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Nico Sonntag

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[1] Auf `https://kaffeeprinzen.de` und `https://hoppenworth-ploch.de`.

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1 Introduction

The European Middle Ages were a society, or more precisely, a set and a sequence of societies all very different from ours. From the perspective of a citizen of our time, it is hard to imagine a landscape dotted with thousands of monasteries, housing maybe hundreds of thousand of *religiosi*[1] in total, as well as the central role religious communities played in the daily life of the laypeople surrounding them. And even though the recent history of the Western world has not at all been free from outbreaks of seemingly irrational and contagious mass behavior, the specific forms of devote religious movements and mass piety of the Middle Ages might often times feel foreign to their contemporary student. Nonetheless, sociology's aspiration has never been to be merely a science of present-day society. This is attested by the works of its founders from Comte to Weber who would never have diminished sociology's role to concerns of current social problems and only them. If it is truly a general social science, its toolkit – theories and methods alike – should not only prove useful in the face of today's cultural and geographic heterogeneity but to the study of the past as well. However, historical social science is a not hostile entrant, competing with historians about the legitimate interpretation of facts. History and sociology are complementary. The social scientist tackling questions on the distant Middle Ages cannot, but must pay respect to the enormous achievements of historical scholarship which is the very foundation of his or her research.

This dissertation focuses on a facet of medieval religion that has been neglected in the sociology of religion. Medieval monasticism featured prominently in Weber's unfinished comparative sociology of world religions (Weber, 1978, 1993) but few researchers have picked up monasticism as well as other forms of religious life as a research topic. The most comprehensive treatments are Kaelber (1998) and Wittberg (1994). Kaelber (1998) analyzes, through the careful interpretation of historical sources, aspects of medieval ascetic rationalism and its effects on the world outside the monastery. Wittberg (1994) adopts a "social movements perspective" on religious orders and asks about the conditions that enable orders to mobilize resources like "support from the hierarchy, a source of livelihood, a dependable supply of new recruits and so on" (Wittberg, 1994: 4). Furthermore, she

[1] "Religiosi" or (the) "religious" is the generic term encompassing more specific groups such as monks, friars, canons, nuns, sisters, brethren etc. Hostie (1983: XI) estimates that in 1500 there were almost 90,000 members of mendicant orders alone.

recognizes orders as so-far neglected cases of "intentional communities" and sets out to study their internal dynamics, especially "the lapses of fervor that regularly afflicted every religious order" (Wittberg, 1994: 4). The first (Chapter 2) and the second study (Chapter 3) of this dissertation closely align with Wittberg's research agenda, concerning the growth and stability of orders as movements and organizations, while the third study (Chapter 3) attends to the spread of monastic ideals beyond the confines of the cloister and the purported consequences on economic development, connecting with threads of Kaelber's scholarship.

The present book is not a general theory of medieval religious orders that covers all aspects of their existence. All it attempts is to use standardized data and quantitative methods to answer a set of specific, but interrelated questions. Orders as well as medieval religion in general are deserving research topics in their own right. However, they also exemplify more general phenomena like religious movements and rational organizations. Applying sociological theories and models is, thus, bi-directional: theories help to explain the phenomena at hand but, at the same time, the findings can help to further theory development – or at a minimum, uncover scope conditions that limit the theories' applicability.

The overarching puzzle behind the various, more specific subquestions relates to the mechanisms and conditions that determine the success of religious movements as exemplified by orders. "Success" entails various aspects. First, ideas and organizational forms have to spread geographically and reach potential adopters. Once established, a movement has to implement appropriate structures that support its long-term survival. Lastly, success may also mean the transmission of ideas from movements to society at large. Relating to these aspects, the dissertations has three goals in particular:

1. *Understanding the mechanisms of diffusion*: Almost all orders originated in a single place with a local community established by its founder as the first attempt to realize his vision together with a small group of initial followers. They then spread beyond their original locations to other regions, transforming themselves into movements with considerable size and elaborate organizational structures. The question addressed in the first study is how that happened. At the most general level, the influences contributing to the diffusion can be classified as either *external* or *internal*. External influences subsume the institutional promotion of a movement by ecclesiastical or worldly powers but also the effect of extraordinary figures – skilled orators and capable leaders – within the movement. Internal influences are self-reinforcing processes of imitation, conformity, or learning that relate to the person-to-person transmission of ideas and practices. The first study attempts to test whether the diffusion of religious orders can be modeled as a contagious process. A contagious process is consistent with micro-level mechanisms such as imitation or persuasion but not necessarily pressure and rational learning. If such diffusion models can be leveraged they allow to decompose

the growth into an internal and external component, thus helping to answer questions about the relative importance of sources of growth. The last subquestion is whether this relative importance itself can be explained by an order's legitimacy and cultural continuity. Orders belonging to an already established tradition were likely perceived as more legitimate compared to radically new forms of religious life. More legitimate orders spread via external influences while genuine innovations spread by cumulative social processes through personal networks that only take off once a critical mass of adopters has been reached.

2. *Understanding the stability and success of monastic communities*: All religious communities were faced with problems of collective action. The very core of *communal* forms of religious life is the *joint production of spiritual (and material) goods*. Coenobitism[2] developed as an alternative to the solitude of eremitism, aiming to preserve aspects it deemed conductive to individual spiritual perfection while reducing the risk of a pitiful and lean existence as well as providing the religious with the support of a like-minded community that shared his goals (Frank, 2010: 23–24). However, the reasons for joining a religious community were manifold. As Benedictine chronicler Ordericus Vitalis remarked about the members of monastic communities "voluntary poverty and true religion inspire many of them, but many hypocrites and possible counterfeiters are united with them, like tare with the wheat" (quoted by Lekai, 1977: 47). Free-riders that enjoy the material gains of membership but scarcely contribute to collective spiritual activities lower the benefit of intrinsically motivated members and damage the reputation of the community and the order as whole. Therefore, a second research question relates to the organizational-level mechanisms devised by orders to prevent the gradual decay of religious life in communities scattered throughout distant regions. How effective were systems of visitations and obligatory meetings of all abbots in enforcing discipline among the communities? The question can be answered by exploiting variation in the travel distances to monasteries. Remote houses, that were less embedded in these institutions of external supervision due to prohibitively high travel costs, should be more unstable and prone to be organizational failure than houses close to monitoring institutions.

3. *Understanding the effect of monastic asceticism on economic development*: Various scholars have noted similarities between monastic asceticism and ascetic Protestantism *sensu* Weber (Weber, 2005; Kieser, 1987; Kaelber, 1998). Weber's main interest was the rationalization of everyday action through an altogether methodical conduct of life. Like the Puritans a few centuries later, monks "attempted to subject man to the supremacy of a purposeful will, to bring his actions under constant self-control with a careful

[2]Religiosi living in a community.

consideration of their ethical consequences" (Weber, 2005: 72). Andersen et al. (2017) make an even stronger claim: the Cistercians, who adopted a strict "work ethic" as a part of their ascetic program, transferred their values to the surrounding populations. Thus, the "cultural virtues emphasised by Weber had a pre-Reformation origin in the Order of Cistercians" and "encouraged growth by instigating the kind of cultural change that Weber attributed to Protestantism" (Andersen et al., 2017: 1756). If monastic ideas and practices are cultural innovations that diffuse through personal network via imitation, it makes sense that certain elements can break away in the process and be adopted by society at large outside of the context of communal religious life. However, in order to judge the plausibility of Andersen et al.'s account, it is important to investigate the nature of Cistercian work requirements and the susceptibility of the lay population to the adoption of the supposed Cistercian values. Moreover, a thorough empirical investigation has to consider alternative mechanisms, such as the diffusion of managerial and technological knowledge, and should systematically study the influence of other orders as well.

In the following, I will briefly review basic terms and concepts relating to orders, before outlining the structure of the dissertation. Since the chapters are written to be self-contained in terms of the theories tested and methods used, the general introduction limits itself to a sketch of the relevant historical background of religious orders. The goal is to free the empirical studies from a possible overload with historical detail and enable a higher level of theory-focused abstraction.

1.1 Religious orders

Orders are a specific form of the universal phenomenon of *religious virtuosi*, resulting from the fact that "members of any religion or religion-based cultural system will vary both in their ability and their willingness to strive for and to attain the ultimate sacred values of their faith" (Wittberg, 1994: 13). The ubiquity of religious virtuosity creates the need for institutionally organized religions to integrate virtuosi into their ideological framework, or in the words of Frank (2010: 36), to "domesticate" them. At the same time, there is always potential for innovators to exploit the desires of those "most qualified" for religious life through the foundation of new radical movements.

The first monastic communities developed as an alternative to the common phenomenon of individual eremitism during late antiquity. Communal life required regulation. Thus, the emergence of coenobitism was accompanied by the codification of so-called *rules*. The most famous of these rules was the Rule of Saint Benedict (or *Regula Benedicti*; McCann, 1969). Its author, Benedict of Nursia, systematized his lifelong experience as abbot in the

6th century. Through the effort of ecclesiastical and secular rulers, including Charlemagne who declared the rule to be the only legitimate one in the Frankish Empire, it became the dominant rule of monastic life in the Western Church during the 8th and 9th century (Frank, 2010: 53–54). Central elements introduced by Benedictine monasticism were the three monastic *vows* of *obedience*, *stability*, and *conversatio morum* (conversion of manners) also known as the evangelical counsels. Obedience means submission to the rule and the legitimate superior until death. Stability (*stabilitas loci*) means commitment to a particular community. The third vow expressed the monks choice to be "a convert to the Gospel." Later orders, beginning with the Franciscans, replaced stability and the conversion of manners with vows of *poverty* and *chastity*[3] (Hostie, 1983: 19). Chastity, poverty, and obedience became the template for all subsequent groups and are still obligated by the Code of Canon Law for all religious institutes (Canon Law Society of America, 1983: can. 573).

Religious institute is a more general term than "order" in modern canon law. However, throughout this book, the term "orders" is used in a broad sense and applied to all communities of religious life in the Western Church, irrespective of the details of canon law. *Religious life* or *consecrated life* embodies all groups of men and women who live their lives in common according to a rule, devoted to Christian ideals (Hostie, 1983: 3). In strict contemporary usage, orders only compromise a sub-set of these communities, namely communities of monks, canons regular, mendicant friars and clerks regular. The particularities of these groups will be subject throughout the book. In addition, there exist so-called (clerical and lay) congregations that historically had a different status in ecclesiastical law. However, in accordance with other writings on the subject (e. g. Wittberg, 1994; Hostie, 1983), I simplify matters and speak of "orders."

Somewhat more problematic is the existence of religious groups, although very similar to orders and congregations, that were never officially recognized by the church, like the Beguines (a movement of lay sisters), and heretical movements like the Waldensians (Wittberg, 1994: 34-35). The Beguines and many other movements of 14th century did not "create a universal corporate framework" and were in fact rather heterogeneous movements born out of the "disillusionment about elaborate structures of government and systems of theoretical perfection" (Southern, 1970: 319). They contrast with the earlier rise of organized orders striving for uniform discipline and conduct that started with the Benedictine reform movements of the 10th and 11th century, especially the Cistercians. Temporal and organizational diversity notwithstanding, the bulk of the theoretical arguments developed about the diffusion of religious groups (Chapter 2) should apply to all those groups. In fact, they should apply, *mutatis muntandis*, to religious movements in general. Theories relating to the need for strictness and discipline (Chapter 3) are equally universal but the specific enforcement

[3]Of course, the practice of celibacy predates the introduction of the vow of chastity.

mechanisms under study require elaborate constitutions and organizational networks that were present in some, but not all orders.

The empirics of the book focus, for most part, on orders that have been undoubtedly recognized as such. The three orders that feature most prominently are the Cluniacs, the Cistercians, and the Carthusians. All three are major orders within the monastic tradition and characterized by elaborate organizational structures (Oberste, 1996; Cygler, 1998). The necessity to demarcate and classify fringe cases arises in Chapter 2, where I attempt to include as many different religious groups as possible in order to test propositions relating to the hypothesized legitimacy of more common types. In this case, I adopt the classification of the data source which explicitly includes the Beguines and other "semi-religious" lay movements (Goudriaan, 2019).

Diversification

The religious landscape within the Western Church of the Middle Ages was not static but dynamic. Orders were the product of religious innovators and are credited by some sociologist with stabilizing the otherwise "monopolistic" Church by broadening the choice menu within the dominant faith:

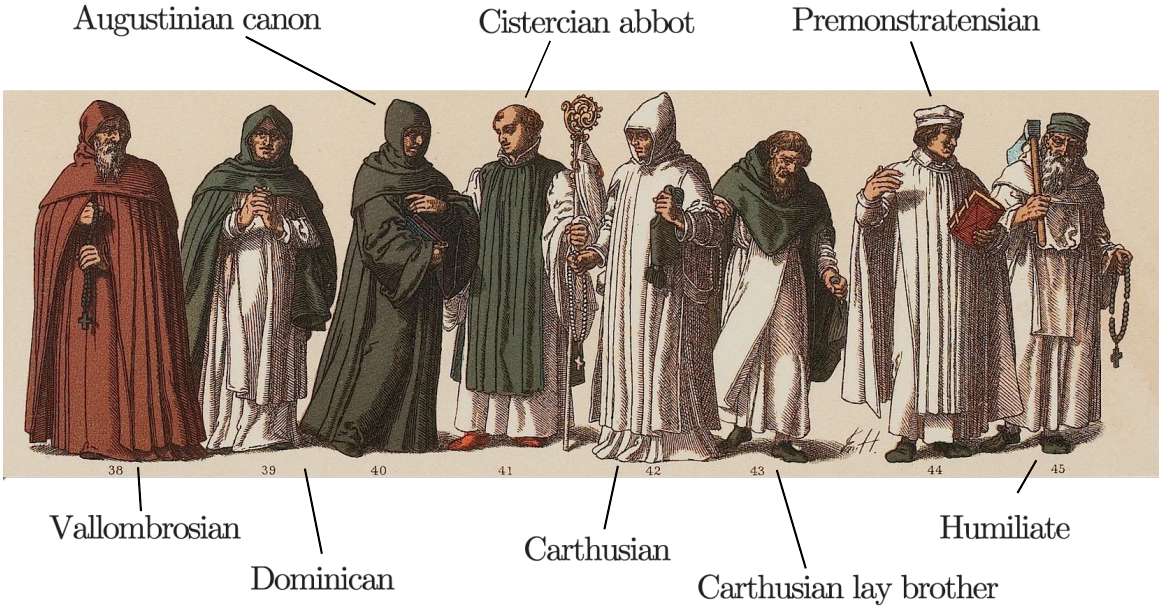
> Catholic religious orders have played a major role in helping the church serve diverse niches. First of all, the orders serve as a substitute for sects, allowing Catholics who seek a very high-tension religious life to have it. [...] Second, the orders provide the church with the equivalent of sectarian preachers and revivalists to appeal to the conservative and strict niches. (Stark and Finke, 2000: 215)

In keeping with their characterization as "quasi-sects," who served religious virtuosi and believers demanding a maximally credible and consistent expression of faith, many orders, like Protestant sects, underwent

> an endless cycle of birth, transformation, rebirth, and often extinction. Seeking to prevent change in their churches, they begin with a high level of fervor for their founder's ideals. Over time, however, the movement gradually strays from these ideals and the initial fervor of the movement begins to wane. (Finke and Wittberg, 2000: 157)

This gives rise to two phenomena that will be central to first two studies in the book: first, the diversification of religious life through repeated reform movements and radical founders who strove to overcome the deficiencies of the past; second, the attempts of orders to implement systems of visitations and other control mechanism to enforce uniform and strict discipline among their communities.

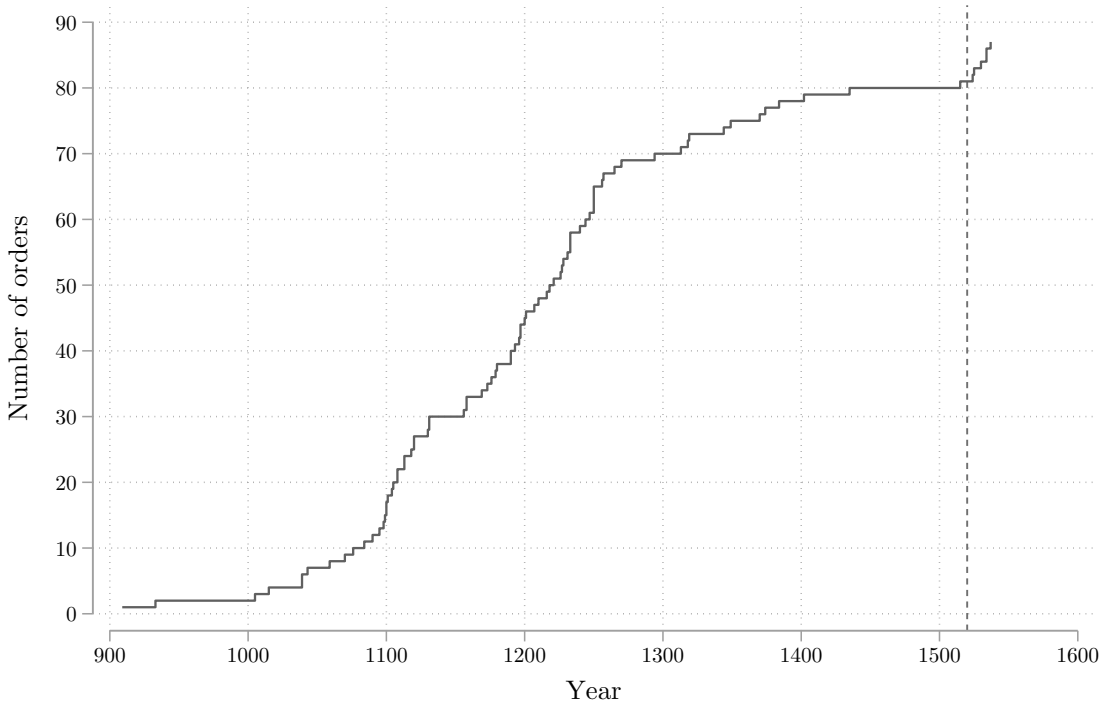
Figure 1.1: Habits of selected orders. Sartorial differences among orders are reflected in some common names such as "White Monks" (Cistercians) or "Blackfriars" (Dominicans). The different status of choir monks and lay brothers was expressed through differing habits. Source: Illustration in public domain (Hottenroth, 1891: Figure 107 (detail)) with own annotations.



The development of differentiated types was the result of disappointment with the old orders. For example, mendicant orders can be seen, *inter alia*, as an innovation preventing the self-destructive accumulation of wealth experienced by the Cistercians and other early monastic orders (Kieser, 1987: 119). However, new foundations were also reactions and adaptations to general societal changes. The rise of mendicant orders was also favored by late medieval urbanization. The availability of currency allowed a life based on donations instead of the husbandry of land (Frank, 2010: 91), while the concentration of dispossessed poor in the cities created a demand for charitable work (Wittberg, 1994: 34). The immediate "tendency toward diversification" by singling out "some salient early characteristic" of the group and concentrating intensely on it (Hostie, 1983: 20–21) was very likely successful because it allowed orders to colonize new "niches" characterized by so-far underexploited resources (e. g. money-based donation vs. landed property) and new social strata with different sets of preferences regarding the expression of religious life. The diversification manifested itself in all domains of religious life including own liturgies (or "rites" Griffin, 1912) and habits (see Figure 1.1).

Figure 1.2 counts the number of *male* orders over time based on Aston's (2001) survey which has been updated using additional sources (Herbermann et al., 1908; Hostie, 1983;

Figure 1.2: Cumulative number of orders over time.



Dinzelbacher and Hogg, 1997; Andrews, 2006).[4] The time series starts with the foundation of Cluny in 909. The process of diversification takes off in the 11th century, almost stops at beginning of the 15th century and resumes ca. 1520 (vertical line) with the Reformation and Counter-Reformation in the 16th century. The growth in the number of new orders was undisturbed by Fourth Lateran Council in 1215 which feared confusion resulting from the variety of religious orders and sought to prevent the generation of new groups (Aston, 2001: 10).

