos 2012), authors such as Duby (1990) list the possibility that the development of monetary flows – in the rest of Europe or in the Iberian Peninsula – promoted the building/reconstruction of religious temples.

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In another work, Olmos (2002) shows how the references to monetary values in the documents preserved from this period allow an association with economic and social dynamism in the surrounding area. Long periods were observed (especially in the eighth and ninth centuries) of great political and military instability in the Peninsula, where the consulted documents do not present references to monetary values; thus, economic and commercial relations were being carried out with much less significance or were only supported by direct exchange mechanisms. Olmos (2002) shows how, during the tenth century, documents referring to 'monetary units' associated with cereal or livestock, such as wheat weights or sheep units, began to appear. The following centuries witnessed an intensification of the documentation of growing money flows – the coins minted in the Arab caliphs in the southern part of the Peninsula (the 'parias') entered circulation as valued coins in the Christian northern kingdoms that provided soldiers for wars between the caliphs, but there were also significant efforts to issue monetary 'billons' by Afonso VI and Afonso VII (already in the eleventh and twelfth centuries). The various moments of subsequent currency issuance (between the thirteenth and sixteenth centuries) can thus be assumed, in line with Puntoni (2019), as moments of monetary reform, which generally aimed to respond to the needs of most kingdoms, controlling inflationary tensions and the problems of seigniorage. Simultaneously, monetary issuances were moments used for propaganda (spreading the image of the king).

As Olmos (2012) and Valdés (2014) mention, the monetary flows in the Iberian Peninsula were conditioned by political instability, either between the several Christian and Arab states of the Peninsula or between the monarchs and the most powerful feudal lords, who had several tense episodes. The bourgeoisie's own development, especially from the thirteenth century onward, has given special dynamism to monetary flows, inflationary tensions or even issues of monetary depreciation (Olmos 2012; Valdés 2014). Although quantitative studies on monetary flows in the various kingdoms of the Iberian Peninsula are scarce, several episodes can be interpreted as critical moments in monetary history. These monetary issues had become severe enough to induce public discussion among the various social classes and both secular and ecclesiastical authorities (Olmos 2012). Some of these moments are listed by Olmos (2012): Catalonia (1118), Cortes de Benavente (1202), Aragon (1204), Alfonso X, Leiria (1254), the war between Afonso X and the Infante Sancho (1282, with inflation rates of approximately 500%), Brabant (1356) and Aragon (1372). In general, these moments of monetary crisis – revealing complex dynamics in the commercial markets of the Peninsula – were used to debate the authority to issue money, the ability to devalue the currency in progress, and the ban or admission of foreign currency circulation.

We do not intend to exhaust all possible discussion detailing the monetary struggles during this period in the different kingdoms and caliphs of the Peninsula. For this purpose, we suggest, in addition to previous studies, the works of Puntoni (2019) and Pastor (2013).

Demographic Cycles in the Iberian Peninsula throughout the Late Middle Age

Demographics was a dimension correlated with monetary flows. Documents, whether concessionary in nature (such as 'forais'/municipal documents of autonomy) or of monastic origin, show how the population grew in periods of relative political and military stability but also suffered significant falls not only in periods of political and administrative instability but also during epidemic crises, which were frequent.

The demographic rhythms of the Iberian Peninsula between the twelfth and fifteenth centuries are discussed in several works (García and Expósito 1983; Cruselles-Gómez 1999). In general, it is difficult to speak of a demographic expansion cycle characteristic of the entire peninsula. Cruselles-Gómez (1999) also observes how demographic cycles were clearly more dynamic in urban areas than in rural areas. The reason is related to the proliferation of epidemics, most likely in urban areas, due to the quality of local accommodations and sanitation and high densities of human concentration (Fonseca 1984). It should be noted that the construction of cathedrals – the current focus – was also concentrated in urban areas, as Icher (1998) noted, since the presence of the cathedral itself was a cause of significant urban dynamism. Authors such as Cruselles-Gómez (1999) are convinced that visible demographic growth reinforced the economic and social dynamics of cities (and villages) on the Peninsula, generating labour circulation and the development of markets for various professions. However, the absence of a clear peninsular cycle of demographic expansion does not prevent the presence of cycles of demographic growth in certain periods in certain areas of the peninsula. We specifically refer to relatively extensive areas within each kingdom between the twelfth and fifteenth centuries. As population circulation was limited, periods of political and military stability in these large areas were most likely associated with demographic growth.