The first wave of foundations in the 10th and 11th century consistented predominantly of orders within Benedictine monasticism. A Benedictine monastic community was contemplative and "the common performance of the daily liturgy [...] could be called its main objective" (Francis, 1950: 442). The monastery was economically autarkical due to landed property, thus, allowing the monk to live a life in seclusion. He did not preach, committed himself to a particular community and was not necessarily a priest. The two most successful reform movements within Benedictine monasticism were the Cluniacs (founded in the 10th century) and the Cistercians (founded in the 11th century). The Cistercians were the first

[4]The survey is still very incomplete. Moreover, it is not always possible to clearly delimitate orders or assign a single founding date. The figure is a rough approximation that is intended to convey how rapidly diversification proceeded during the 12th and 13th century.

to codify a distinction between ordained *choir monks* on the one hand and *lay brothers* on the other hand. The latter – who often came from the lower classes – were "excluded from some specific expressions of [monastic] life—recitation of the office in choir, voting in chapter, holding an office" (Hostie, 1983: 72). Eremitical orders were a variety of monasticism and limited social interaction to a minimum. Some deviated from the earlier Benedictine model to point that they devised their own rule. The 11th century Carthusians, for example, secluded themselves to solitary cells, while still forming a stable community united under a common government and with common economic institutions (Francis, 1950: 442). Ten of the 16 orders founded in the 9th and 10th century were monastic or eremitical (at least another 10 were founded until the end of the Middle Ages), the others belonged to the rising movement of canons regular.

Canons regular (e. g. the Premonstratensians) were ordained clerics living a common life modeled after monastic principles. They can be considered an "attempt to adapt the basic pattern of monasticism to the needs and responsibilities" of priests (Francis, 1950: 443). The canons regular gave priority to the fulfillment of specific tasks like parish ministry, caring for the sick or even public service projects. "The special ministry they offered [...] gave them the distinctive traits that marked them as decidedly different from monastic orders" (Hostie, 1983: 100). The canon wanted to "to sacralize the existing world" whereas "the monk strove to create a new world" (Hostie, 1983: 93). The canons regular adopted the rediscovered ancient Rule of St. Augustine as a more suitable alternative than the Rule of St. Benedict. The latter made it difficult to integrate their focus on specific objectives, but the former "could be accommodated to every type of institutional structure because it anticipated none of them" (Hostie, 1983: 79).

Besides canons regular, there were also secular canons. The clergy was usually recruited from wealthy and noble families. For a sizable share, renouncing their family property and living in poverty was an unacceptable choice. Because the Church wanted to promote common religious life also for those clergymen who performed pastoral duties, the solution was to permit priests to retained their private property while living in a community of a specific type (Francis, 1950: 443). Secular canons were not members of an order even though they nonetheless constituted an important variety of religious communities.

The 12th and 13th centuries saw the rise of military orders. At least 25 were founded during these 200 years with the purpose of supporting the Crusades in the Holy Land as well the Reconquista of the Iberian peninsula (Aston, 2001: 21). In contrast to other types of orders that still exist to the present day, military orders largely vanished or were transformed into social organizations of a completely different kind (Francis, 1950: 444). Their rules and constitutions were inventions designed to accommodate their specific purpose but, at the same time, resemble monastic and canon ideas of communal life. This continuity is visible, for example, in the authorship of the Knights Templar's rule, written by the famous

Cistercian abbot Bernard of Clairvaux (Aston, 2001: 21). Despite their specific purpose and military governance structures "professed knights, sergeants-at-arms, and chaplains were subject to the same severe regimen as the most rigorous orders of monk" (Francis, 1950: 444). In this sense, they can be legitimately included as another type of orders.

Mendicant orders emerged in the 13th century. The friars[5] deviated strongly from the original vision of monasticism and introduced a number of radical innovations. They rejected even *collective* property, becoming communities of beggars; they abandoned the seclusion of the cloister, and dispensed with the principle of stability. The friar "moved from house to house and from province to province at the dictates of his superiors for the purposes of study, preaching, or administration" (Lawrence, 2015: 219–220). Compared to the canons regular, the mendicant orders implemented more consistently a form of organization that allowed them to concentrate entirely on their ministerial tasks of teaching and preaching. The Franciscans were the most successful group. The movement lacked an organizational structure during Francis of Assisi's lifetime and "was essentially based on personal devotion to the founder and his charismatic leadership" (Francis, 1950: 445). The rule he wrote was insufficient to permanently establish a uniform organization after his death. The Franciscan soon split into the more radical "spirituals" and the "conventuals [...] leaning more toward the usual religious life structure" (Hostie, 1983: 110). In total, there were at least a dozen groups of friars founded during the 13th century, some of which were rather short-lived.

In the 14th and 15th century a new wave of foundations took place, which, as mentioned above, were often not recognized by the Church and were more local and less interested in establishing overarching structures. The wider societal context were elements in popular religion that developed as a reaction to calamities, most of all the Black Death.

> In general these manifestations of popular religious need were too widely diffused to become an organized movement. Yet there was always the possibility that some specially disturbing event would intensify the prevailing mood of wordly despair and supernatural hope until a spontaneous polarization of energy took place. (Southern, 1970: 306)

An example of such excitement were the flagellants: a group of itinerant preachers with large following who mortified their flesh by whipping and repudiated the need for indulgences by the official Church. Beyond such extreme and ephemeral phenomena, the growth of "irregular" groups with a distaste for traditional forms of religious life was a product of this popular sentiment. Southern (1970: 300) calls them "fringe orders and anti-orders." I call them *lay brother* (and *lay sisters*) in Chapter 2 to emphasize that they did not belong to the

[5] "Friars" is another term for mendicants. I distinguish between members of different groups by using the appropriate term such as monks, canons regular, friars, knights etc. However, "monastery" or "monastic community" are sometimes used as generic terms, even though it would be more correct to speak of "religious houses" and differentiate between monasteries, friaries etc.

clergy and did not usually follow an approved rule or take any vows (Southern, 1970: 340). Famous groups or movements with this rather diverse residual category were the Beguines and Begards, the Alexians, and the Brethren of the Common Life. The latter were founded by Geert Groote who "envisaged his communities [...] working for their living" (Southern, 1970: 348). Because they worked in regular occupations, they were more integrated with the urban environment than other kinds of religious communities, giving them a specific character of their own. Only the Brethren of the Common Life and the Alexians are counted in Figure 1.2.

The previous section has focused on male orders. With one exception, the empirical analyses will likewise only consider male orders. There is a both a practical and a theoretical reasons. The practical reason is the lack of European-wide data on female monasteries.[6] The theoretical reason is the weaker differentiation between female orders. Due to the normative restrictions imposed by the church, female religious were, for a long time, limited in their choice of tasks (Southern, 1970: 308–318). They could neither perform the daily liturgy, nor dedicate themselves to public preaching and other forms of active ministry. This changed during the Late Middle Ages – the Beguines and other lay movements were signs of increasing self-confidence – but the observed variation during the Middle Ages is more limited compared to male orders.[7]

The diversification of orders over time is what allows to answer the research questions posed at the beginning of this introduction by comparatively studying the growth, the survival, and the legacy of orders. The different conditions of their foundations enable to study underlying mechanism of diffusion reflected in system-level patterns of their growth. The implementation of differentiated institutions of external control offers the opportunity to compare them with respect to their effectiveness. And correlating the geographical distribution of multiple orders with measures of economic activity and present-day attitudes helps to sort out whether orders with specific ideological commitments have positively influenced development in a way that can still be measured today.

1.2 Structure of the book

The chapters of the book are organized as three self-contained studies each relating to a different aspect and research question: the diffusion of orders (Chapter 2), the stability of

[6] Though that is changing with projects like the *Female Monasticism's Database* (Röckelein, 2015)

[7] The Ursulines, founded in the 16th century, became the first female teaching order and in 1614 adopted a fourth vow "of being employed in the instruction of young girls who [...] would live in the monastery" (Hostie, 1983: 26). Knowledge about the exact scope of tasks carried out by medieval female religious is still being revised in light of new discoveries. For example, residues of lapis lazuli pigment in the teeth of a 11th or 12th century nun suggests a greater role of women in the production of illuminated texts that is commonly assumed (Radini et al., 2019). However, the evidence regarding the lack of independence in the organization of their communities is solid.

monastic communities (Chapter 3), and the long-run economic effects of ascetic monasticism (Chapter 4). Table 1.1 presents a structured overview of the three studies.

The first study (Chapter 2) aims to understand whether traditional diffusion models can be fruitfully employed to explain the growth of religious medieval orders. Understanding the spread of orders, who were "sect-like" groups within the Western Church, contributes to a general theory of the conditions of success for religious movements. The empirical analysis utilizes data on the foundings of 1,981 religious houses by three major orders in Europe as case studies as well as two regional datasets of 593 houses by six orders in England and 1,005 houses by 36 orders in the Netherlands. The findings demonstrate that the growth of most, but not all, orders is consistent with a diffusion via contagious person-to-person spread. Moreover, external factors such as skillful leaders and institutional support played an important role in the orders' growth. The extent to which external factors were responsible for an order's growth seems to vary with its legitimacy. The influence of external promotions was higher for more legitimate orders whereas orders outside legitimate categories of religious life diffused via contagion in personal networks.

The second study (Chapter 3) focuses on the determinants of stability and longevity of monastic communities. The club-good model of religion contents that the success of a religious movement in this regard is to large extent determined by the movements ability to overcome problems of free-riding and collective action. According to the theory, seemly irrationally strict religious prescription, prohibitions, and ritual requirements are instrumental because they deter free-riders from joining the group as well as limit individualistic consumption opportunities of engaged members, nudging them to coordinate their time investments towards joint spiritual activities. This theory is being tested using European-wide historical data from the 10th to the 15th century on 1,981 communities of three major movements within Western monasticism: the Cistercians, the Cluniacs, and the Carthusians. During the Middle Ages, all three orders institutionalized systems of visitations in order to enforce strict and uniform observance of monastic rules among their geographically dispersed communities. Assuming that abbots entrusted with the duty were more likely to conduct the visitation if the associated costs were low, the research design exploits variation in the travel distances necessitated by the different monitoring arrangements. Remote monastic communities, that were visited less regularly, suffered from lax observance, mismanagement, loss of internal discipline and commitment and, as a result, dissolution. The analyses show associations between certain measures of higher travel costs and higher dissolution rates of monasteries, thus partly confirming the theoretical expectations.

The third study (Chapter 4) re-examines the claim by economists Andersen, Bentzen, Dalgaard and Sharp (2017) that the work ethic of the Cistercian order instigated the kind of cultural change that Max Weber attributed to Protestantism. I show that the hypothesis rests on a selective and highly speculative reading of the historical scholarship on the Cistercian

order. Moreover, I replicate and extend the analysis of the positive association between past Cistercian presence and population growth as well as past Cistercian presence and contemporary values. Testing theories about the historical origins of economic development is often complicated by a combination of vague theories and scant data. The proposed mechanisms can only be tested indirectly and theories are often insufficient to deduce the precise specification of statistical models or to choose among competing ways to measure a theoretical construct. I conduct a systematic robustness check that takes into account a wide range of plausible model specifications. While the correlation between Cistercians and population growth proves robust, all models that aim to identify a causal effect either rely on specific and hard to justify choices regarding the operationalization of central constructs or fail to provide confirmatory evidence at all. The chapter concludes with recommendations on how to study the cultural and economic impact of Christian orders more systemically.

Chapter 5 provides a selective summary of the results and contributions as well as a brief outline of central avenues for future research.

Table 1.1: Summary of the three studies.

	Chapter 2	Chapter 3	Chapter 4
Research question(s)	Can cumulative growth curves of orders be modeled using traditional diffusion models? Is the pattern of diffusion influenced by legitimacy?	How effective were systems of visitations in stabilizing monastic communities?	Did Cistercian presence stimulate economic growth via the diffusion of values of hard work and thrift?
Dependent variables	New foundings per year, cumulative number of foundings	Dissolution of a monastery	Population growth, individual attitudes toward work and thrift, regional employment
Core predictor variables	Current number of monasteries, number of similar orders	Travel distance to supervising institutions	Various measures of Cistercian presence
Unit of analysis	Time points nested within orders	Time points nested within monastic communities	English historic counties, respondents (European Value Study), NUTS2 regions
Methods	Non-linear least squares, linear multilevel models	Event history analysis (Cox models)	Instrumental variable regression (2SLS), ordinary least squares regression
Main data sources	Snyder (2008), Clunypedia (2022), Analecta Cartusiana (2022), English Monastic Archives (2015), Goudriaan (2019)	Snyder (2008), Clunypedia (2022), Analecta Cartusiana (2022)	Andersen et al. (2017), English Monastic Archives (2015), EVS (2020)

2 Did religious orders spread like viruses?

In the last decade, sociologists of religion have become increasingly interested in the explanation of the spread of historical religious movements. The conditions of the success of the Reformation and the rise of early Christianity have been two of the most active areas of research. For example, Kim and Pfaff (2012) use information of students' place of origin from historical matriculation lists to show that towns with stronger ties to the universities of Wittenberg and Basel – centers of the Reformation – were more likely to adopt the new faith. A recent review by Everton and Pfaff (2022) provides an overview of methods from the diffusion of innovation literature that have been applied to the study of historical religious movements. *Diffusion of innovation* in a sociological sense encompasses the "spread of new ideas, behaviors, technologies, and institutions" (Everton and Pfaff, 2022: 431).

The authors stress the usefulness of social network analysis, like the already cited work by Kim and Pfaff (2012), as the most direct approach to studying diffusion. However, network analysis has demanding data requirements. It is striking that most of the studies reviewed by Everton and Pfaff focus on the modern or early modern period but none on the Middle Ages. This is surprising considering the dynamics of religious change during the European Middle Ages and may be explained by the considerable difficulty in obtaining adequate data. The few studies that go even further back in time and focus on the antiquity often do not observe network ties directly but infer them based on untestable assumptions. A popular approach is *proximal point analysis* (PPA) which "connects sites by linking each to its k nearest neighbors, typically three" (Everton and Pfaff, 2022: 439). For instance, Collar (2013) uses PPA to construct a network among archaeological sites to trace the transmission of Rabbinic Judaism through the ethnic network of the Jewish Diaspora.

Network analysis is undoubtedly a powerful tool and a natural choice for research on religious diffusion processes. However, if data in certain historical periods is sparse and network connections have to be imputed, it loses some of its competitive edge. At a minimum, it might be useful to consider other highly theory-laden methods that are based on a different set of assumptions in order to increase robustness and harness sources of data not suitable for network analysis.

The simplest form of data relates to the macro-level of the social system, such as a time series on the size of a religious movement. In his book *The Rise of Christianity* Rodney Stark exemplifies the power of interpreting historical macro-data through the lens of a basic

formal model of movement growth. He utilizes an exponential growth model to show that estimates of the Christian population during the 3rd and 4th century are the plausible result of a growth rate comparable to what has been observed for modern religious groups. Hence, explaining Christian growth does not require mass conversions, whose existence is rather dubious, as had been claimed by other authors (Stark, 1997: 3–13).

The present chapter will likewise explore the usefulness of models at the system-level for the study of historical religious movements. More specifically, it will import simple models from the classical "diffusion of innovation" literature:

> Diffusion curve analysis scrutinizes the rate at which actors in a social system adopt innovations (in the form of new ideas, new behaviors, or new institutional structures). By abstracting away from the individual actor's adoption, diffusion curve analysis estimates network effects and external effects with much more modest data requirements than actual network analysis. (Rossman et al., 2008: 202)

The most basic mechanism within this class of models is related to epidemiological models of contagious viral spread. Potential adopters of a behavior randomly mix with carriers of a behavior. If a so-far "uninfected" actors meets an already "infected" actor, the behavior is mechanically transmitted with a certain probability. The process is self-reinforcing because the stock of "infected" actors grows over time, thereby increasing the probability of a random meeting until the pool of potential adopters becomes too small. This mechanism produces the well-known S-curve pattern of slow – fast – slow growth.

It has been previously suggested that the cumulative growth of medieval religious orders follows an S-curve and is, therefore, the result of a contagious diffusion process (Grübler, 1996; Snyder, 2008, 2009; Brissaud, 2009). Because data on individual membership does not exist for the Middle Ages, growth is measured as the number of foundations of monasteries and religious houses. However, the cited studies neither use adequate statistical methods to test the proposition nor do they state with sufficient clarity what could theoretically be learned from this finding. The present chapter attempts to go beyond these descriptive studies and to systematically apply theoretical ideas from the diffusion of innovation literature in order to explain differences in the observed pattern of cumulative growth.

Religious orders can be conceptualized as quasi-sects within the Roman Catholic Church (Finke and Wittberg, 2000). Beyond their specific relevance for the history of the Church and history in general, they are examples of religious movements with strict membership requirements (e. g. poverty, celibacy, and life-long commitment) whose religious virtuosity often is in tension with general society. Understanding their diffusion can help to shed light on the conditions of success of "sect-like" religious groups. Moreover, as mentioned above, understanding the spread of *medieval* religious movements fills an important research gap in

the quantitative sociology of religion that has so far neglected the Middle Ages. At the same time, orders are the perfect testing ground for the application of the diffusion models to the growth of religious groups. In contrast to many other religious movements, vows of chastity prevent *religiosi* from procreating. Therefore, orders lack biological growth which permits a specific focus on how religious ideas with radical implications for the life of "adopters" spread in susceptible populations.

The goal of this chapter is threefold: First, I will test the claim that the growth of orders regularly exhibited an S-curve pattern consistent with contagious diffusion. By means of appropriate tests, it is also possible to determine whether a trajectory, that at first sight appears to be S-shaped, is really consistent with a contagion process, or whether it is necessary to resort to alternative explanations such as social learning or threshold models (Young, 2009). Second, while it is true that some orders were – at least for a time – decentralized movements that spread predominantly via word-of-mouth and personal contacts, most were organizations embedded in the ecclesiastical and political institutions of their time. Institutional promotion, but also charismatic and skillful leaders, are external factors that can operate independent of previous growth. The empirical analyses will explore the relevance of such external influences for the spread of medieval orders. Lastly, the degree of externally determined vs. contagious spread might be moderated by a movement's legitimacy. Only orders that were perceived to be within a legitimate tradition could be promoted by influential change agents whereas radical and innovative groups that deviated strongly from earlier forms of religious life could only spread incrementally via contagion in personal networks.

2.1 Models of social diffusion

The application of diffusion models has *prima facie* plausibility. Order were often supported by the Church authorities and rulers but their expansion did not follow a central and rational plan. Many orders were founded without the prior approval by Church and only later officially recognized. They were genuine movements, emanating from the ideas of charismatic founders who were able to mobilize public support for their ideals (Wittberg, 1994).

The importance of personal contact during the Middle Ages is already attested by the lack of long distance communication as well as the illiteracy of the majority of the population. Even monastic orders whose life was mostly confined to the walls of the cloister had personal contact to the outside world. As Lekai (1977: 378–379) remarks about the Cistercians, "[a] vital link between the monasteries and their secular environment was the fact that the enclosed abbeys harbored the sons (in some cases, the fathers) of those who remained outside. [...] Although twelfth-century Cistercians cherished nothing more than the solitude of their self-chosen 'deserts,' the sweeping success of the Order can only be explained by a fruitful

interaction between those desert-abbeys and their surroundings." The monks employed laymen as laborers, they recruited monastic personnel from the local gentry, accommodated guests of all social strata (hospitality was a "traditional monastic service"), and formed pious confraternities for wealthy benefactors. Like many medieval Christian institutions, Cistercian monasteries were also involved in alms-giving and some abbeys even maintained hospitals. The legend of Bernard of Clairvaux, an influential Cisterian abbot, claims that he arrived with more than 30 young noblemen of Burgundy, his friends and relatives, who were convinced by him to collectively seek admission into the monastery (Lekai, 1977: 34). The story can be interpreted to demonstrate both his qualities as a charismatic leader and the relevance of personal networks.

The incentives for membership as well the social strata of potential postulants varied between orders as well as the time periods included in the study. The diffusion models abstract from such details. They likewise abstract from the exact process of foundation. Foundations were sometimes initiated by the orders themselves, other times they were invited by noble founders or wealthy laypeople. Especially orders whose economic model was based on agriculture and hence landed property were dependent on donations by wealthy benefactors. Therefore, in a strict sense, potential adopters consist of two separate groups: providers of material support and potential recruits. However, this differentiation will not be modeled explicitly.