Cycles of Religiosity in the Iberian Peninsula throughout the Late Middle Age

The third factor in the erection of cathedrals – the religiosity of the classes of believers – also had particular dynamics in the Iberian Peninsula. Christians of the medieval Iberian Peninsula did not have the idiosyncratic crises that those in France, Central Europe or Italy had (with well-organized sectarian or heretical currents, as discussed by Peters 1980, or Russell 1963). However, religiosity crises, as well as some critical political episodes, occurred in the Iberian Peninsula, as detailed in works by Araújo (2011) and Jesus (2016). Such religious movements, managed by figures of the clergy and of secular authorities, drove the construction of places of worship. These places had the size and grandeur proportional to their centrality, to the dimension of the veneration flows of the invoked *oragos* (Icher 1998) and to the commitment and prestige of local promoters (sometimes kings and landlords, and often clerics, namely, bishops).

The construction (or reconstruction) of cathedrals presented a multidimensional purpose – from the manifestation of wealth and ostentation for the purpose of expressing ideological and political supremacy to the consolidation of the

surrounding space as a central location in economic, political, scientific and religious terms. Finally, supporting the building of the temple was seen from the perspective of citizens of the Middle Ages as an 'investment', not only in a greater cause (the spread of Christianity) but also in ensuring a personal return, both from a perspective of spiritual returns, such as indulgences and 'perpetual masses', and from the perspective of strategic valorization in the local and regional social community, in line with the arguments of Kolm and Ythier (2006).

From Spatial Autocorrelation to Contagion Analysis – Contagion, Mimicry or Cycles of Economic Expansion

From the above literature, we find three validated dimensions of local dynamics essential for the promotion of religious construction:

- the presence of vast resources (measured in monetary accumulation, following Olmos 2012);
- the existence of a growing population (Valdés 2014);
- finally, the presence of an expressive religiosity supported by local entrepreneurial leaders (Araújo 2011).

However, as Riccetti (2002) or Orme (2017) claim, in the cycle of expensive buildings, the following three factors become relevant:

- the presence of an architectural culture;
- the existence of a cycle of economic development extended to the entire surrounding space (in our case, the neighbouring dioceses);
- the influence of competition or complementarity in the aforementioned space (that is, of the surrounding dioceses).

We will now explore these dimensions.

From Architectural Culture to the Regional Development Cycle and the Neighbourhood Effect

The construction of buildings is associated with the gathering of factors related to leadership and collective needs. As Riccetti (2002) notes, buildings that are constructed and upgraded are a source of additional future work, namely, reconstruction and expansion.

Economic development has also been discussed as one of the most powerful forces changing the social and economic structures of most agents in a region (Lopes 1988). With the increase in income generated and distributed in the same region, this economic cycle includes the possibility of accumulating the resources necessary to finance the construction of more expensive structures. Recent work validates this assumption, relating the economic growth of a region to a significant investment in civil construction projects (Lopes *et al*. 2002). Therefore, we can expect that a cycle of construction or expansion (either of buildings for collective use or of buildings for private use) must reflect that previous cycle of economic growth.

However, even though the region is characterized by economic growth and the accumulation of resources, this does not mean that income and resources have been

distributed equally among the subregions. The evidence shows regional inequalities exist for various reasons. Distribution processes tend to be more advantageous for some than for others, which will lead to the concentration of construction projects in one place at the expense of others. In addition, the 'neighbourhood effect' in construction investment can reflect a dimension of complementarity, when more is built in a region because there is also more new construction around, or a relation of substitutability, when due to internal competition, determined locals capture resources from neighbouring regions, increasing the volume of their own construction and decreasing the volume of construction in the neighbouring regions. Works that address these dual dimensions in the 'neighbourhood effect' include those by Martín Martín (2013), who authored a relevant study showing how bishops tended to interfere closely in neighbourhood political issues in the Iberian Peninsula during the Late Middle Age. The next section will describe our empirical effort to test this dimension of spatial autocorrelation in the construction of Iberian cathedrals through the Middle Ages.

Empirical Section

Empirical Model

Based upon the theoretical discussion, our empirical model will explain the construction of cathedrals in the Iberian Peninsula between the twelfth and fifteenth centuries considering the following three assumptions.

- The principle of maintaining building upkeep, by which existing buildings tend to ask for renovations and improvements (although with decreasing marginal value, following Olmos 2012 or Riccetti 2002);
- The principle of centre–periphery competition in regional economics, by which existing structures of capital located at a centre tend to attract investments from neighbouring areas (Orme 2017);
- The mimetism effect, by which the abundance of inputs in a given diocese and in their neighbouring areas will motivate the construction of religious infrastructure (Araújo 2011).

Therefore, the likelihood of a given diocese constructing/expanding a cathedral is identified as y^*. It is modelled as a function of neighbouring diocese activity (*Neighbour*) and of the existing structure of religious buildings ($\mathbf{x}$). We follow the modelling established by Arima (2016).

Therefore, we will define $y^*_i = \alpha Neighbour_i + \mathbf{x}_i\boldsymbol{\beta} + e_i$. Assuming agents are value-maximizers (i.e., they will construct a cathedral if the construction is worth the effort), the probability of observing cathedral construction ($y = 1$) can be written as:

$$\begin{aligned} P(y = 1|x, Neighbour) &= P(y* > 0|x, Neighbour) \\ &= P(e > -\alpha Neighbour - \mathbf{x}\boldsymbol{\beta}|x, Neighbour) \\ &= \boldsymbol{\Phi}(\boldsymbol{\alpha} Neighbour + \mathbf{x}\boldsymbol{\beta}) \end{aligned} \quad (1)$$

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$$y_i = \begin{cases} 0, \text{ if } y* < 0 \\ 1, \text{ if } y* > 0 \end{cases} \tag{2}$$

where $\boldsymbol{\alpha}$ is the vector of coefficients associated with *Neighbour* and $\boldsymbol{\beta}$ the vector of coefficients associated with the controls $\mathbf{x}$. Following Arima (2016), we assume that the unobservable term e is normally distributed; then, the probability of a cathedral's construction or expansion is given as $P(y = 1|\mathbf{x}, Neighbour) = P(y* > 0|\mathbf{x}, Neighbour) = P(e > -\alpha Neighbour - \mathbf{x\beta}|\mathbf{x}, Neighbour) = \Phi(\alpha Neighbour + \mathbf{x\beta})$. $\Phi(.)$ is the cumulative normal density function, which primarily leads to a nonspatial probit model.

We use the probit model with spatial dependency designed by Smith and LeSage (2004). Following Arima (2016), this model is more appropriate for our observations in dioceses/religious areas because '[...] spatial dependencies are ascribed to occur between regions, not between individual observations. In their model implementation, SLS used county-level observations grouped by states (i.e., regions) and spatial dependencies were assigned between states instead of between individual counties.'

Therefore, following Smith and LeSage (2004) and Arima (2016), we write our empirical model predicting the construction of a cathedral in a given century between the twelfth and fifteenth centuries as follows:

$$y_i^* = \alpha Neighbor_{ij} + \mathbf{x}_{ij}\boldsymbol{\beta} + \theta j + e_{ij} \tag{3}$$

with

$$\theta_j = \rho \sum_{k=1}^{m} w_{jk}\theta_k + \mu_j$$

In equation (3), θ_j: $j = 1, \ldots, m$ is the effect of the neighbouring dioceses and may be defined as a spatial autoregressive process, where w_{jk} is the weight reflecting the degree of spatial proximity between dioceses j and k. ρ is the parameter that reflects the overall degree of spatial dependency between dioceses – we will give a particular focus to this parameter in further estimations. The idiosyncratic error (e_{ij}) is assumed to be normally distributed, conditional on θ. μ_j is also assumed to be normally distributed.