The following section briefly reviews basic diffusion models. While discussing the theoretical concepts, I will use terms referring to the individual level like "actors" and "potential adopters," even though the empirical test will utilize data on monastic foundations. The number of religious houses will be treated as a proxy for the underlying diffusion process among the population of potential adopters. Moreover, the models do not assume that every inhabitant within the respective geographical region is a potential adopter. Potential adopters are the subset of the general population that is in principle susceptible to be persuaded to join an order.

2.1.1 Internal influence

In the classical approach there are two ideal-typical processes, often termed *internal* (or endogenous) and *external* (or exogenous) influence model (Rossman et al., 2008; Mahajan and Peterson, 1985: 12–25). Internal influence refers to the spread of technological innovations, ideas, information, and cultural practices via personal contact. However, the model abstracts from the personal networks within a population. The basic idea is that the rate of adoption is a function of the number of prior adopters. A religious movement starts with few members who are in contact with the population of potential adopters and convince a few others to join. As the number of members increases, more people are proselytizing and the movement's

growth accelerates – up to the point where the pool of potential adopters becomes too small. Growth stalls because the probability of prior adopters to be in contact with susceptible individuals is diminishing. When looking at the cumulative number of adopters over time, this pattern of slow initial growth, followed by a rapid increase and eventual tapering off produces an S-shaped curve. Mathematically, the rate of adoption in this model is often expressed as a differential equation[1]

$$\left(\frac{dN_t}{dt}\right) = bN_t(N_{\max} - N_t) \tag{2.1}$$

where N_t are prior adopters at time t multiplied with the remaining risk pool that equals the maximum number of adopters N_{max} minus the number of prior adopters. The coefficient b reflects the adoption tendency. Integrating this function yields the logistic cumulative adoption function that produces the S-curve with N_0 indicating the value of N at $t = 0$

$$N_t = \frac{N_{\max}}{1 + \frac{N_{\max} - N_0}{N_0} e^{-bt}}. \tag{2.2}$$

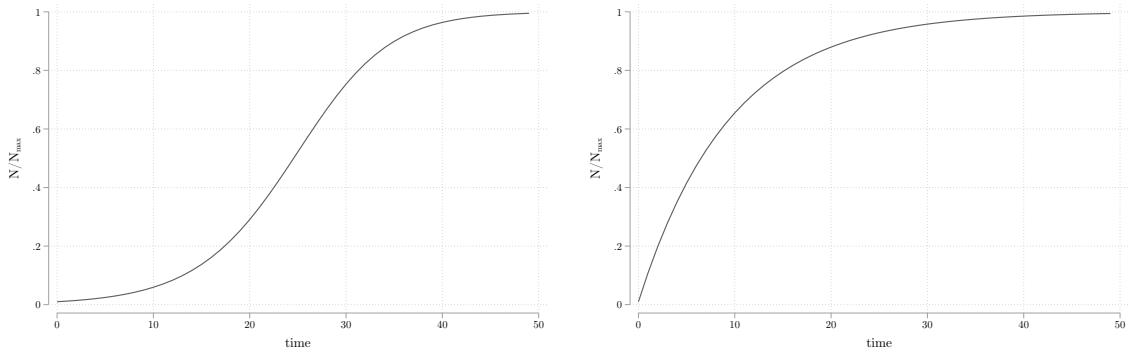
The terms "internal" or "endogenous" refer to the fact that, given a small number of initial adopters, a cascading process or chain reaction ensues that stops once the susceptible population is fully converted.

The model's micro-foundation is implicitly based on the assumption of *random mixing*, i. e. every actor has an equal probability to interact with every other actor (Mahajan and Peterson, 1985: 24). Hence, social networks are irrelevant because there are (potential) ties between everyone. In a homogeneously mixed population, the probability to have contact with a prior adopter is proportional to N_t. Furthermore, the model does not only abstract from interpersonal networks but also from the individual decision to adopt an innovation, or in the case at hand, join a religious group. In contrast to models rooted in decision theory, it is "based on the notion of *exposure* rather than on utility maximization" (Young, 2009: 1900). Because personal contact remains the theoretical channel of transmission and because the transmission happens via mere contact, such a process is often metaphorically described as a *contagious* process (Rossman et al. 2008: 206; Young 2009: 1902–1904). The model is agnostic regarding the exact mechanism which can be thought of as resulting from active persuasion or imitation.

A different motivation for the same model speaks of *population growth* rather than contagious diffusion among an existing population (Hannan and Carroll, 1992: 51–52). Though orders do not grow via biological procreation, this perspective is attractive for the present study because it helps to clarify the model's assumptions. The data on the

[1] Mathematical notation follows Rossman et al. (2008) for the most part.

Figure 2.1: Ideal typical diffusion curves: Examples of cumulative adoption functions of pure internal influence (logistic function, left) and pure external influence (confined exponential function, right).



foundations of medieval orders covers a time-span of a couple of hundred years. In the simple internal influence model, adopters are in an irreversible state and accumulate over time. It seems like a gross oversimplification to describe the spread of an order that spans multiple generations using a model that assumes a stable population of adopters. However, the population growth perspective shows the harmlessness of the simplification. Changing the assumptions and incorporating generational replacement of the adopter population also yields Equation 2.1 (see Appendix 2.A). The factor b has a slightly different interpretation because it does not simply reflect the adoption tendency but rather the adoption rate minus the death rate among members of an order.

It should be noted that there are diffusion processes besides pure contagion or imitation as well as non-diffusion processes that will also result in a sigmoid cumulative adoption curve (Young 2009, Rossman et al. 2008: 207–209, Martin 2009: 156–164). Some of these models as well as the difficulties in empirically distinguishing among them will be discussed in Section 2.1.5.

2.1.2 External influence

The second ideal-typical model is the external (or exogenous) diffusion model. In contrast to internal diffusion, the model captures processes that are not driven and accelerated by the number of prior adopters. The rate of adoption is constant and is often interpreted as spontaneous adoption without social influence. Hence, the number of new adopters is solely a function of the size of the remaining risk pool of susceptibles. The diffusion process starts with fast growth and slows down over time. This idea is expressed in the differential equation

$$\left(\frac{dN_t}{dt}\right) = a(N_{\max} - N_t) \tag{2.3}$$

where the parameter a equals the strength of a constant external influence. The cumulative adoption distribution can be derived by integration

$$N_t = N_{\max}(1 - e^{-at}). \tag{2.4}$$

This confined or negative exponential growth model produces a concave curve with immediate fast growth followed by slow growth (Rossman, 2014: 51).

The constant rate of adoption is termed "external" under the assumption that factors unrelated to the interaction of actors in the social system, like marketing with a fixed budget per period, have a more or less constant probability of reaching potential adopters. One might argue that the sparsity of long-distance communication makes this kind of diffusion rather unlikely to occur in the Middle Ages. But there are in fact several plausible "change agents" (Mahajan and Peterson, 1985: 15) which could be modeled as a constant growth factor in the spread of historical orders:

- *Promotion by wordily or ecclesiastical institutions*: For example, the Carolingian dynasty promoted the foundation of monasteries to "pray perpetually for the stability of [the] kingdom" and because "abbeys on the frontiers [...] performed an important role in colonising newly conquered territories" (Lawrence, 2015: 64). The church hierarchy also supported orders in various ways, like recommending "it to the laity for financial support and new recruits" (Wittberg, 1994: 77). Such institutional promotion can operate independently of previous growth.

- *Influence of important leaders*: For example, Bernard of Clairvaux, the most preeminent abbot in the history of the Cistercian order, was incessantly traveling in an official capacity of the church. During the 1130s alone, he traveled through north-western France (1131), to Aquitaine (1132), through Italy (1133), to the diet of Bamberg (1135), the synod in Pisa (1135), Rome (1135), then back home and through Italy again (1337–1338).[2] "The Cistercian Order grew and expanded with his own expanding fame and popularity. His biographers remarked that the power of his eloquence was such that 'mothers hid their sons and wives their husbands' in order to keep them safe from the Saint's recruiting efforts" (Lekai, 1977). It seems plausible to model the influence of one person's traveling as a constant factor.

- *Legitimacy from categorical conformity*: Rossman (2014) argues that innovations nested within existing and legitimate categories are more likely to spread exogenously. "Diffusion can be rapid when the innovation is similar to incumbent practices and compares favorably along well-established criteria" (Rossman, 2014: 53). As long

[2] Based on the list provided by Snyder (2008: 72). These are only the documented and known travels (see Snyder, 2008: 71 Fn 7).

as the actors are aware of the movement, some might join spontaneously without persuasion or other means of direct contact. For example, the Cistercians were a reform movement within Benedictine monasticism that may have been more legitimate from the beginning than new foundations that deviated from the established model such as the first mendicant orders. The latter rejected many elements of the traditional religious life structure while introducing ideas hitherto unknown to Western monasticism: most notably, the rejection of even *collective* property and the abandonment of seclusion in the cloister (Lawrence, 2015: 219). Many orders sought to increase their legitimacy among church authorities, benefactors and potential members by adopting time-honored monastic rules while radical innovators like Francis of Assisi drew up their own rule.[3] "Insofar as their new ideology of virtuoso spirituality replicates the old [...] its elements would simply be taken for granted as normal and natural" (Wittberg, 1994: 142). Radical religious movements are expected to diffuse contagiously via personal contacts while groups that are *ab initio* perceived as being within a legitimate tradition may spread via constant hazard.

2.1.3 Mixed influence

The internal and external influence models can be easily combined in a mixed influence model subsuming both previous models as special cases (Bass, 1969; Mahajan and Peterson, 1985: 21–22). The differential equation now contains two parameters, reflecting external (a) and internal (b) influence:

$$\left(\frac{dN_t}{dt}\right) = (a + bN_t)(N_{\max} - N_t). \tag{2.5}$$

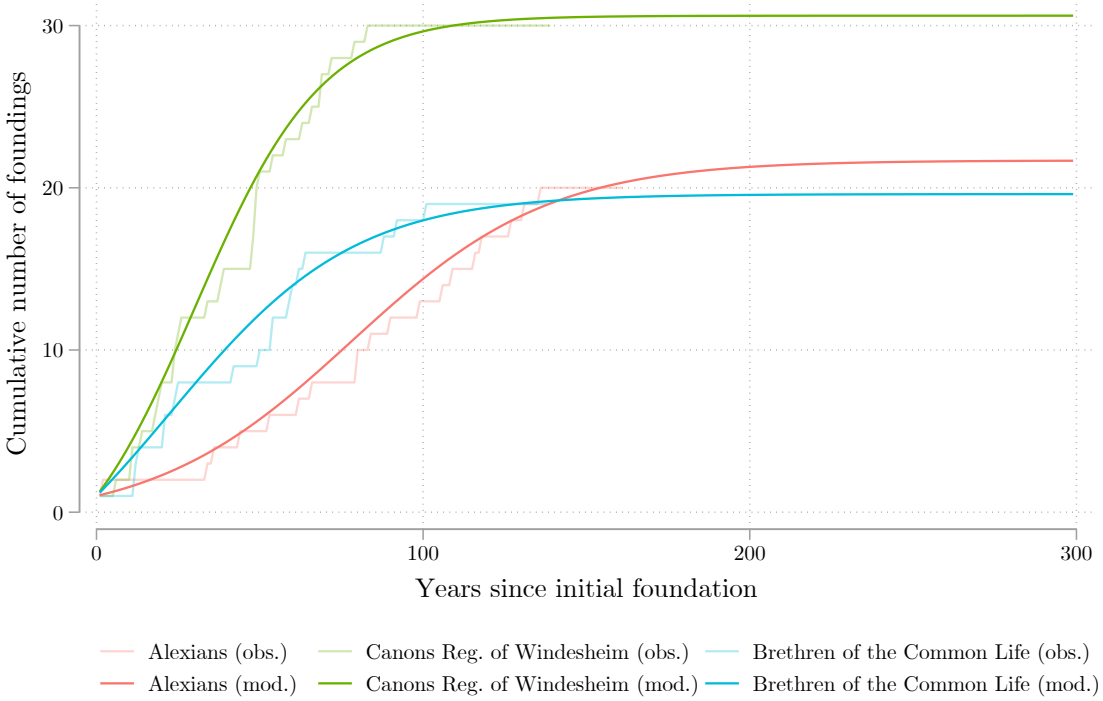
The equation is known as the *Bass model* due to its popularization by Bass (1969).[4] By integration we arrive at the cumulative adoption function

$$N_t = \frac{N_{\max} - \frac{a(N_{\max}-N_0)}{a+bN_0} e^{-(a+bN_{\max})(t-t_0)}}{1 + \frac{b(N_{\max}-N_0)}{(a+bN_0)e^{-(a+bN_{\max})(t-t_0)}}} \tag{2.6}$$

[3] Above else, the Rule of Saint Augustine became a popular choice, mainly because of the legitimacy attached to the author, Augustine of Hippo. According to Southern (1970: 242), "[a]s a 'Rule' its great beauty was that it left so much to the imagination." It was a document "whose prestige more than its substance met the technical objections" against new orders who were looking for an alternative to the Benedictine rule (Georgianna, 1981: 15).

[4] Mansfield (1961) anticipated the equation in his study of varying rates of imitation for different technological innovations. However, he treated the factor a as an atheoretical constant, whereas Bass gave a theoretical justification for both (Rossman et al., 2008: 210, Fn 8).

Figure 2.2: Exemplary predicted growth curves based on mixed influence models of three orders in the Netherlands during the Middle Ages (see Section 2.4 for a description of the data). The Alexians spread predominantly via internal influence with a visible logistic sigmoid curve; the Brethren of the Common Life spread mostly, but not entirely, via external influence. The growth curve of the Canons Regular of Windesheim is produced by a mixture of internal and external influence. It has characteristics of both ideal-typical shapes.



with N_0 indicating the initial number of adopters at time $t = 0$.[5] The resulting curve is a mixture of the confined exponential and logistic growth model (see Figure 2.2). Empirically, it is not just possible to estimate the relative importance of external and internal influences but to model the parameters themselves as outcomes. This approach to the *explanation* of diffusion curves was pioneered by Mansfield (1961) and has been extended by Rossman et al. (2008). The goal would be to predict variation in the degree of endogenous or exogenous diffusion using explanatory characteristics of the religious movements.

[5] Re-expressing the model in terms of the cumulative probability function $F(t)$ rather than N_t as well as setting $F(0) = 0$ leads to a more transparent equation

$$F(t) = \frac{1 - e^{-(a+b)t}}{1 + \frac{a}{b}e^{-(a+b)t}}.$$

It is now easily recognized that the curve's overall shape is determined by the ratio of a and b which can be thought of as a single parameter (Jackson, 2010: 187).

2.1.4 Possible extensions

These three basic models can be extended in a number of ways (Mahajan and Peterson, 1985: 35-54). This includes models for spatial diffusion as well as multi-innovation models for the simultaneous spread of complements and substitutes. In the following, I will briefly review two relevant extensions that pertain to the vast timespan of the present study. A valid criticism of the diffusion approach to the study of religious orders concerns the stability of the parameters such as a, b, and $N_{\max}$. When studying long-term societal processes, it is likely that fundamental parameters change due to manifold factors such as political and institutional disruptions or demographic trends. Therefore, it can be necessary to not just account for characteristics of the order that might explain varying diffusion patterns but also to include time-varying context variables. For example, population growth might increase the internal influence parameter due to higher population density facilitating the transmission of information. Or it may increase the maximum number of adopters simply because a larger population also contains more potential members.

The latter concern can in principle be alleviated by endogenizing $N_{\max}$ as a function of time-varying population characteristics S_t

$$N_t^{\max} = f(S_t)$$

where t now indexes time. By substituting $N_{\max}$ in Equation 2.5 we obtain a dynamic diffusion model (Mahajan and Peterson, 1985: 35-54):

$$\left(\frac{dN_t}{dt}\right) = (a + bN_t)(f(S_t) - N_t). \tag{2.7}$$

The extension is conceptually straightforward. The main challenge is empirical in nature. Although there exist estimates of changes in the European population size during the Middle Ages (Russell, 1972), such figures, besides their highly speculative character, are also usually available only for fairly wide time intervals (of 100 years or more). It is difficult to combine this kind of estimates with the more fine-grained data on monastic foundations necessary to detect features of adoption curves. Results from models that interpolate the missing values are typically quite sensitive to the exact assumptions used in the procedure.

Relatedly, one might object that the spread of religious movements in geographically wide-spanning regions is very likely not the outcome of a single, prolonged diffusion process but of multiple and sometimes overlapping developments. The random-mixing assumption could be violated with the consequence that subpopulations are segregated along linguistic, cultural or ethnic lines (or simply by geography). In such case, an order could initially spread among the population in one particular region and only later encroach upon a neighboring, culturally-distinct population that has limited cultural exchange with the region of origin.

In the simplest case, the basic models can be extended to account for two simultaneous diffusion processes. The principle can be illustrated with the cumulative adoption function of a *bi-logistic* diffusion model (Fokas, 2007: 18–19):

$$N_t = \frac{N_1^{\max}}{1 + N_1^{\max} e^{-b_1 t}} + \frac{N_2^{\max}}{1 + N_2^{\max} e^{-b_2 t}}. \tag{2.8}$$

The cumulative number of adopters is the sum of two logistic functions. There are two ceiling parameters ($N_1^{\max}$ and $N_2^{\max}$), one for each logistic function, as well as two parameters of internal influence (b_1 and b_2).

The model has four parameters and thus is very flexible.[6] It can be fitted to aggregate growth processes with a wide variety of forms. For this reasons, its value is mainly descriptive. If an observed diffusion pattern does not match the simpler models, something like bi-logistic diffusion can be a starting point in the search for more elaborate explanations. However, the fact that such a model fits the data does not in itself provide strong corroborative evidence in favor of the postulated contagion process.

2.1.5 Other diffusion processes

The following section briefly discusses alternative processes that may drive the diffusion of cultural practices. The focus will be on parsimonious models of aggregate macro-dynamics most popular in the sociological literature on diffusion.[7]

Population heterogeneity without social interaction

The simplest alternative explanation for "why innovations take time to diffuse" is that "people sometimes delay in acting on new information" (Young, 2009: 1902). Even if everyone is aware of an innovation, some might be more hesitant than others and therefore wait longer before they finally adopt. Martin (2009: 158 Fn8) contents that it is nearly impossible to distinguish a contagious process from a heterogeneous propensity to adopt. If the propensity to adopt is normally distributed, "the cumulative density function is basically the same as the logistic."

The external influence model can be generalized to accommodate the idea that people are differentiated with regard to their adoption tendency. The cumulative adoption function

[6] "With four parameters I can fit an elephant, and with five I can make him wiggle his trunk" (attributed to John von Neumann: Dyson, 2004). There are even more flexible variants that model the processes as consecutive, i. e. the second diffusion process starts with a time-lag (Fokas, 2007: 18–19).

[7] For example, I shall not discuss models of social learning that are explicitly decision-theoretic. Such models are based on the idea of "learning from the experiences of others." The adoption of an innovation or practice has observable consequences. Thus, the payoff to prior adopters reveals information that actor use to update their own expected payoff from adoption (for a discussion of such models in the context of the diffusion of technological innovation: Young, 2009).

after replacing the constant a with the density function $f(x)$ of an assumed variable adoption tendency x is

$$N_t = N_{\max}(1 - \int e^{-xt}\, df). \tag{2.9}$$

The second derivative with respect to t is negative irrespective of the distribution of $f(x)$ (Young, 2009: 1902). Thus, the cumulative adoption curve is always concave and cannot be S-shaped. Not "[a]nything that goes from around zero to some upper bound without decreasing is pretty much guaranteed to follow a similar curve" (Martin, 2009: 158). Fortunately, the underlying mechanisms do impose some restrictions on the curve's shape that can be leveraged for empirical testing.

SIR-models

Hayward (1999, 2005) applied the idea of social contagion very explicitly to the spread of religious movements. His mathematical models of church growth draw on the epidemiological literature about infectious diseases. More specifically, he uses a variant of the SIR-model (SIR = susceptible-infected-removed) which is a working horse of epidemiological modeling (Earn, 2008). The population in these models is divided into three states: susceptibles who are at risk of infection; infectives who are spreading the disease; and people "removed from the system after having had the infection" (Hayward, 1999: 262). The equivalents in the religious sphere are potential converts; converted "enthusiasts" who are actively recruiting new converts to the religious group; and adopters of the religion who are no longer enthusiastic but passive and non-recruiting. Therefore, in contrast to diffusion models, infected persons (or adopters) do not remain contagious but loose their "enthusiasm" over time. Hayward's (1999) model predicts that many religious movements may stop growing because they run out of recently converted enthusiasts even though the pool of susceptibles is not yet depleted. However, the empirical analyses will not consider the church growth model since a satisfactory test of the church growth model – one that would allow to distinguish between a diffusion process with and without waning enthusiasm – would require data on the number of active enthusiasts which is not available for most historical periods.[8]

Social influence

Another class of models are social influence or *threshold models*, first studied by Schelling (1971) and Granovetter (1978). Actors are assumed to have varying thresholds reflecting

[8]It would be possible to assume that 1) being a religious was a lifelong vocation 2) therefore, monks, friars etc. remained enthusiastic their whole life and then set the respective parameter to a constant equal to 3) an estimate of the mean life years spent in a monastery. Based on the evidence from two London priories (Cluniac and Augustinian), this might have been in the ballpark of 30–35 years since monks entered the monastery on average at the age 15 and the majority died in their forties (DeWitte et al., 2013). However, such an approach raises methodological challenges and questions deserving their own paper.

their degree of responsiveness to social influence (Young, 2009: 1905). *Ego* will adopt novel cultural practices only if at least a certain fraction of *alteri* has already adopted them. These models can either be network-based (Valente, 1996) or simply aggregate popularity in a collective (Granovetter, 1978). The assumption is that actors decide based on popularity alone but not based on "how good or desirable the innovation has proven to be" (Young, 2009: 1905). The thresholds are open to multiple interpretations. Popularity could be a signal of the desirability of a monastic lifestyle but thresholds may also reflect susceptibility to social pressure or an inclination towards conformity.

The possible patterns of population-level adoption resulting from such a process are variegated. Young (2009) makes additional assumptions in order to derive testable implications. Under plausible conditions, "if the process accelerates initially, then it accelerates initially at a superexponential rate for some period of time" (Young, 2009: 1909). A pure contagion process cannot accelerate superexponentially.

2.2 Empirical implications of diffusion models

The traditional diffusion perspective has been criticized for a lack falsifiable implications. While the Bass model and other variants of internal and external influence models have been successfully used in forecasting (Mahajan and Peterson, 1985), various authors have questioned its sociological fruitfulness. According to Braun et al. (2012: 223–225), system-level approaches like the analysis of aggregate diffusion processes have descriptive value but are inadequate for explanatory reconstructions. They illustrate the problem with data on the growing number of participants in the Monday demonstrations in Leipzig over a period of several weeks in the fall of 1989. The logistic model and the confined exponential model fit the data equally well which makes any decision for or against one of the models seem arbitrary.

Martin (2009: 156–156) is even more pessimistic regarding the utility of contagion models – including extensions such as the Bass model – because manifold micro-level processes are compatible with a logistic or generalized S-shaped curve and the contagion model "always appears to fit changes that go from low to high and stay there" (Martin, 2009: 159). However, Young (2009) has shown that it is possible to distinguish empirically between various diffusion processes using aggregate data. Competing explanations such as contagion, social influence and social learning leave footprints in, at the first glance, similar looking S-curves. What is more, as has been discussed in Section 2.1.5, the assertion that heterogeneity in the openness to new cultural practices is enough to produce sigmoid curves seems to be wrong.

Thus, one approach to hypothesis testing is to pay more attention to theory-guided restrictions on the shape of the curve. Another approach is to develop hypotheses regarding systematic variation in the parameters governing the shape of the cumulative adoption

function (Mansfield, 1961). Even though it may be almost always possible to fit some sort of curve to aggregate data, it is also possible to predict the features of the trajectory based on theoretical arguments. Cultural sociologist Gabriel Rossman has contributed to this line of work both theoretically (Rossman, 2014) and methodologically (Rossman et al., 2008) focusing on the mixed influence model. He speculates that the common interpretation as a "non-social" residue is responsible for the low interest in external influence processes compared to contagious processes and urges researchers to pay more attention to the (social) circumstances determining the relevance of external vs. internal influence (Rossman, 2014: 62–63).

2.2.1 Contagion vs. other processes

Using historical data on three major monastic orders – the Cluniacs, the Cistercians, and the Carthusians – I will first test the hypothesis that their growth during the High and Late Middle Ages (900–1500) is the result of a contagious social process with additional external influence. As Young (2009: 1904) has shown, the internal influence model as well as the Bass model implies that the hazard rate decreases relative to the number of adopters (see Appendix 2.B). This restriction on the adoption curve is empirically meaningful because it is easy to generate S-shaped curves that violate the requirement. The findings of such a test provide corroborating evidence for or against the hypothesis of social contagion.

2.2.2 Internal vs. external influence

Moreover, using the same data, I will use a descriptive, case-wise modeling strategy to test whether external influence is observable for the Cistercians but not the other two orders. As explained in Section 2.1.2, a plausible source of external influence was the public works of important leaders. While the Cluniacs as well as the Carthusians did have influential members[9], none of them was constantly traveling like the already mentioned Bernard of Clairvaux. The fact that the latter was indisputably one of the most visible figures of the medieval church, very likely contributed to the enormous success of the Cistercians during the 12th century (Lekai, 1977: 33). For example, Rasmussen (2015: 50–54) has shown that regions visited by Bernard during one of his journeys in 1145 acquired more additional

[9]One of the most notable Cluniac publicist during the Middle Ages was Peter the Venerable (1092–1156), a contemporary of Bernard of Clairvaux (1090–1153). The most notable Carthusian monk was very likely the order's founder, Bruno of Cologne (1030–1101). He was a close adviser to Pope Urban II (1035–1099), another influential Cluniac monk, who initiated the First Crusade. The Second Crusade was proclaimed by Pope Eugene III (1080–1153), the first Cistercian pope, who entered the Cistercian order due to Bernard's influence. Bernard's standing among these formidable men is easy to prove: He was canonized in 1174, only 21 years after his death. The only other Saint among the aforementioned, Bruno of Cologne, was canonized in 1623 – more than 500 years after his death. Moreover, Bernard was pronounced *Doctor of the Church*, a rare honor that has been bestowed on only 37 men in the history of the Church.

monasteries in the ten year period afterwards than the rest of France. Hence, I expect that the Cistercians grew primarily with a constant rate *during Saint Bernard's abbacy* but endogenously otherwise. Consider two re-specifications of the mixed-influence model (Equation 2.5):

$$\left(\frac{dN_t}{dt}\right) = (a_0 + a_{1t} + bN_t)(N_{\max} - N_t) \tag{2.10}$$

$$\left(\frac{dN_t}{dt}\right) = (a_t + bN_t)(N_{\max} - N_t) \tag{2.11}$$

the first with one permanent constant external influence (a_0) and a second (a_{1t}) only present during the time of Bernard of Clairvaux's travels in the services of the Church; the second including the external factor only during the period of Bernard of Clairvaux's public works. The prediction is that the Cistercian diffusion process will be best described by the more restrictive Equation 2.11. The other two orders, who did not have the benefit of a coequal public figure, are expected to have diffused mainly via internal influence and to show only marginal growth due to external influence.

2.2.3 Legitimacy and external influence

Lastly, I will test the hypothesis that the degree of spread via external influence is related to the perceived legitimacy of a religious order. Rossman's (2014) argument has already been sketched (Section 2.1.2). His basic proposition is that "[o]nly innovations that are nested within legitimate categories may have an exogenous diffusion pattern" (Rossman, 2014: 55). If a religious group is too different from known categories, then most people will be reluctant to adopt. For example, men seeking salvation through the ascetic program of consecrated life could have been more inclined to join traditional orders while adherence to new, not yet generally accepted doctrines was perceived as a risky choice. Donors and benefactors providing financial support in order to secure their own salvation were likewise drawn to legitimate forms of orders, especially if the novel interpretation of religious virtuosity was not yet recognized by the church (Wittberg, 1994: 72). Reform movements within existing categories, like the monks of Cluny or Cîteaux within Benedictine monasticism, were "undertaken as a return to roots, that is, to a primitive observance of the rule in its pristine meaning" (Hostie, 1983: 18). Even when they introduced new spiritual and organizational elements, it was in order to outperform incumbent religious communities "along well-established criteria" (Rossman, 2014: 53), so to speak. The early Cistercians strove for a more austere asceticism than other Benedictine monks, preferring simplicity in architecture and clothing as well as reintroducting manual labor as a mandatory activity for choir monks (Kieser, 1987; Lekai, 1977: 26). Austerity and the guiding precept *ora et*

labora were well established ideals before the Cistercians. Radical movements, however, will spread endogenously via personal networks. Potential members have to be convinced to adopt the new way of life via active persuasion or the observation of actual practice. Hence, "[i]nnovations that deviate from extant categories will either diffuse via increasing hazards or not at all" (Rossman, 2014: 55). The non-diffusion of some innovations implies that non-legitimate orders are expected to be on average less successful in terms of total foundations compared to legitimate innovations. This prediction is in line with well-known theories from the sociology of religion which argue that "[n]ew religious movements are likely to succeed to the extent that they retain cultural continuity with the conventional faith(s) of the societies in which they seek converts" (Stark, 1996: 136).

Following this argument, legitimacy is a precondition for exogenous channels like important personalities or institutional support to produce diffusion via constant hazard. It may even increase the prevalence of spontaneous adoption in general, especially if secular benefactors are more likely to support the foundation of a monastery affiliated with the new order. At the same time, the repeated spread of orders from a novel category will help to establish legitimacy and institutionalize the category (Rossman, 2014: 56).

This theory can be tested by comparing the diffusion curves of as many orders as possible. Moreover, it must be somehow possible to operationalize the rather abstract idea of a "category." There are two characteristics of orders that can be used for this purpose. The first refers to the *rule*. Orders, especially when seeking papal approval, adopted a rule as the foundation of common life (Hostie, 1983: 15–16). The most common rules were the Rule of Saint Benedict and the Rule of Saint Augustine. The latter rose to prominence during the 12th century when the canons regulars established themselves as an alternative to traditional monasticism (see Fn 3 and Hostie, 1983: 16, 78–79). The rule only provides a basic framework. Even orders who share the same rule distinguish themselves through different organizational constitutions as well as customs and usages or a fourth vow that singles out a specific mission (Hostie, 1983: 16,20). However, rules and "scriptural models" were important devices to tie an order to a legitimate tradition of religious life (Wittberg, 1994: 142). Orders that adopt new or less established rules are therefore expected to spread endogenously or not at all.

The second property is the *type* of order. Orders became more differentiated over time and were increasingly characterized by diverse "charisms" and ways of life. As explained in the introduction, it is now customary to distinguish at least between monks, canons regular, friars (mendicants), knights (military orders) and clerics regular. Even though every strict categorization is somewhat anachronistic and post-medieval, it captures important differences and similarities of orders (for example: Wittberg, 1994: 197–205).[10] The corresponding

[10]However, categorizations vary. Some authors add separate categories for hermits (eremitical orders) or hospital orders (Aston, 2001). Others categorize hospital and military orders as subgroups of canons (Hostie,

hypothesis is: The more orders of the same type have settled in a region, the more legitimate the type should be. Orders of rare types are expected to spread endogenously while orders of common types are expected to spread more exogenously on average. Female orders will have their own categories for they were always perceived differently. Female religious did not enjoy the same legitimacy as their male counterparts which was especially true in regard to their treatment by the official church (Southern, 1970: 309–319; Wittberg, 1994: 73).[11]

2.3 Previous research

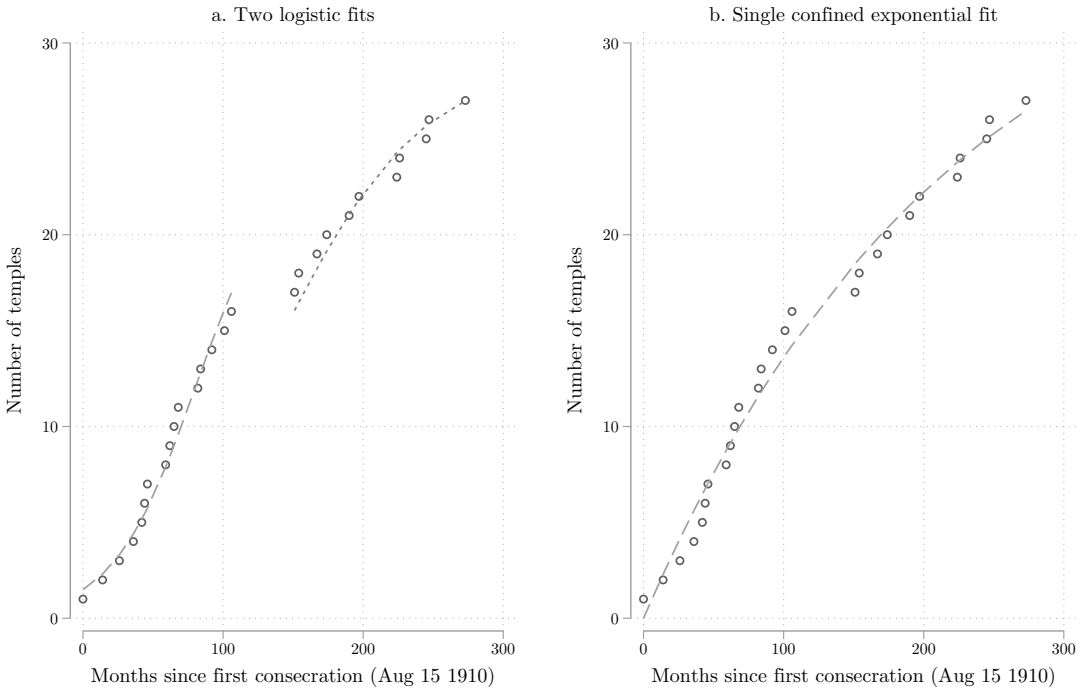
Previous applications of diffusion related models to religious phenomena exhibit weaknesses very much in line with the criticisms discussed in Section 2.2. "Socio-physicist" applications of logistic growth models to religious data generally lack a strong theoretical foundation and proceed without the proper specification of hypotheses. The curve-fitting thus often seems arbitrary. Marchetti (1997) analyzes the canonization events of about 1000 saints mentioned in the Catholic calendar. The growth in number of saints can be described by two successive logistic curves (or "pulses"), i. e. a bi-logistic process, both lasting about 1000 years.[12] Even though the author indulges in far-reaching speculations, the exact meaning of the indicator (canonizations) remains unclear. He only writes that it is "taken as a measure for the 'temperature' of faith" (Marchetti, 1997: 190) which probably means as an indicator of the vitality of Catholic faith. More similar to the present study, Ausloos (2014) studied the growth of the Antoinist Cult community, a religious sect founded in 19th Belgium. He uses data on their finances as well as the number of temple inaugurations. Especially the latter is of interest because it closely aligns with the study of monastic foundations. Ausloos fits logistic functions to the cumulative number of new temples without providing a convincing theoretical reason. He makes passing reference to the ecological notion of limiting carrying capacity (Ausloos, 2014: 68) but does not discuss the interpretation of the concept. The growth of the sect can be modeling using two partial logistic functions (see Figure 2.3a). He concludes that "complex social systems rarely follow a single S-shaped trajectory" but are irregular due to external social and historical forces (Ausloos, 2014: 75). His conclusion points to the necessarily of including meaningful period effects rather than assuming constant parameters in the social system. However, Ausloos never attempts to estimate a model

1983). Moreover, there are orders and related movements that fall outside the five categories, most notably lay religious groups such as the Beguines and Beghards (Wittberg, 1994: 35). The categorization used for the empirical analysis will reflect a pragmatic compromise.

[11] The stark difference between male and female orders is especially obvious in the case of canons and canonesses. Canons were usually ordained priests which was (and still is) impossible for women. The term "canonesses" for the female counterparts of such orders thus cannot point to a deep similarity regarding religious life and the kind of ministry performed.

[12] In order for the logistic function to fit the first wave of canonization, its beginning has be to projected 500 years backwards, i. e. the latent growth process starts 500 BC – which seems implausible.

Figure 2.3: The number of temples of the Antoinist Cult in Belgium as a function of the number of months, since the consecration of the first temple on 1910/08/15. The left subfigure is a replication of Figure 4.2 by Ausloos (2014: 62).



other than the logistic function. A quick re-analysis illustrates the difficulty in choosing the most appropriate specification: A single confined exponential growth function fits the data reasonably well on the first sight (see Figure 2.3b) even though it seems to miss the accelerating growth during the initial phase of the period under study.[13] The general point is that researchers seem preoccupied with the logistic growth function and rarely test it against alternative models.

There have been few attempts to use data on the foundings of monasteries to investigate the spread of orders. Grübler (1996: 19) suggested in the introduction to a review article on diffusion dynamics that the "nonlinear, S-shaped time path of the initial spread of Cistercian rule resembles the diffusion patterns we will observe for technologies." This remark about early Cistercian growth from 1115 to ca. 1170 – when the majority of Cistercian houses was founded – is not based on a formal analysis but on a visual interpretation of the plotted curve. However, it mainly functions as a prelude to the literature review. Snyder (2008, 2009) attempts a more comprehensive analysis of the Cistercian reform's growth, investigating

[13]The worse fit in terms of mean absolute deviation (0.565 vs. 0.861) could just points to less overfitting since the model is more parsimonious and only uses 2 degrees of freedom.

both aggregate as well as spatial data. He, too, identifies an S-shaped curve (Snyder, 2008: 31) but he does not link this pattern to the internal influence – or any specific – theoretical model. He only briefly remarks about the diffusion of innovation literature:

> Normally, the S-curve is associated with a promoter or campaign and that's [sic] why it was chosen for this current study, because of the influence of Bernard of Clairvaux in propagating the reform. (Snyder, 2008: 22)

But as already pointed out, the S-curve is generally considered the result of a contagious process, spread via word-of-mouth, a chain-reaction propagated by many independent "carriers" of the reform's ideas. A promoter or campaign is an external influence and it makes sense to model Bernard's influence analogously. Furthermore, he briefly compares the growth curve of the Cistercians with those of the Premonstratensian canons and the Carthusians, finding a similar trajectory for the Cistercians and the Premonstratensian. Brissaud (2009) shows that the growth of French Franciscan order measured by the cumulative number of foundations can be approximated by a bi-logistic process. A first wave of foundations starts in 1200 and ends about 100 years later. The second wave starts in 1350 and ends with the Reformation. However, the article again lacks a clearly articulated justification for fitting the models.

To conclude, attempts to model the growth of religious movements have generally employed the logistic model. While some researchers have made passing (and sometimes misleading) references to either the ecological or diffusion of innovation literature, in all cases the choice of a model lacked a proper theoretical justification. If we take the analyses and the authors' conclusions at face value, it seems that religious movements spread endogenously and not through external institutional factors.

2.4 Data

The following analyses all apply classical diffusion models to data on cumulative foundings of religious orders. Therefore, the central variables are new foundings in a given year ($N_{t+1} - N_t$) and the stock of all past foundings up to year t (N_t). *Stock of fast foundings* means that the yearly cumulation does not take dissolutions and closures into account.[14] This simplifies the application of conventional diffusion models and may be defended on the grounds that the latter refer to the latent diffusion process and not the manifest foundings *per se*. Moreover, note that "founding" or "foundation" does not exclusively refer to the original formation of

[14] Monastic communities – at least those about which we know something and which could be documented by historians – were characterized by stupendous longevity. For example, only 10 % of Cistercian and Carthusian as well as 15 % of Cluniac monasteries had been dissolved 300 years after their foundation (see Chapter 3).

a new religious house or community but includes existing communities who changed their affiliation to a different order.

Datasets

One of the main challenges for the study of medieval orders is to obtain complete and comparative data for more than one order. Fortunately, there now exist complete and digitized monastic census for a few European countries such as England (English Monastic Archives, 2015) or the Netherlands (Goudriaan, 2019).The drawback of such databases is their regional focus. They collect data within current national borders that often do not correspond to meaningful historical geographic units. Moreover, many orders spread all over Europe and it would be preferable to reconstruct their diffusions in their entirety. The first part of the analyses, therefore, focuses on three orders for which I have been able to obtain high quality data on all their known European settlements. Nonetheless, the national monastic census are invaluable because they enable the comparative study of orders. They strive to collect complete data on all known orders and according to standardized procedures. Therefore, the second part complements the European-wide case studies with more complete regional data from England and the Netherlands.