Following Mourao and Vilela (2020), we can think of the previous models as binary-dependent variable models based on the usual spatial Durbin model:

$$y_{it} = \alpha + \rho W_i y_{it} + X_{it}\beta + W_i X_{it}\gamma + e_{it} \tag{4}$$

We also identify $\alpha Neighbour_{ij}$ in equation (3) as $W_i X_{it}\gamma$ in equation (4), and therefore, $y*$ also depends upon the cumulative value of religious cathedrals in the neighbouring areas. Therefore, $y*$ can be modelled as

$$y_i^* = \mu_j + W_i X_{it}\gamma + \mathbf{X}_{ij}\boldsymbol{\beta} + \rho \sum_{k=1}^{m} w_{jk}\theta_k + e_{ij}$$

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Data and Sources

To move forward in this effort, we construct two major variables:

- A variable that signals information about the existence of construction or significant changes in the main cathedral in each diocese (Olmos 2012; Valdés 2014). This binary variable has been represented by y^*_i;
- A variable with the accumulated value of religious heritage associated with each diocese (Araújo 2011; Riccetti 2002). We will consider this variable as a proxy for $\mathbf{X}_i$.

Thus, we established each set of 50 years between 1100 and 1500 as a temporal unit, and we observed the historical dioceses of the Iberian Peninsula as a spatial unit. This means that dioceses created after a given date do not appear before that date, as necessary for methodological rigour. For example, the diocese of Majorca was only considered after 1237, the year of its emergence from the diocese of Barcelona. In terms of time units, the use of (long) periods of 50 years is explained by the following motivations. First, the 'construction cycle' is a long cycle even if we consider recent investments or cycles for public works (Lopes *et al*. 2002). As authors such as Icher (1998) or Araújo (2016) point out, the construction of cathedrals occurred over long periods, sometimes involving more than a century between the beginning and the conclusion of the initial project. Second, the existence of accumulated dynamics both in the inputs that we analysed in the second section (dynamics of local and regional markets, demographics and religiosity) and in the evidenced output (the construction of the cathedral) is supported by long cycles, in line with the studies by Riccetti (2002).

The work of identifying these dioceses was thus long. It was based on several sources, from local archives to historical, religious and architectural literature (Barreira 1937; Ferreira 1957; Gaspar 1979; Guerreiro 1982; Costa 1998; Azevedo 1985; Navascues 2010; Sobrino 2019). The existence of construction or significant modifications in the main cathedral of each diocese was identified by a binary variable. We mark this as 1, thus, the half-century when each cathedral began its construction or when the sources identified a significant expansion effort. As a significant expansion effort, we considered structural changes, the introduction or extension of any of the five structural elements in cathedrals of this period (Guerreiro 1982; Navascues 2010): vaults, chapels, naves, transepts and towers. We identify this variable as (Y_{it}), which should not be confused with the variable Y^*. In terms of descriptive statistics, Y_{it} has the following values: 1152 observations, with a mean of 0.487, a standard deviation of 0.722, a maximum of 1000, and a minimum of 0.000.

The accumulated value of the religious heritage of each cathedral in each diocese results from the accumulated value of Y_{it}. Therefore, for each period t, we identify this accumulated value as X_{it}. In terms of descriptive statistics, X_{it} has the following values: 1152 observations, with a mean of 3.114, a standard deviation of 3.690, a maximum of 17.000, and a minimum of 0.000.

The effort we put into building these variables, while honest, is not without its limitations. Ideally, to test our hypotheses, we should have, for each year and for

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each diocese, a monetized value of the construction or expansion effort of each cathedral. Such information would allow us to generate much more in-depth measures, including the surrounding economic dynamics as well as a much more detailed indication of the valuation of other 'inputs': demographic dynamics and religiosity. However, given the available sources and data, such estimates are not yet possible for all our observed cathedrals and dioceses.

Results and Discussion

Table 1 shows our results for the set of dioceses observed in the Iberian Peninsula.

We preferred to divide the estimates in equation (3) by centuries to detail how the reaction of each diocese was different from century to century. In the first row, we have the estimated coefficients for the spatial autocorrelation parameter ρ. Thus, it is possible to observe that the dynamic capacity of neighbouring regions influenced the dynamics of religious construction in the dioceses of the Iberian Peninsula and had its period of greatest significance between the years 1200–1300 and 1300–1400. Between 1100 and 1200, we noticed that the dynamics of religious cathedral construction were mainly influenced by the existence of accumulated value in religious buildings (parameter β). The statistical significance found for all the estimated coefficients of parameter β (positive parameters) over the period reveals that the local dynamics of each diocese is the main factor affecting the construction or expansion of the cathedral. This perspective is convergent with the perspective of Icher (1998). On the other hand, we cannot fail to mention that the estimated value for Υ reveals, for periods from 1200 onward, a sense of 'spatial competition' between neighbouring regions; the negative sign indicates that the greater the accumulated value of religious heritage in the surrounding dioceses, the expected likelihood of building or expanding a cathedral in a given diocese is less, for most spaces in the Iberian Peninsula. The values of log-likelihood as well as R^2 suggest that the model estimated for the period between 1400 and 1500 has a higher quality than the models estimated for the remaining periods.