European-wide case studies

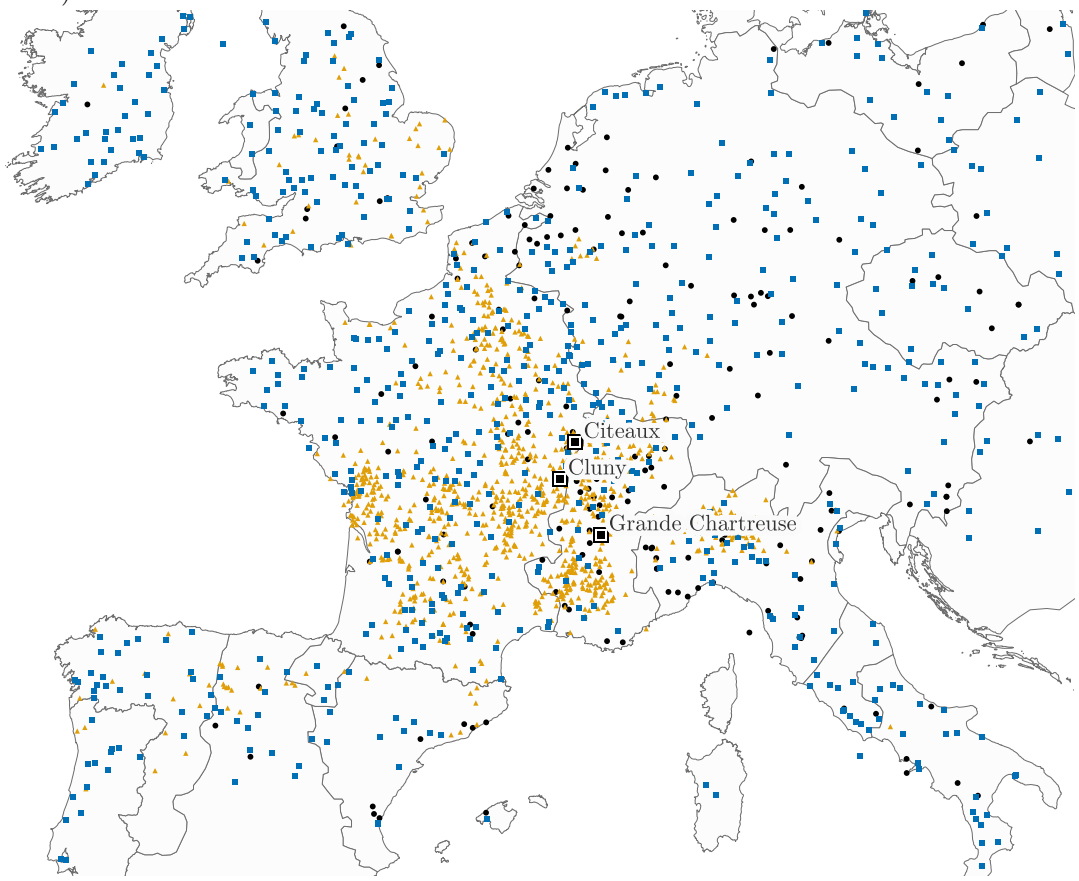
The three orders selected as European-wide case studies are the Cluniacs, the Cistercians, and the Carthusians. Those three major orders were chosen because of their comparability: All three originated – in relative proximity – in remote locations west of the alps in (present-day) France but managed to spread beyond their region of origin (see Figure 2.4). Moreover, all three orders are monastic orders. However, they also differ in certain respects: The reforms of Cluny and Cîteaux were movements within Benedictine monasticism whereas the Carthusians were more strongly eremetical compared to earlier forms of organized Western monasticism and reduced communal life to a minimum. The Cluniac reform was initiated in the early 10th century. The Cistercians and the Carthusians were both foundations of the late 11th century as a part of the ongoing diversification within the realm of organized religious life (Aston, 2001: 10).

The nucleus of the dataset on the Cistercians is based on the work of Snyder (2008).[15] I manually corrected mistakes in his data using additional sources and included previously missing abbeys as well as abbeys founded between 1401–1500. The dataset contains information on 722 known Cistercian abbeys, covering foundations in the period 1100–1500.

The list of all charterhouses (Carthusians monasteries) was taken from the database on the Analecta Cartusiana webpage (Analecta Cartusiana, 2022). The Analecta Cartusiana is

[15] Parker Snyder kindly provided me with his data upon request.

Figure 2.4: Map of all Cluniac (orange triangles), Cistercian (blue squares) and Carthusian (black dots) monasteries founded 900–1500. Borders of European kingdoms ca. AD 1200 according to the *Harvard Digital Atlas of Medieval and Roman Civilization* are shown as an orientation (Campbell et al., 2022a).



a series of books on the history and spirituality of the Carthusian monks. Each monastery's geolocation was added manually. The data contain information on 221 charterhouses that were founded before the 16th century.

The locations of Cluniac sites were taken from the Clunypedia mapping project which seems to be the most comprehensive source on historical membership in the Order of Cluny (Clunypedia, 2022). The Clunypedia database contains information on location and foundation dates. I downloaded all database entries as of 2022 and kept sites classified as priory, abbey, or college. The reduced dataset has entries on 1,038 monasteries that were founded or reformed by Cluny before 1500.

The data on individual monasteries was transformed into three aggregated time series containing the yearly number of new as well as cumulative number of past foundings. The Cistercian dataset contains an additional dichotomous variable that equals 1 during the time of Bernard's public works (1128–1153) and zero otherwise. Descriptive statistics are

Table 2.1: Descriptive statistics of the European-wide data.

	T	Mean	Std. dev.	Min	Max
Cluniacs (910–1494)					
Cumulative foundings (N)	585	708.28	402.63	3	1038
Yearly foundings	585	1.77	8.76	0	190
Cistercians (1099–1487)					
Cumulative foundings (N)	389	568.94	219.02	1	722
Yearly foundings	389	1.85	4.02	0	51
Bernard of Clairvaux	389	0.07	0.25	0	1
Carthusians (1085–1498)					
Cumulative foundings (N)	414	91.64	70.77	2	221
Yearly foundings	414	0.53	0.91	0	8

presented in Table 2.1.

English Monastic Archives

The English Monastic Archives Database (henceforth EMA) includes a digital gazetteer of 781 known religious houses in England that existed before the Dissolution of the Monasteries during the 16th Century (English Monastic Archives, 2015). The EMA only covers monastic orders and canons regular. It does not cover other forms of religious life such as mendicant orders, even though there were, for example, at least 48 Dominican houses in medieval England (Jedin et al., 1987).[16] The dataset contains information on 19 orders, 9 of whom had less than 10 houses. Since the number of orders is insufficient to estimate a multilevel analysis, I will carry out separate regression analyses for each order. This, in turn, demands a minimum number of houses because otherwise it is not possible to estimate mixed influence models with meaningful precision. The final dataset includes male orders with more than 10 houses. Female orders were excluded because only three of them have the required minimum number of foundations.[17] The 9 Gilbertine double monasteries that housed both male and female religious were added to the Gilbertine canons. In the end, the analysis sample contains three monastic order (Benedictines, Cluniacs, Cistercians) and three order of canons regular (Augustinian canons, Gilbertines, and Premonstratensian). Three orders of each type permit a preliminary test of whether successively increasing category density correlates with a more exogenous diffusion pattern. Since the number of Benedictine houses seems to grow in two consecutive waves, the order will be split in "pre 850" and "post 850" Benedictines.[18] The

[16] It includes two minor mendicant orders: the Bonhommes and Trinitarian brothers.

[17] Augustinian canonesses (23), Benedictine nuns (78), Cistercian nuns (28).

[18] More precisely, during a hiatus between 804 and 878 no new foundations were recorded. Founding activity apparently resumed after Alfred the Great's decisive victory over the vikings.

Table 2.2: Descriptive statistics of the English Monastic Archives Database.

	T	Mean	Std. dev.	Min	Max
Augustinian canons (1004–1378)					
Cumulative foundings (N)	375	116.76	86.07	1	209
Yearly foundings	375	0.56	1.22	0	13
(pre 850) Benedictine monks (597–804)					
Cumulative foundings (N)	208	14.89	7.02	1	24
Yearly foundings	208	0.12	0.38	0	2
(post 850) Benedictine monks (878–1363)					
Cumulative foundings (N)	486	112.75	89.02	1	214
Yearly foundings	486	0.44	1.12	0	14
Cistercian monks (1127–1350)					
Cumulative foundings (N)	224	57.40	15.19	1	70
Yearly foundings	224	0.31	0.87	0	8
Cluniac monks (1077–1192)					
Cumulative foundings (N)	116	20.41	11.16	1	35
Yearly foundings	116	0.30	0.55	0	2
Gilbertine canons (1131–1362)					
Cumulative foundings (N)	232	17.78	6.29	1	24
Yearly foundings	232	0.10	0.37	0	3
Premonstratensian canons (1145–1267)					
Cumulative foundings (N)	123	25.82	12.09	1	37
Yearly foundings	123	0.30	0.60	0	3
Total (597–1378)					
Cumulative foundings (N)	1764	70.41	76.25	1	214
Yearly foundings	1764	0.35	0.93	0	14

motivation for splitting the time series is that it permits the use of the Bass model for both waves rather than a more complicated model. Descriptive statistics are shown in Table 2.2.

Medieval monasteries in the Netherlands

The second – much more comprehensive – national dataset is a census of medieval and Early Modern monasteries within the borders of the present-day Netherlands that been compiled by Koen Goudriaan (2019). The census includes information on all Dutch monasteries, houses of third orders, and collegiate churches until 1800. The classification used is much more fine-grained compared to the EMA. For instance, Augustinian canons are subdivided into various reform movements of canons regular rather than grouped into one, broad category. The census also includes information on the rule adopted by every monastery. The dataset

has been assembled by automatically "webscraping" the information for every available year from the online map.[19] The downloaded data resulted in a panel dataset that contains the status (order, rule, location etc.) for each community in each year of its existence. The monastery-level panel has then been aggregated at the order-level.

Besides orders *sensu stricto*, the analysis also keeps both "orders" of laypeople, like the mendicant third orders, as well as secular canons. The latter were priests "leading a more or less communal life which centered around the praying of the Latin Office, but without the monastic vows of poverty, obedience and chastity" (Goudriaan, 2019). Even though not an order, they nonetheless constitute a distinct category of religious life. Hence, the analysis treats them as if they were a separate "order" within its own category.

The analysis sample includes all foundings until 1520, the eve of the Reformation. In order to analyze the dataset, it was necessary to consolidate the classification of orders. The raw data sometimes uses various synonyms for the same kind of community, e. g. communities classified "Community of Priests" were reclassified as "Secular Canons." Including the secular canons and excluding monasteries with unknown affiliation, the census identifies 53 different male and female religious groups. The final analysis sample consists of the 36 groups or orders with ≥ 6 foundings. The 17 small orders were nevertheless used in the construction of the category density measures. The exclusion of small orders restricts the variation in the data and makes it difficult to test the prediction that less legitimate orders will not diffusion at all.

To measure category density, a type and rule had to be assigned to each order. My typology differentiates among 12 types of orders: 1) Canonesses regular 2) Canons regular 3) Female third orders 4) Lay brothers 5) Lay sisters 6) Male third orders 7) Mendicant orders 8) Military orders 9) Monastic orders 10) Nuns 11) Second orders 12) Secular canons. "Second orders" are cloistered sisters of mendicant orders (e. g. Clarisses) whereas female and male "third orders" were lay counterparts to mendicant orders. "Lay sisters" and "lay brothers" are broad categories that encompass diverse groups who did not take vows and (with some exceptions) did not adopt a rule.

The assignment of a rule was based on the information on individual communities. Every order was assigned the modal rule adopted among its communities, with the majority of orders being entirely homogeneous.[20] The 36 orders fall within 11 different categories of rules. Nine of them are rules in the proper sense, of which the Rule of Saint Augustine is by far the most popular. Almost half of the orders in the anaylsis sample (16 of 36) as well as the total sample (24 of 53) adopted the Augustinian rule. The imbalance may cause low predictive power due to limited variance in the data. The two other categories are collegiate

[19] `https://geoplaza.vu.nl/cms/projectportfolio/kloosterkaart/`

[20] The notable exception are the Alexians and Alexian Sisters. Some of their communities were initially founded without a (known) rule.

Table 2.3: Descriptive statistics of Dutch medieval religious houses.

	Obs. (order-years)	Mean	Std. dev.	Min	Max
Male orders					
Cumulative foundings (N)	6228	13.85	19.53	1	167
Yearly foundings	6228	0.09	0.40	0	7
N_{type} (houses)	6228	33.00	28.58	1	174
N_{rule} (houses)	6228	71.95	79.45	1	284
N_{type} (orders)	6228	3.15	1.76	1	7
N_{rule} (orders)	6228	5.98	5.93	1	20
Female orders					
Cumulative foundings (N)	3246	18.20	25.15	1	120
Yearly foundings	3246	0.13	0.49	0	8
N_{type} (houses)	3246	62.45	71.42	1	253
N_{rule} (houses)	3246	107.13	91.89	1	284
N_{type} (orders)	3246	3.34	1.68	1	7
N_{rule} (orders)	3246	8.83	6.22	1	20
All orders					
Cumulative foundings (N)	9474	15.34	21.72	1	167
Yearly foundings	9474	0.11	0.43	0	8
N_{type} (houses)	9474	43.09	49.80	1	253
N_{rule} (houses)	9474	84.01	85.56	1	284
N_{type} (orders)	9474	3.22	1.74	1	7
N_{rule} (orders)	9474	6.96	6.18	1	20

churches of secular canons who are treated as a separate category as well as the residual category "no rule." Lumping together orders without rule implicitly assumes that it is just another category whose elements gain legitimacy with increasing density. Appendix 2.D lists the assigned type and rule for every order.

Both measures of category density are operationalized in two different ways: First, as the number of *orders* within the same category (i. e. type or rule); second, as the number of *houses* with the same category. The first operationalization is the preferred variant as it is closer to my reading of Rossman (2014). The second is based on the idea that successful religious movements will contribute more to the legitimation of categories than small movements with limited growth. All four variables are time-varying, that is, an incumbent order's legitimacy can be raised by the growth of later entrants. Table 2.3 summarizes the dataset.

2.5 Methods and analytical strategy

2.5.1 Relative hazard rate

Let p_t be the proportion of the maximum number of monasteries already founded at t, i. e. $p_t = N_t/N_{\max}$, and Δ_t the yearly change $\Delta_t = p_{t+1} - p_t$. In order to compute p_t the empirical maximum of foundations will be used, not the maximum estimated by any model. If the diffusion is the result of a contagious process, the quantity[21]

$$H_t = \frac{\Delta_t}{p_t(1-p_t)}. \tag{2.12}$$

should be non-increasing in t and strictly decreasing if there is any external influence (Young, 2009: 1918). The relationship will be assessed using local polynomial regressions.[22]

2.5.2 Descriptive single-case modeling

The pure internal and external model as well the mixed influence model can all be directly estimated via non-linear least squares (Greene, 2012: 222-241) as long as a single order is considered. For example, the cumulative adoption function of the logistic model can be estimated in the form

$$N_t = \frac{N_{\max}}{1 + \frac{N_{\max}-N_0}{N_0} e^{-bt}} + \varepsilon_t \tag{2.13}$$

with ε_t being a stochastic error term. The procedure gives point estimates $\hat{N}_{\max}$ and $\hat{b}$ as well as robust inference statistics.[23] I always estimate logistic and bi-logistic model using the cumulative adoption function and using the cumulative number of foundings as dependent variable.

One of the main drawbacks of the non-linear least squares method compared to OLS are convergence issues. Especially in the case of the Bass mode, it is often easier to estimate the discrete analogue[24] to the differential equation (2.5) than the cumulative adoption

[21] H_t is the discrete hazard rate ($\Delta_t/(1-p_t)$) divided by the proportion of maximum foundings already realized (p_t).

[22] Young utilized a polynomial cubic OLS model for a more formal test. More specifically, the quadratic and the cubic coefficient of the model

$$H_t = \alpha + \beta t + \gamma t^2 + \delta t^3 + \varepsilon_t$$

should not significantly differ in sign if the relationship is (strictly) decreasing. However, the overall model fit needs to be reasonably well for a polynomial regression will give misleading results otherwise.

[23] All models estimated via non-linear least squares use jackknife standard errors in order to deal with violations of the distribution assumptions. The jackknife method was chosen because the obtained standard errors were more conservative (i. e. larger) than Huber-White standard errors.

[24] The empirical data are discrete time series data containing the number of additions during a given year. In line with the majority of the diffusion of innovation literature, I treat the discrete models as an

function (2.6):[25]

$$N_{t+1} - N_t = (a + bN_t)(N_{\max} - N_t) + \varepsilon_t. \tag{2.14}$$

To conform with the theoretical model, estimates of a and b are constrained to be non-negative.[26]

The same approach can be used to estimate the modified equation in order to test the hypothesis that the only operant exogenous influence in the diffusion of the Cistercian order was Bernard of Clairvaux. The regression equivalents of Equations 2.10 and 2.11 are:

$$N_{t+1} - N_t = (a_0 + a_1\text{Bernard}_t + bN_t)(N_{\max} - N_t) + \varepsilon_t \tag{2.15}$$

$$N_{t+1} - N_t = (a\text{Bernard}_t + bN_t)(N_{\max} - N_t) + \varepsilon_t \tag{2.16}$$

where Bernard_t represents a dummy variable that equals 1 during the time of Bernard's public works (1128–1153) and zero otherwise. The first regression model includes Bernard as an additional external influence while the second drops the constant a_0 and models Bernard as the only external influence.

2.5.3 Multilevel models

The multilevel procedure for modeling multiple diffusions is an extension of the traditional approach to the estimation of the Bass model. It therefore makes sense to briefly review the least squares approach. Starting with the discrete analogue of Equation 2.5 and re-writing it as a quadratic equation

$$\begin{aligned} N_{t+1} - N_t &= (a + bN_t)(N_{\max} - N_t) \\ N_{t+1} - N_t &= aN_{\max} + (bN_{\max} - a)N_t - bN_t^2 \end{aligned} \tag{2.17}$$

approximation of the continuous-time differential equations since there is no reason to expect the theoretical process to operate in discrete time intervals. The growth of an order is an ongoing process and the yearly grouping of data is – from a theoretical perspective – arbitrary. Examples of theoretically plausible discrete-time processes are church services or demonstrations that only happen once a weeks, i. e. with a fixed time interval. If one assumes discrete time in the underlying theoretical model, the cumulative growth can be predicted recursively using the respective difference equations (Huckfeldt et al., 1982: 29–44).

[25] Another concern with NLS is the sensitivity of the optimization procedure to initial values. Alternative solutions are often implausible (e. g. negative $N_{\max}$) and can be discarded without further consideration. If estimation proved to be unstable and produced multiple sets of plausible values, I triangulated the results with other methods like OLS and chose parameter values most similar to other methods.

[26] Negative values are rare and most often occur when the parameter in question is close to zero. Negative values can be meaningful in principle: A positive a in combination with a negative b could be construed in the sense that, although the doctrines of a religious groups appeal to potential adopters who join with a constant rate, potential adopters are repulsed by meeting actual members of the group (hence a negative feedback from current membership size).

produces an expression that can be estimated as a linear model by substituting $\alpha = aN_{\max}$, $\beta = bN_t - a$ and $\gamma = -b$ as well as adding an error term:

$$N_{t+1} - N_t = \alpha + \beta N_t + \gamma N_t^2 + \varepsilon_t. \tag{2.18}$$

The estimated coefficients can be used to obtain values for a, b and $N_{\max}$:[27]

$$\begin{aligned} N_{\max} &= \frac{-\beta \pm \sqrt{\beta^2 - 4\alpha\gamma}}{2\gamma} \\ a &= \frac{\alpha}{N_{\max}} \\ b &= -\gamma. \end{aligned}$$

If there are data on enough innovations available, it is possible to move away from single-case, descriptive models, and try to predict systematic variation in the degree of external and internal influence. Mansfield (1961) devised a two-stage procedure. In the first stage, a set of M regression equations in the form of (2.18) is being estimated (one for each innovation) and the underlying model parameters for each innovation are obtained. In the second stage, the parameters estimated in the first stage are the outcomes of a regression whose regressors are properties of the innovations. The goal is test whether certain properties predict variation in, for example, the size of the internal influence parameter b_i $(i = 1, \ldots, M)$.

Rossman et al. (2008) have generalized this approach using linear multilevel models. Their method allows the inclusion of time-level variables, is statistically more efficient, and less cumbersome. The observations for all innovations are pooled in one regressions model that includes innovation-level and time-level predictors. Rossman et al. (2008: 217–218) provide formulae that allow to derive the influence of the predictors on the Bass model parameters from the estimated coefficients.[28]

Using the data on medieval Dutch monasteries, I will estimate a model of the following form

$$\begin{aligned} N_{i(t+1)} - N_{it} = {} & (\alpha_{0i} + \alpha_1 \mathrm{NType}_{it} + \alpha_2 \mathrm{NRule}_{it} + \alpha_3 \mathrm{Female}_i) + \\ & (\beta_{0i} + \beta_1 \mathrm{NType}_{it} + \beta_2 \mathrm{NRule}_{it} + \beta_3 \mathrm{Female}_i) N_{it} + \\ & (\gamma_{0i} + \gamma_1 \mathrm{NType}_{it} + \gamma_2 \mathrm{NRule}_{it} + \gamma_3 \mathrm{Female}_i) N_{it}^2 + \varepsilon_{it} \end{aligned} \tag{2.19}$$

[27] Under the condition that $\beta^2 - 4\beta\gamma \geq 0$. Otherwise the formulae are more complicated (Rossman et al., 2008: 213).

[28] The exact procedure for retrieving the effect of covariates on the fundamental parameters are documented in the article as well as the supplemental materials provided by Rossman et al. (2008). The computation of standard errors for the derived parameters is not discussed in the main text but can be reconstructed from the equations in the accompanying spreadsheet. I will not review the method in detail and interested readers are directed to the original source.

where the subscript refers to order i at time t. The regression equation can be viewed as a more general form of Equation 2.18. The number of cumulative foundations N_{it} as well as its squared term are interacted with additional explanatory variables. Moreover, at the level of the order, the model includes both a random intercept denoted by α_{0i} as well as random slopes for N_{it} and N_{it}^2 denoted by the main effects β_{0i} and γ_{0i}. The main explanatory variables are the time-varying operationlizations of category density – NType_{it} and NRule_{it} – as explained in Section 2.4. The model will be estimated using maximum likelihood and assumes an unstructured covariance matrix.

2.6 Results

2.6.1 European-wide data: relative hazard rate

A first look at the cumulative growth curves in Figure 2.5 reveals several important facts: The growth of the Congregation of Cluny resembles a classical S-curve. There is a small deviating uptick of new foundations during the Late Middle Ages (after the year 1250 indicated by the vertical line) but growth during the first 350 years seems to be a candidate for pure internal influence. Contrary to Snyder's (2008) visual assessment, Cistercian growth is – aside from an brief initial acceleration – far from being ideal-typically S-shaped. The growth pattern lacks the symmetry of a logistic function. However, it seems consistent with a strictly decreasing hazard in relation to the number of yet unrealized monasteries. Like with the Cluniacs, there seems to be a resurgence during the Late Middle Ages but until the year 1400 (the vertical line) the diffusion trajectory could be interpreted as approaching a fixed maximum. The Carthusian growth curve deviates from both ideal-typical models as well as the mixed influence model. The slowdown in growth during the 13th century with subsequent resurgence after 1250 (vertical line) cannot be reconciled with the predictions of basic diffusion models, i. e. the hazard rate certainly increases in relation to yet unrealized foundings. Therefore, the more formal test below does not need to consider the Carthusians. However, as will be shown in the next section, the growth pattern is consistent with a bi-logistic diffusion process.

Figure 2.6 shows binned values of H_t for the Cluniacs as well as the Cistercians overlayed with a LOWESS smoother (red) applied to the non-binned data. The test is restricted to the time periods identified earlier (≤ 1250 for the Cluniacs and ≤ 1400 for the Cistercians). The LOWESS fit seems consistent with a strictly decreasing relationship for the Cistercians but in the Cluniac case the hazard rate is increasing relative to number of already founded monasteries during the period 1050–1150, i. e. the period of strongest growth (see Figure 2.5). Hence, growth during this time period is faster than expected if it were the result of a pure internal influence process.

Figure 2.5: Cumulative number of monasteries ever founded by three monastic orders.

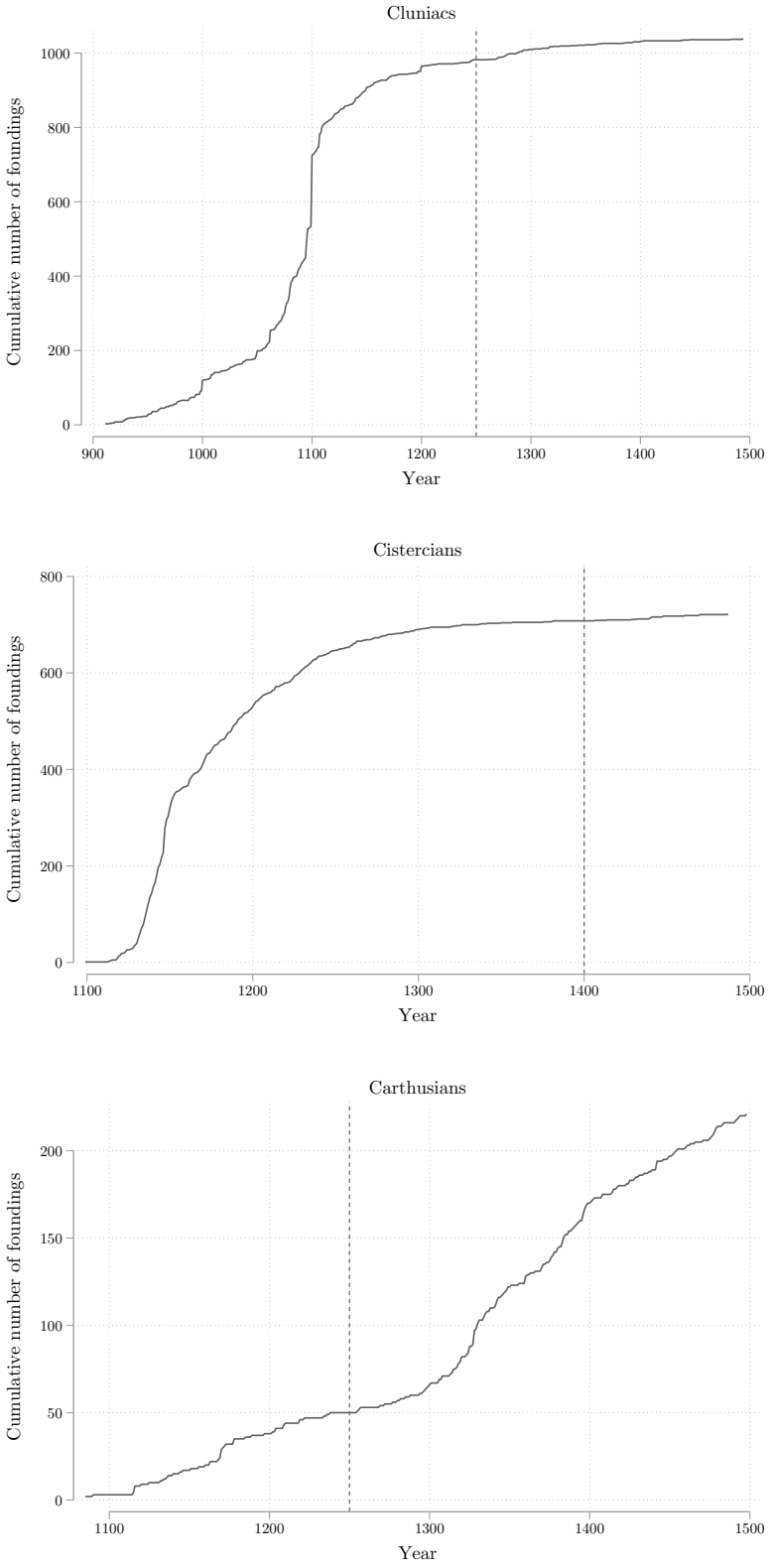
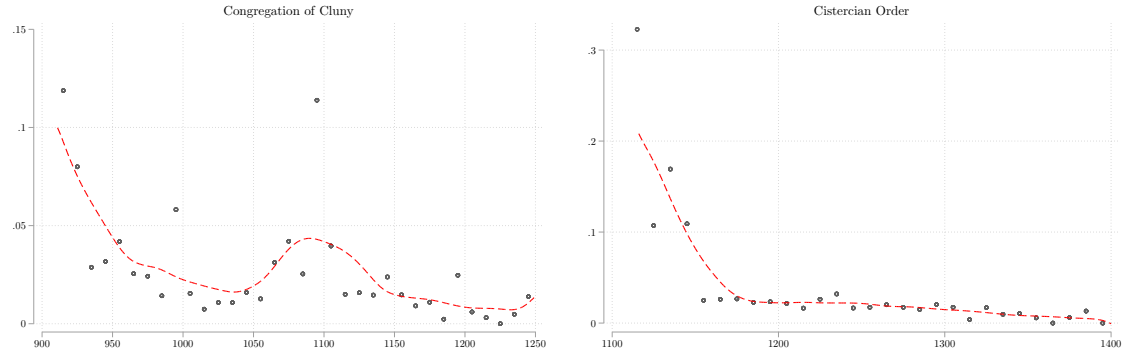


Figure 2.6: Binned scatter plot (10 year intervals) of H_t over time. The red line is a LOWESS smoother of H_t with a tricube weighting function and a bandwidth of 30 % of the observation window.



2.6.2 European-wide data: internal vs. external influence models

Cluniac

It was not possible to directly estimate the Bass model using the Cluniac data without additional parameter restrictions.[29] In order to test whether there is any trace of external influence, a restricted version was estimated by setting the parameter N_{max} to 1 and modeling the cumulative number of foundations as a proportion of the observed maximum of 1,038 (see also Footnote 5).

Table 2.4 shows estimates of mixed influence (Bass) and internal influence models (logistic). The non-linear least squares estimate of an external influence parameter a is significant but numerically minuscule and the parameter of internal influence in the Bass Model 1 is only slightly smaller (0.032) compared to the pure internal influence models (0.039). The relevance of external factors thus seems negligible. Furthermore, for the internal influence model, the estimated size of b is not affected by restricting the sample to foundings before 1250. In the case of the mixed influence model, restricting the sample period brings the estimate of b closer to the results of the logistic model. Figure 2.7 shows predicted values for the mixed influence and internal influence models. Both models miss two features of the growth process: First, the almost linear growth until 1050 and, second, the steepness of the growth during the next 100 years. The latter is a consequence of the fact that both models cannot capture the accelerating relative hazard rate that has been demonstrated in the previous section.

To conclude: The hypothesis that the Cluniac growth process was a contagious process in a strict sense has already been rejected. The findings point to the possible relevance of

[29] There are three approaches: Estimating the linear model using OLS and computing the parameters from the coefficients, estimating the differential equation directly via non-linear least square or estimating the cumulative adoption function via non-linear least square.

Table 2.4: Diffusion models of Cluniac growth. The table shows coefficients from non-linear least squares estimates with t-values in parentheses. Models Bass 1 and Logistic 1 use the full observation period, models Bass 2 and Logisitic 2 the period until 1250.

	Bass Model 1	Bass Model 2	Logisitc Model 1	Logistic Model 2
a	0.000**	0.000**		
	(7.607)	(5.829)		
b	0.032**	0.038**	0.039**	0.039**
	(35.481)	(34.220)	(213.804)	(193.669)
$N_{\max}$			1009.885**	980.473**
			(732.090)	(534.724)
T	585	341	585	341
AIC	−2087.223	−1108.834	5960.177	3587.348

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. Variance-covariance matrix estimated using Jackknife method. Source: Own data. Calculations using Stata 17.

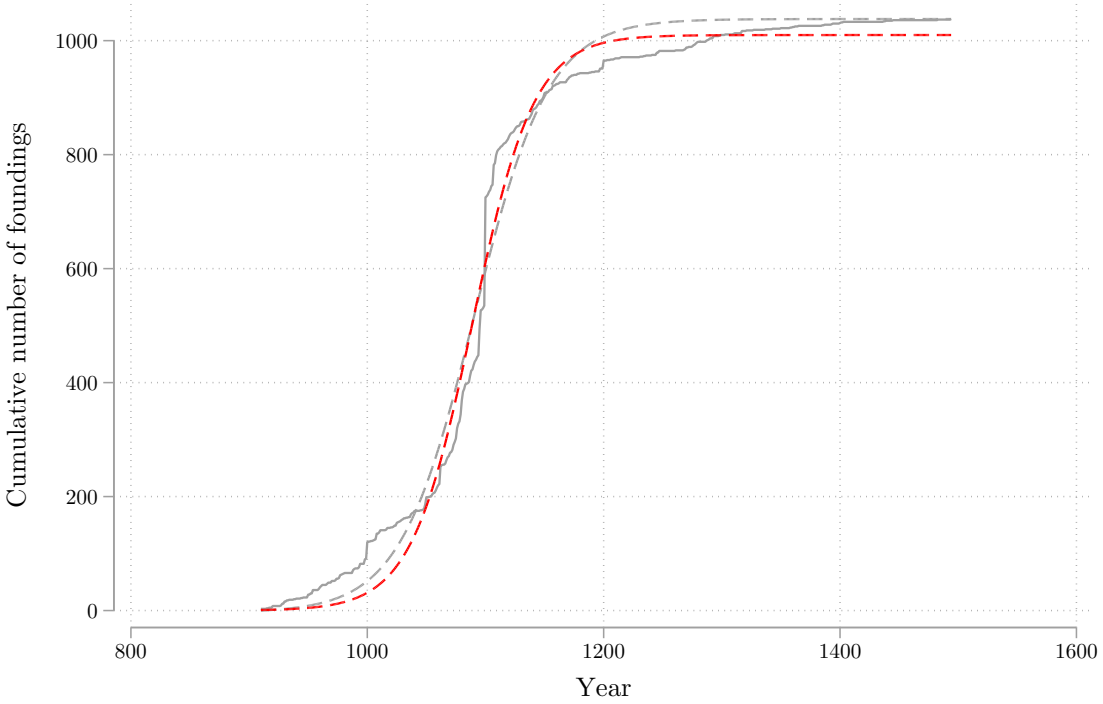
other mechanisms besides contagious spread via direct contact. Moreover, in accordance with the expectations, there is almost no evidence of spread via constant hazard due to important figures or other forms of direct institutional promotion. Hence, little is gained by preferring the Bass model over the logistic model as a first approximation.

Cistercians

The diffusion of the Cistercians is expected to follow a mixed influence process, with the external influence being confined to the period of Bernard of Clairvaux. Table 2.5 presents estimates of two pure internal influence and three mixed influence models. The first logistic model covers the time-span until 1160 during which growth has been described by Grübler (1996) to follow an S-curve. The second model covers the full period 1098–1500. The estimated internal influence parameter is larger for the initial period but the estimated maximum number of foundations is smaller. Figure 2.8 plots the predicted values of both models against the observed values. Visual inspection reveals that a pure internal influence model is probably consistent with the order's growth during the period 1098–1160 (pending a more formal test against alternative models) but not the full observation period. The question is whether a (modified) Bass model can account for the initial acceleration as well as the development after 1160.

Table 2.5 contains the results from a sequence of three Bass models. The first is the simple Bass model with one, time-constant external influence factor. The coefficient a is significantly different from 0 and large in comparison to b (note the multiplication by 100).

Figure 2.7: Predicted values for Bass Model 1 (gray) and Logistic Model 1 (red). The Bass Model has been scaled by multipling the predicted share of monasteries with the maximum observed number of monasteries.



Therefore, the Bass model indicates the presence of both internal and external influences. The second model estimates Equation 2.10 which contains an additional external influence factor present during the period of Bernard's public works (1128–1153). The permanent external influence factor a_0 is almost zero and not statistically significant at any level. External influence is concentrated in the period when Bernard of Clairvaux was the traveling figurehead of the order. The temporary external influence is larger than the a parameter from Bass Model 1 ($0.005 < 0.016$). Both models are based on the same observations and use the same dependent variable. It is therefore possible to compare the goodness-of-fit measures. Bass Model 2 fits better both in terms of the RMSE as well as the AIC. Bass Model 3 drops the permanent external influence parameter. This does not change the estimates of a_1, b, and $N_{\max}$. The more parsimonious model uses one less degree of freedom and the fit as measured by the RMSE and the AIC increases slightly.

Figure 2.9 visualizes the estimates. Subfigure 2.9a demonstrates that a mixed influence model better approximates the cumulative diffusion process than an internal influence model. However, it does not adequately capture the steep rise during the first half of the 12th century. The Bass Model 2 (Subfigure 2.9c) fit almost perfectly. The sudden increase

Table 2.5: Diffusion models of Cistercian growth. The table shows coefficients from non-linear least squares estimates with t-values in parentheses. Internal influence models are based on the logistic growth function with the cumulative foundings as dependent variable. Mixed influence models are estimated via difference equations with yearly foundings as dependent variable. The b coefficient of the Bass models has been multiplied by 100.

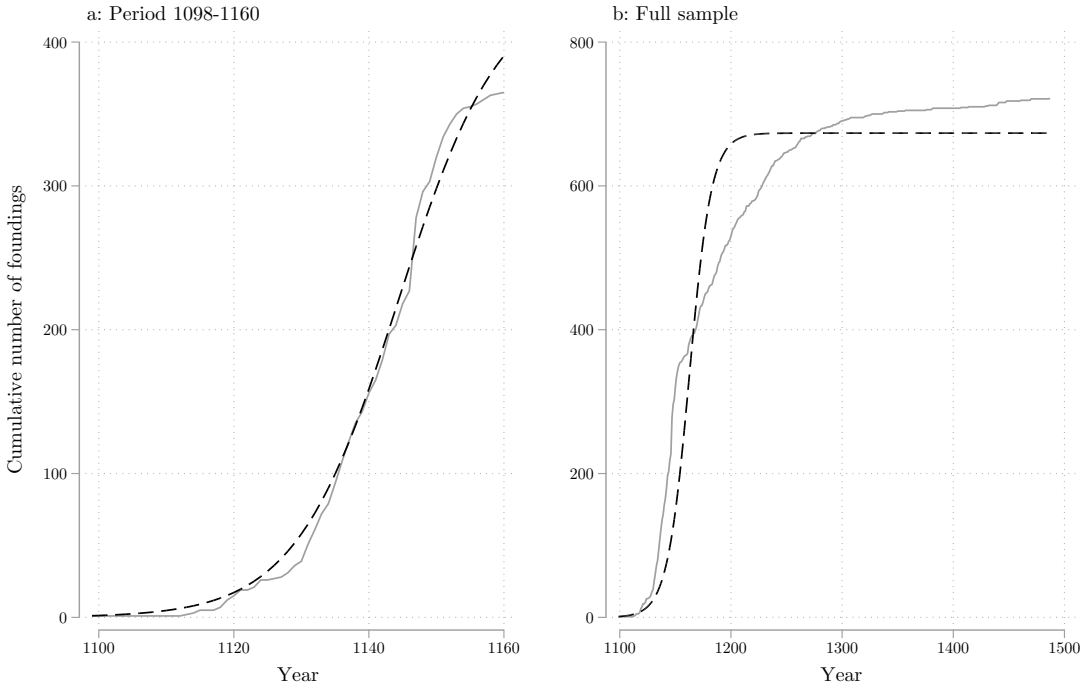
	Logistic 1	Logistic 2	Bass Model 1	Bass Model 2	Bass Model 3
a			0.005**		
			(4.908)		
a_0				0.000	
				(0.538)	
$a_1 \times$ Bernard				0.016**	0.016**
				(5.425)	(5.861)
b ($\times 100$)	0.131**	0.101**	0.004**	0.004**	0.004**
	(141.863)	(26.710)	(6.943)	(8.346)	(10.059)
$N_{\max}$	440.502**	673.386**	704.291**	712.710**	712.548**
	(37.318)	(195.062)	(238.281)	(266.595)	(279.454)
T	61	389	388	388	388
RMSE	11.089	60.940	3.243	2.606	2.604
AIC	468.606	4303.424	2016.936	1848.321	1846.706
Internal $N_{\max}$			460	459	473
External $N_{\max}$			244	253	239

+ p $\leq$ 0.1, * p $\leq$ 0.05, ** p $\leq$ 0.01. Variance-covariance matrix estimated using Jackknife method.
Source: Own data. Calculations using Stata 17.

in new foundations coincides with the onset of the additional external influence due to Bernard of Clairvaux. Some of the features that made the 1128–1153 cumulative growth resemble an S-curve, such as the deceleration during the 1160s, are better explained by his biography. Although his death in 1153 slowed down the expansion, the order continued to grow via contagious diffusion until the 14th century. The congruence of observed and predicted growth is largely preserved when simplifying the model (Subfigure 2.9d). Given the near perfect agreement, there are legitimate concerns about overfitting a selected case. Hence, it is important to systematically study orders with influential figures – such as the Premonstratensians under their founder Norbert of Xanten – using a similar modeling strategy.