After discussing Table 1, we divide Iberian dioceses by considering them as Portuguese (if belonging to the kingdom of Portugal) or Spanish (if belonging to the kingdoms of Castile-Léon, Navarre or Aragon). We opted for this division to avoid generalist insights that would happen if we had not done this methodological step. In line with the arguments of diverse authors (Fonseca 1984; Navascues 2010), given the autonomy of individual spaces – even in ecclesiastical terms – additional reasons arise for justifying this division.

Table 2 shows the estimated coefficients for equation (3) but only considers the data for the Portuguese dioceses. Some differences can already be found in light of the results shown in Table 1. First, the Portuguese dioceses only felt the effect of spatial correlation from 1300 onward. In particular, from 1400 onward, the dynamics of religious construction in the surrounding spaces stimulated religious construction in each diocese, with the curious aspect being that here, unlike the estimated parameter for dioceses across the Iberian Peninsula (Table 1), the

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Table 1. Estimations of the spatial autocorrelation model (Iberian Peninsula, 1100–1500).

	Periods	1100–1199	1200–1299	1300–1399	1400–1500
Iberian Peninsula	ρ (spatial autocorrelation)	0.037 (0.787)	0.323*** (0.122)	0.321*** (0.103)	0.197*** (0.075)
	β (accumulated local religious constructions)	0.467*** (0.018)	0.328*** (0.013)	0.228*** (0.009)	0.102*** (0.006)
	Υ (surrounding dioceses' religious constructions)	0.004 (0.093)	−0.156*** (0.052)	−0.120*** (0.033)	−0.043*** (0.015)
	Log-likelihood	−1095.98	−235.2	−79.2	61.33
	R^2	0.242	0.494	0.609	0.719
	N	125	225	325	475

Table 2. Estimations of the spatial autocorrelation model (Portugal, 1100–1499).

	Periods	1100–1200	1200–1300	1300–1400	1400–1500
Portugal	ρ (spatial autocorrelation)	0.196 (0.205)	0.133 (0.180)	0.298* (0.159)	0.755*** (0.0829
	β (accumulated local religious constructions)	1.519*** (0.098)	1.911*** (0.120)	1.714*** (0.219)	1.132*** (0.189)
	Υ (surrounding dioceses' religious constructions)	−0.185 (0.382)	0.159 (0.533)	0.126 (0.630)	1.196** (0.357)
	Log-likelihood	−13.67	−115.3	−241.6	−755.4
	R^2	0.766	0.695	0.493	0.186
	N	17	18	18	18

Table 3. Estimations of the spatial autocorrelation model (Spain, 1100–1499).

	Periods	1100–1200	1200–1300	1300–1400	1400–1500
Spain	ρ (spatial autocorrelation)	−0.040 (0.189)	0.377*** (0.141)	0.349*** (0.119)	0.284*** (0.115)
	β (accumulated local religious constructions)	0.436*** (0.032)	0.289*** (0.029)	0.190*** (0.018)	0.184*** (0.016)
	Υ (surrounding dioceses' religious constructions)	−0.026 (0.133)	−0.182*** (0.044)	−0.169*** (0.061)	−0.081 (0.051)
	Log-likelihood	53.018	−45.62	−152.32	−204.3
	R^2	0.398	0.272	0.429	0.398
	N	108	137	237	457

estimated parameter for the Portuguese period between 1400 and 1500 is positive and significant. This evidence (Υ positive and significant) indicates a complementary relationship between the religious capital accumulated in the neighbouring dioceses and the construction or expansion of the cathedral in each Portuguese diocese (Fonseca 1984). It should be noted that this period in the Portuguese space is one of clear economic and demographic growth in most years as a result of the centrality that the country gained from the dynamics of sea voyages and Iberian discoveries. Once again, the estimated β values were significant and positive, indicating that dioceses with accumulated capital in religious constructions tended to carry out more modifications/expansions than spaces with less accumulation of religious capital.