The Bass model and its variants can be used to decompose the order's growth into foundings due to internal and external influence (Table 2.5). Even though the estimates come with a strong caveat due to the simplifying assumptions of the model, they may nonetheless give an idea of the relative importance of those factors. All three variants of the mixed

Figure 2.8: Predicted values based on models Logistic 1 (left) and Logistic 2 (right) from Table 2.5. The gray line indicates observed values.

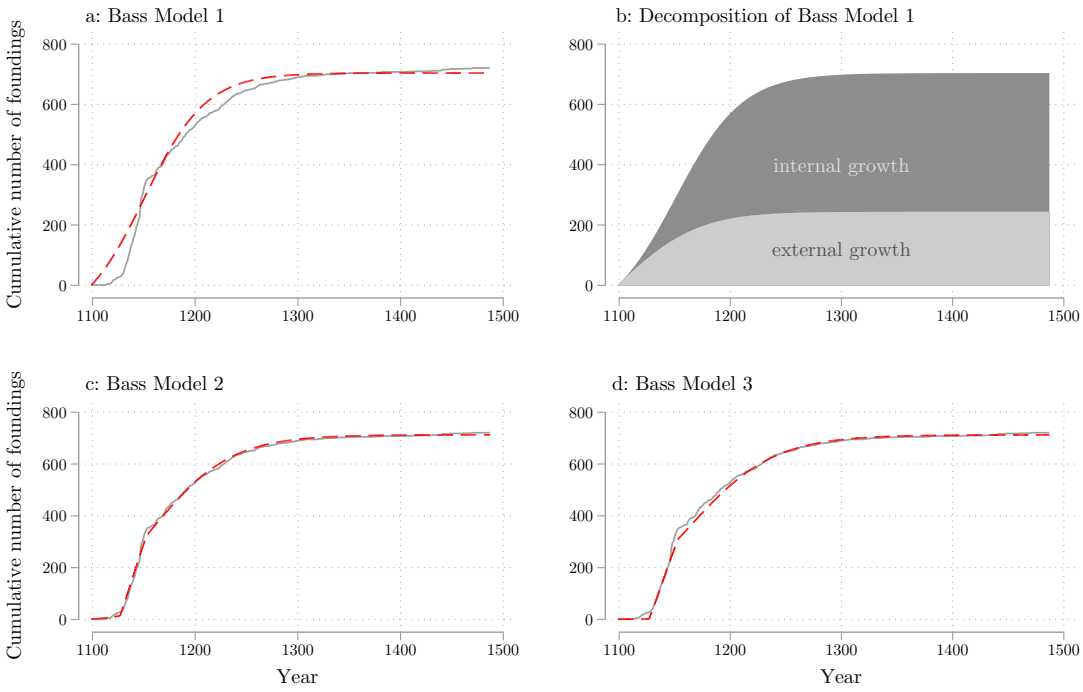


influence models quantify the external influence at ca. 240–250 foundings. Thus, Bernard could have been responsible for more than one-third of all medieval Cistercian settlements. Subfigure 2.9b nicely illustrates the effects of external influence. Monasteries founded to due external circumstances are seeds of further contagious spread. They "jump-start" the diffusion process. However, it should be kept in mind that the model in its current form does not estimate a counterfactual $N_{\max}$. It does not answer the question of how many Cistercian monasteries there would have been had Bernard of Clairvaux never assumed his public role. It is impossible to even tentatively answer this question using data on a single order as it requires a comparative study of orders with and without influential figures.

Carthusians

The Carthusian diffusion pattern is more complex than the simple models used so far. However, it might be possible to inductively generate a hypothesis about the underlying process. Looking at the maps in Figures 2.10 and 2.11, it is apparent that the majority of monasteries before 1200 were founded close to the order's origin. 22 settlements were located in the Kingdom of Burgundy and 4 more in the Piedmont region in the Kingdom of

Figure 2.9: Predicted values based on Bass model estimates from Table 2.5.



Italy. Beginning in 1200, new foundations were no longer concentrated in certain regions but geographically dispersed all over Europe. Therefore, there could have been two diffusion processes: one rapid initial spread limited to the order's region of origin and a slow building second one to other European regions.

In order to lend support to this interpretation, a bi-logistic model (Equation 2.8) was estimated. The results are given in Table 2.6 and a graphical summary is provided in Figure 2.12. The first diffusion process is faster than the second one ($b_1 = 0.054 > b_2 = 0.019$) but has a lower estimated maximum number of foundations, only about 29 compared to 206. The predicted maximum of the first diffusion process is close to the number of monasteries that was founded in Burgundy and bordering regions until the end of the 12th century. 1200 is almost exactly when the first diffusion process was approaching its maximum (Figure 2.12d).

The second, presumably European-wide diffusion process starts at the same time but has a much slower build up. The shape of the overall growth process is the result of the first, regionally confined process slowing down before the second growth pulse takes off. As discussed in Section 2.1.2, the model has descriptive value because it shows that the observed facts are consistent with a certain interpretation (see Section 2.7). The main take-away for the question at hand is the absence of external influence, i. e. the Carthusians could have

Figure 2.10: Carthusian foundations 1085–1199. Borders of European kingdoms ca. AD 1200 according to the *Harvard Digital Atlas of Medieval and Roman Civilization* (Campbell et al., 2022a).

Figure 2.11: Carthusian foundations 1200–1500. Borders of European kingdoms ca. AD 1200 according to the *Harvard Digital Atlas of Medieval and Roman Civilization* (Campbell et al., 2022a).

Table 2.6: Bi-logistic model of Carthusian growth. The table shows coefficients from non-linear least squares estimates with t-values in parentheses.

	Bi-logisitc growth
b_1	0.054**
	(36.587)
$N_1^{\max}$	28.694**
	(52.873)
b_2	0.019**
	(315.117)
$N_2^{\max}$	206.282**
	(217.272)
T	414
AIC	2373.792

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01.
Variance-covariance matrix estimated using Jackknife method.
Source: Own data. Calculations using Stata 17.

spread endogenously, without the help of institutional promotion.

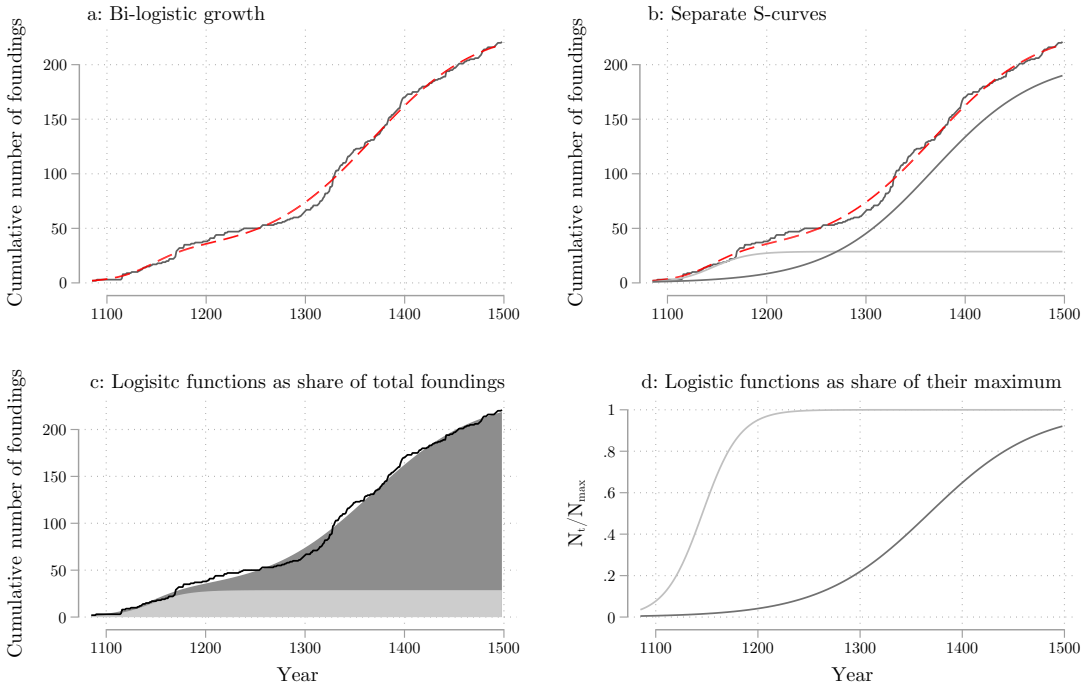
2.6.3 Category density and legitimacy

The hypothesis that legitimacy caused by higher categorical density predicts more exogenous diffusion patterns can be tested using data on multiple orders. The first test will exploit data from the English Monastic Archives. The second test uses data of the Dutch monastic census.

England

The English Monastic Archives have data on six male orders with enough foundings to allow the estimation of mixed influence models. The test assumes that categorical density is determined by the order of entry into England. Therefore, comparing the ratio of the external and internal influence parameter within a given a category – monks or canons regular – should reveal an increasing weight of external influences with every new order entering the respective category, i. e. the ratio a/b is expected to increase. Table 2.7 presents the results of seven separate mixed influence models estimated via non-linear least squares. Alongside the a/b-ratio the table presents information on the year of entry as well as the numbers of monasteries already founded within the categories when the order made its first

Figure 2.12: Bi-logistic model of Carthusian growth. (a) shows the empirical cumulative growth (gray) and the growth curve predicted by the bi-logistic model (red). (b) adds predicted values of the two separate logistic growths processes. (c) decomposes the cumulative number of monastic foundations into the two overlapping subprocesses. (d) re-expresses the two logistic functions as shares of their respective predicted maximum number of foundations.



foundation in England.

Looking at the monastic orders, the first wave of Benedictine foundations had a ratio of 0.675 while the Cistercians, the latest monastic order in the dataset, has a ratio of about 55 million. That means the numerator is almost zero and the Cistercian spread almost entirely by constant (exogenous) hazard. The second wave of Benedictine foundings deviates from the prediction because the a/b-ratio is smaller than during the first wave. However, both parameter estimates are not statistically significant, indicating a bad fit of the Bass model (see Figure 2.15 in Appendix 2.C for visualizations of the predicted growth curves). Interestingly, the Bass models describes the growth of the Cluniacs in England well and the ratio is 8.12, thus suggesting that in contrast to the European-wide growth there is some external influence present.

The pattern among the canons regular is roughly in line with expectations. The Augustinian canons spread first and without any sign of external influence. However, it must be stressed that both parameters are tiny and statistically insignificant, thus indicating that

the model does not satisfactorily describe the growth pattern.[30] The two later entrants, the Gilbertines and Premonstratensian, have higher a/b-ratios and spread predominantly via exogenous influence. The estimated Premonstratensian ratio is lower than the Gilbertines', even though the latter established their first house earlier. However, there is only a 14 year difference between the entry dates. It is not clear whether this is enough time to aid the institutionalization of the canons regular as a legitimate category. The important finding is that both orders spread with a strong exogenous component compared to the Augustinians.

The Benedictines and the Augustinians were the most successful with regard to the maximum number of foundings $N_{\max}$ (the "market potential"). This may point to the potential relevance of a "first-mover advantage." In the spirit of organizational ecology (Hannan and Carroll, 1992), it could be hypothesized that they were able to colonize an ecological niche before other entrants and thereby lowered the growth potential of later orders.

Netherlands

The database *Monasteries in the Netherlands until 1800* includes enough orders to systematically study the effect of category density on the diffusion process. The analysis pools panel data of 36 male and female orders. Three models are estimated: A baseline Bass model without additional covariates, a model that operationalizes category density as the count of *orders* that fall within the same category, and a third model that operationalizes category density as the number of *houses* that fall within the same category. Both models include a dummy variable that indicates the difference between male and female orders. Table 2.8 presents results where the regression coefficients are already transformed back to the model parameters (the regression models are documented in Appendix 2.E, Table 2.11). The first column summarizes the baseline model. The orders in the Dutch database spread on average with mixed influence. The external component is rather strong: Only the a but not the b parameter is significant. Thus, it is not possible to rule out that the average order spread more or less exclusively via exogenous, constant hazard. The a/b-ratio based on the point estimates is 4. This number is below the values observed for the Cistercians in the European-wide as well as the English data. Accordingly, the predicted curve in Figure 2.13 demonstrates that the external influence does not fully dominant the baseline specification (red) due to the visible initial acceleration.

The second column is the model with the preferred operationalization that counts the number of orders within a given category (rule or type). Category density measured by the number of orders of the same type that exist in the region in a given year shows the

[30] Looking at Figure 2.15 in Appendix 2.C suggests that Augustinian growth followed an S-curve pattern. However, the process took longer to accelerate than a simple internal influence model would predict.

Table 2.7: Mixed influence diffusion models of male orders in the English Monastic Archives. The table shows coefficients from non-linear least squares estimates with t-values in parentheses. All models are estimated via cumulative adoption functions. Entry year refers to the year of the first foundation in England. Categorical density is measured as the number of communities of either monks or canons regular that had been founded before the order made its first foundation in England.

	Ben. (< 850)	Ben. (≥ 850)	Cluniacs	Cistercians	Augustinians	Gilbertines	Premonstratensians
a	0.001^{**}	0.000	0.006^{**}	0.044^{**}	0.000	0.008^{**}	0.005^{**}
	(3.198)	(0.213)	(18.608)	(5.396)	(0.004)	(7.425)	(5.443)
b	0.002^{**}	0.000	0.001^{**}	0.000	0.000	0.002^{**}	0.002^{**}
	(16.865)	(0.049)	(8.747)	(0.075)	(0.063)	(9.515)	(14.144)
$N_{\max}$	21.947^{**}	202.193^{+}	40.240^{**}	65.151^{**}	196.390^{**}	21.906^{**}	36.815^{**}
	(174.485)	(1.805)	(38.901)	(69.942)	(6.685)	(301.585)	(265.209)
T	207	485	115	223	374	231	122
AIC	669.569	3799.938	398.913	1297.331	2672.943	607.886	461.321
RMSE	1.211	12.127	1.353	4.407	8.589	0.896	1.583
Type	Monks	Monks	Monks	Monks	Canons reg.	Canons reg.	Canons reg.
Ratio a/b	0.675	0.000	8.120	55278278.580	0.000	4.850	2.588
Entry year	597	878	1077	1127	1004	1131	1145
Density (N_{type})	1	25	74	181	1	45	80

$+$ p $\leq$ 0.1, * p $\leq$ 0.05, ** p $\leq$ 0.01. Variance-covariance matrix estimated using Jackknife method. Source: Own data. Calculations using Stata 17.

Table 2.8: Effects of category density and gender on diffusion parameters. The coefficients of category density are the response to a one standard deviation increase.

	Baseline	Density (orders)	Density (houses)
Baseline Bass model			
a	0.004^{**}		
	(3.518)		
b	0.001		
	(0.153)		
$N_{\max}$	21.337^{+}		
	(1.956)		
Effect of covariates on a			
Category density: type ($+1\sigma$)		0.009^{*}	0.001
		(2.240)	(0.938)
Category density: rule ($+1\sigma$)		−0.011	0.001
		(−1.167)	(0.090)
Female order		0.003	−0.001
		(1.444)	(−0.197)
Effect of covariates on b			
Category density: type ($+1\sigma$)		-0.001^{**}	−0.000
		(−5.436)	(−0.204)
Category density: rule ($+1\sigma$)		0.000	−0.000
		(1.214)	(−0.281)
Female order		−0.000	−0.000
		(−0.212)	(−0.092)
Effect of covariates on N_{max}			
Category density: type ($+1\sigma$)		-1.038^{**}	1.822
		(−4.945)	(0.092)
Category density: rule ($+1\sigma$)		4.220	0.167
		(1.084)	(0.052)
Female order		1.785^{**}	3.143
		(4.180)	(0.123)
Order-years	9433	9433	9433
Orders	36	36	36

$+$ p $\leq$ 0.1, * p $\leq$ 0.05, ** p $\leq$ 0.01. Results based on estimates in Table 2.8 (Appendix 2.E).

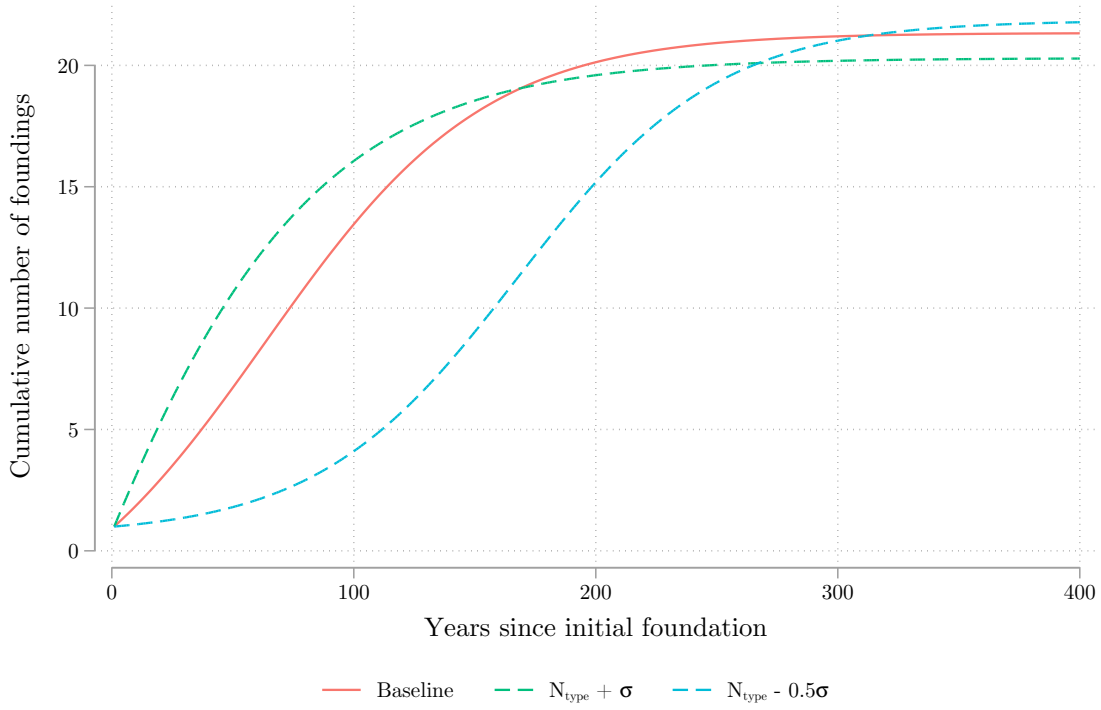
expected relationships with external and internal influence. Based on the model estimates, increasing type category density by one standard deviation and holding everything else constant, significantly increases the exogenous hazard ($p < 0.05$) and significantly decreases the endogenous hazard ($p < 0.01$). The relationship with the maximum number of foundings is significantly negative ($p < 0.05$). A one standard deviation increase is associated with a decrease in the average maximum number of foundings by one. This small negative relationship is very likely not a consequence of legitimation. It rather indicates that the measure might be correlated with niche crowding. In line with evidence from England, innovative orders diffused more endogenously because they lacked legitimacy but they could also realize more foundings due to the fact the demand for the specific life form had not been satisfied. The predicted changes in the curve's shape of a one standard deviation increase (about two additional orders of the same type) and half a standard deviation decrease can be seen in Figure 2.13. The green dashed curve ($+1\sigma$) approximates confined exponential growth while the blue dashed line (-0.5σ) conforms much more to what would be expected given a purely contagious process. The response of the projected trajectory is strong while the maximum number of foundings is only sightly affected. In the Netherlands at least, the ultimate success does not vary much by category density which might be explained by niche crowing offsetting the effect of legitimacy. Based on the results, we can conclude that categories are already institutionalized by the previous spread of a few similar orders and that legitimate types of orders spread predominantly via exogenous influences.