Table 3 shows the estimation of equation (3) only for Spanish dioceses in the period under analysis. The differences with the results achieved for the Portuguese dioceses are notable, especially in the values estimated for Υ. These values were estimated to be significant and negative, which shows that, in Spanish dioceses, a spatial competition effect persisted between neighbouring dioceses. The more expanded a particular cathedral was, the lower the expected probability of the construction of religious buildings in neighbouring dioceses in the observed periods. The remaining parameters under observation – ρ and β – were in line with the results of the previous tables. Therefore, there were particularly positive and significant ρ values after 1200, showing that works in neighbouring dioceses led to significant development in each diocese in question. This result converged with our central hypothesis; that is, the influx of expressive inputs/resources in the various regions tended to produce more frequent 'outputs' in the set of analysed regions. These results also follow Olmos (2012) and Valdés (2014). Once again, dioceses with more highly valued accumulated capital tended to be more likely to have more religious construction works.

Conclusion

The building of collective-use structures traditionally involves high costs, be it the construction of buildings representing state or local powers, sports stadiums or pavilions, living quarters or religious infrastructure. Thus, this work focused on the economics of religious constructions. The focus of such an analysis was the Christian kingdoms of the Iberian Peninsula between the twelfth and fifteenth centuries.

Thus, we intended, in concrete terms, to determine whether the construction of buildings such as cathedrals in each observed diocese was driven by the traditional hypothesis about the dynamics of religious capital accumulation in the region. However, in addition to this hypothesis, we also intended to assess the pressure of developments in the surrounding region in the construction of cathedrals or in their expansion; in a simple way, we intended to assess whether the construction of neighbouring cathedrals influenced (positively or negatively) the probability of a diocese building its own cathedral or expanding the existing one.

For this purpose, after the construction of a detailed database with specific sources, we evaluated not only the effects of spatial autocorrelation present in our data but also the dynamics of local religious construction. Thus, the results were separated within the Iberian Peninsula into the Portuguese dioceses and the Spanish dioceses, to explore in greater detail.

Through spatial autocorrelation analysis, we observed different outcomes for Spanish dioceses than for Portuguese dioceses. For Spanish dioceses, we observed a negative 'neighbourhood effect' if neighbouring dioceses had more valuable buildings. Thus, the presence of an older cathedral or one with more significant accumulated changes tended to decrease the likelihood of new cathedral construction in a nearby diocese. In contrast, for the Portuguese dioceses observed in the late Middle Ages, the referred effect (associated with parameter Υ) had statistically significant positive estimated coefficients, validating the presence of positive spillovers from the accumulated value of temples in neighbouring dioceses. Across the diversity of the peninsular dioceses, the contagion effect of dynamism (associated with the traditional parameter ρ) was positive and statistically significant, indicating that the dynamism in a diocese was replicated in neighbouring dioceses, which leads us to identify religious elements as special factors affecting construction, in addition to the cycles of economic development of the fourteenth and fifteenth centuries in the Iberian Peninsula.

These results are pioneering in the literature on the economic history of the Middle Ages in the Iberian Peninsula. They are innovative not only in the use of spatial autocorrelation analysis, which has not been tested for this approach thus far, but also in revealing the religious history of the Iberian Peninsula, showing the correlation between local economic development and the building of its medieval cathedrals.

We intend to expand this analysis to more medieval European dioceses and to detail the effects for each Iberian kingdom. We also intend to expand this effort to analyse the construction of primary mosques in the administrative divisions within the (Arab) caliphates of the Iberian Peninsula. We additionally intend to explore the possibility of monetizing religious buildings; therefore, we intend to identify the value of the (monetary) costs associated with the effort of constructing each cathedral. Finally, the state of the regional economy is broadly relevant to the potential for cathedral-building projects, and this aspect is considered a promising further avenue, namely, by adding the number of recorded fairs or demographic estimations as soon as appropriate values can be identified for the observed dioceses.

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