The pattern observed for category density measured by the number of orders with the same rule is inconsistent with the hypothesis. For orders with more common rules, the coefficient of external influence is smaller although the difference is far from reaching a commonly accepted level of significance. Moreover, it has no effect on internal influence. However, adopting a common rule seems to increase the maximum number of foundings by about 4 additional communities. This could be interpreted as a consequence of legitimation but does not fit the negative effect on the exogenous spread parameter.

Lastly, female orders do not seem to differ from male orders regarding the relative importance of internal and external influence. They are, *ceteris paribus*, marginally more successful in terms of maximum foundings.

The alternative operationalization used in the third column produces smaller effect sizes, none of which are significant. The overall pattern of statistical associations is consistent with the theoretical expectations. Higher values of both indicators of higher category density correlate with a more external and less internal influence.

Figure 2.13: Predicted curves based on measures of category density (second column, Table 2.8).



2.7 Discussion

Did religious orders spread like viruses? The answer obviously depends on the exact interpretation of that analogy. The majority of the orders studied did not spread via simple endogenous hazard. The ideal-typical S-curve seems to be the exception, not the norm. In the European-wide case-studies, the Cluniacs and Carthusians spread without external influence but both trajectories deviated from the simple internal influence model usually presumed to underlie a contagious diffusion. The spread of the Cistercians was initially dominated by an exogenous factor and represents a mixed rather than a pure diffusion process. Likewise, the majority of orders in the English Monastic Database exhibited at least some significant external influence. And again, the average diffusion process of 36 medieval orders within the borders of the present-day Netherlands is best described by a mixed influence model with substantial exogenous hazard. It should not be surprising that the growth of historical orders was not simply the result of contagion and imitation. They were shaped by institutional and political forces as well as the contingent actions of important figures.

While the present study has established the relevance of external influence, the manifold underlying processes are still in need of elaboration and systematic testing. As a first step

in that direction, the Dutch data strongly suggests a moderating role for legitimacy and category density. However, the research design does not constitute a strict causal test. In the best case, it would be possible to identify an exogenous source of either category density or another source of legitimacy. Moreover, the small effects of categories pertaining to rules is surprising given the importance attached to textual and genealogical legimitation (Wittberg, 1994: 142) and raises the possibility of refined indicators. It could also be fruitful to change the unit of analysis and model the monastic rules themselves as innovations whose adoption is to be explained.

Legitimacy very likely does not operate in isolation because potential adopters have to be aware of the existence of a religious movement (see also Appendix 2.F for a discussion of how to model awareness). It is more like a catalyst and precondition for the uninhibited working of other external influences (Rossman, 2014: 53). Future research should focus on the exact transmission mechanism from institutions and persons to potential adopters. The most tangible example of external influence is the remarkable Cistercian growth resulting from Bernard of Clairvaux's travels. However, the case study is lacking the important contextual factors and cannot answer the question whether his success in promoting the Cistercian movement was conditional of the perception of the order as a legitimate form of monastic life.

Notwithstanding my emphasis on external influence, the mixed influence model is a generalization of the model of contagious diffusion. It reflects that the portion of religious movements' spread that cannot be explained by external factors is the result of a contagious process. The endogenous portion is then be best understood as resulting from mechanic imitation or persuasion upon contact and not other forms of self-reinforcing system behavior like social learning or social pressure (Young, 2009). The subset of the population that constituted the potential adopters were potentially predisposed by their cultural and social environment to join an order.

Coming back to the case studies, the Cluniacs are the most direct evidence against the usefulness of the classical diffusion framework. The accelerated growth cannot be reconciled with pure internal influence. One possibility is to look for alternative models that may be consistent with the macro-level pattern, such as the threshold and social learning models. However, if the spread of one order calls for the consideration of an alternative model, this casts doubt on the whole project if it is not possible to identify scope-conditions that govern the applicability of the traditional diffusion models. Moreover, the explanation of religious phenomena by decision theoretic models like social learning must be careful to plausibly specify the utility function. Some important payoffs of monastic life – like promise of salvation – are hardly observable and do not lend themselves easily to modeling via Bayesian learning (Montgomery, 1996). Another possibility is the decomposition of the Cluniac diffusion process into multiple regional diffusion processes. Cluniac spread in

England, for example, (see Section 2.2) had a strong external component and was predicted well by the Bass model. Deviant European-wide patterns may result from the aggregation of separate, regional diffusion processes.

A step in this direction was taken with the Carthusians data. The overall diffusion is consistent with a bi-logistic growth process which was initially confined to regions close to the order's origin. What is needed, however, is a theory that explains why some orders diffused in a seemly steady fashion while others diffused in an interrupted and partitioned process. It could be that the latter is expected to happen with a certain probability because social interactions were shaped by cultural heterogeneity among the regions. Developing and testing such a theory would necessitate the reconstruction of the spatial networks of diffusion (Everton and Pfaff, 2022). Another possibility concerns the policy or strategy regarding foundations. Aston (1993: 13) suggests prior to 1200 only "desolate sites [...] where the peace and solitude demanded could be to a large extent guaranteed" were accepted. Foundations in upland areas such as the French Prealps were expensive and required the support of extremely wealthy individuals like kings or bishops. Over time the Carthusians adapted their strategy, allowing foundations adjacent to urban centers and enabled the endowment of single monastic cells rather than a whole complex (Aston, 1993: 13). This might have eased the order's spread beyond their original roots. Thus, uneven diffusion patterns could be the result of changes in orders' strategies and adaptations to societal changes, increasing the growth potential ($N_{\max}$).

The diffusion of innovation approach to historical religious movements allows the comparative study of religious groups with minimal data requirements. It goes beyond mere description but reveals theoretically meaningful systematic relationships. At a minimum, it has already proven to be fruitful in generating a host of theory-guided hypotheses. Of course, it was never intended to privilege simple diffusion models vis-à-vis alternative approaches like more elaborate models of spatial and network diffusion. The intent was to evaluate the usefulness as a complementary perspective. Especially spatial diffusion models seem promising as a direction for future research given the hypotheses suggested in the discussion. The limitations of a diffusion perspective are apparent as well. The application of mathematical models to historical phenomena requires enormous abstractions and simplifications. They do not give definite answers but demonstrate the compatibility of historical data with a sociologically informed interpretation. It is an open question, how much historical detail can be integrated into the models, that is, if the manifold changes in institutional and cultural factors during the rather long observation periods can be somehow measured and included in order explain more of the variation. It seems more likely that – while certain refinements are possible – diffusion models can at best remain rough approximations whose parameters have to be interpreted in light of detailed historical knowledge and complimented by more focused quantitative studies.

2.A Logistic model from a population growth perspective

The following is an adaption of the exposition of a classical logistic growth model by Hannan and Carroll (1992: 51–52). The logistic model can be reformulated as a compound growth process

$$\left(\frac{dN_t}{dt}\right) = r(N_t)N_t \tag{2.20}$$

were the growth rate $r(N_t)$ is a function of the size of the religious order at time t. N_t is often called "density" in the ecological tradition even though it is usually just a count, not a ratio of two quantities. The growth rate can be specified in terms of an adoption rate (r_b) and a death rate (r_d).[31] The rate of adoption can be specified as a density-dependent process

$$r_b(N_t) = b_0 - k_b N_t \quad b_0, k_b > 0. \tag{2.21}$$

The negative sign of the second term reflects the already established assumption that the more adopters already exist, the harder it gets for every individual member to meet and convince susceptible individuals (i. e. the effectiveness of individual members decreases). Because orders existed for multiple generations, we assume that members die at a certain rate and are over time replaced by new generations. However, in contrast to classical models of population growth, it does not make sense to assume a density dependent death rate.[32] Thus, the death rate is a constant

$$r_d(N_t) = r_d = d_0 \quad d_0 > 0. \tag{2.22}$$

Obviously, the number of deaths per unit of time increases as N_t increases because the death rate is multiplied by the size of the order (see below).

The growth rate is the combination of the time-dependent adoption and the time-constant death rate

$$r(N_t) = (b_0 - d_0) - k_b N_t. \tag{2.23}$$

This expression can be substituted in Equation 2.20

$$\left(\frac{dN_t}{dt}\right) = ((b_0 - d_0) - k_b N_t)N_t \tag{2.24}$$

$$\left(\frac{dN_t}{dt}\right) = (b_0 - d_0)N_t - k_b N_t^2. \tag{2.25}$$

This process has a steady state at $N_{max} = (b_0 - d_0)/k_b$. Simple algebraic transformations

[31] Orders are peculiar because they *only* grow by acquiring new outside members. For common religious groups, r_b may represent a combination of a birth and a conversion rate.

[32] When modeling competition among different orders it could make sense to introduce a density dependent defection rate in addition to a death rate.

yield the original differential equation:

$$\left(\frac{dN_t}{dt}\right) = (b_0 - d_0)N_t - \frac{N_t^2(b_0 - d_0)}{(b_0 - d_0)/k_b} \tag{2.26}$$

$$\left(\frac{dN_t}{dt}\right) = (b_0 - d_0)N_t \left(1 - \frac{N_t}{(b_0 - d_0)/k_b}\right) \tag{2.27}$$

$$\left(\frac{dN_t}{dt}\right) = bN_t \left(1 - \frac{N_t}{N_{\max}}\right) \tag{2.28}$$

$$\left(\frac{dN_t}{dt}\right) = bN_t(N_{\max} - N_t). \tag{2.29}$$

This exercise shows that a logistic model does not assume immortal actors but is consistent with a constant replacement of the adopter subpopulation. The factor b has a slightly different interpretation because it does not simply reflect the adoption tendency but rather the adoption rate minus the death rate among members of an order: $b = b_0 - d_0$.

2.B Relative hazard rate

Starting from the mixed influence model and using the notation $\dot{N}_t = dN_t/dt$, the hazard rate is obtained by a simple division:

$$\dot{N}_t = (a + bN_t)(N_{\max} - N_t)$$

$$\frac{\dot{N}_t}{N_{\max} - N_t} = a + bN_t.$$

Young (2009) is interested in what he calls the *relative hazard rate*, i. e. the hazard rate in relation to the number of adopters at time t. By division we obtain:

$$\frac{\dot{N}_t}{N_t(N_{\max} - N_t)} = \frac{a}{N_t} + b = H_t.$$

This quantity is clearly decreasing over time as N_t increases. Hence, an empirically observed increase in H_t contradicts the Bass model.

The ability to discern seemingly identical curves is demonstrated in Figure 2.14. The dashed line is the result of a Bass model with the parameter values $a = 0.0025$ and $b = 0.75$. The solid line was generated by a flexible diffusion model of the form

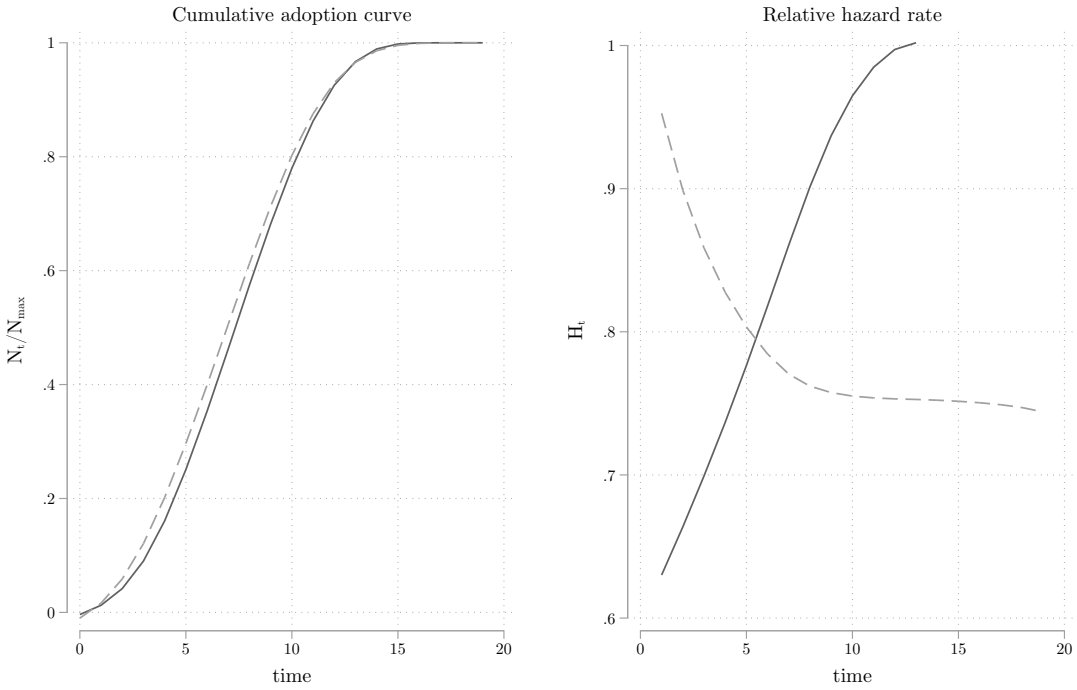
$$\dot{N}_t = N_t^{1+\alpha}(1 - N_t)$$

with $\alpha = 0.1$ (example taken from Young, 2009: 1904–1905). Martin (2009: 159) interprets this as a "pressure" model where the rate of adoption is not just a function of the frequency

of contacts between adopters and non-adopters but the probability of adoption also increases with N_t (if $\alpha > 0$) due to social pressure. He then proceeds with a pessimistic assessment:

> Contagion will take somewhat longer to get started, and then catch up quickly once a certain point is reached, but given the fuzziness of actual data – and this has perhaps not been appreciated – there is probably no way to distinguish a pure contagion process from a "pressure" process, even though the two make very different arguments about the fundamental nature of influence.

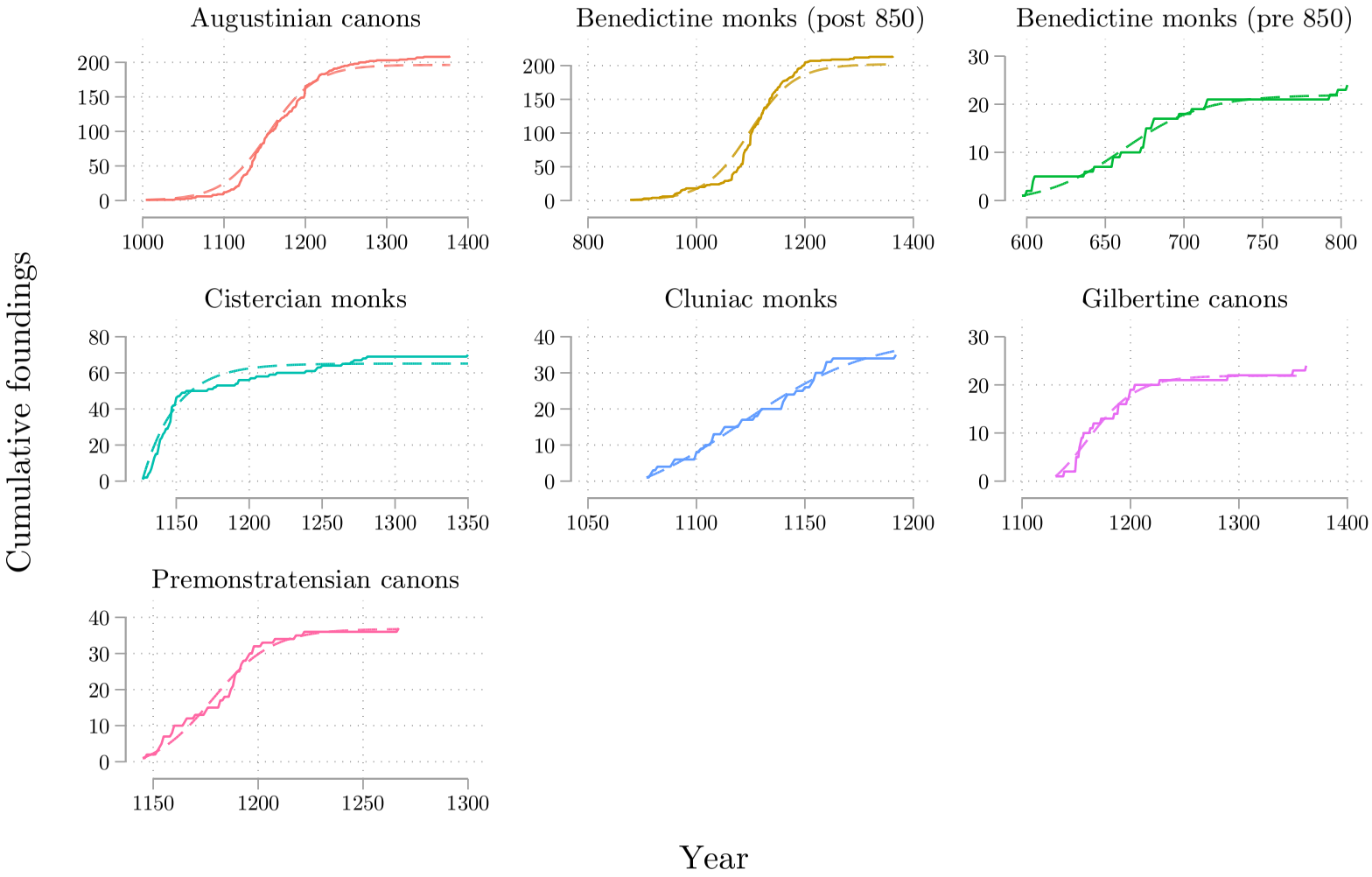
Figure 2.14: Cumulative adoption curves (left) and relative hazard rates (right). The solid line is the generalized diffusion model, the dashed line is the Bass model.



As can be seen in Figure 2.14, the two simulated cumulative adoption curves appear very similar. Nonetheless the trajectories of the relative adoption rates are quite different. The relative hazard rate of the Bass model starts at its maximum and decreases afterwards; the relative hazard rate of the flexible diffusion model starts at its minimum and increases monotonically. Of course, it will be more difficult to distinguish curves empirically given the "fuzziness of actual data" but it is still an improvement over eyeballing cumulative adoption curves.

2.C English Monastic Archives: Bass model

Figure 2.15: Cumulative adoption curves based on Bass models from Table .



2.D Dutch Monastic Census: Categorization

Table 2.9: Orders included in the analysis sample with assigned type, rule, and sex. Last column refers to the maximum number of observed foundings.

Order	Type	Rule	Sex	Max. *N*
Alexian Sisters	Lay sisters	Augustinian	Female	13
Alexians	Lay brothers	Augustinian	Male	20
Austin Friars	Mendicant	Augustinian	Male	7
Beguines	Lay sisters	No rule	Female	93
Benedictine Nuns	Nuns	Benedictine	Female	15
Benedictines	Monastic	Benedictine	Male	20
Brethren	Lay brothers	No rule	Male	11
Brethren of the Common Life	Lay brothers	No rule	Male	19
Bridgettines	Nuns	Augustinian	Female	6
Canonesses Regular	Canonesses regular	Augustinian	Female	74
Canonesses Regular of Sion	Canonesses regular	Augustinian	Female	7
Canonesses Regular of Venlo	Canonesses regular	Augustinian	Female	10
Canonesses Regular of Windesheim	Canonesses regular	Augustinian	Female	8
Canons Regular	Canons regular	Augustinian	Male	13
Canons Regular of Sion	Canons regular	Augustinian	Male	8
Canons Regular of Windesheim	Canons regular	Augustinian	Male	30
Carmelites	Mendicant	Carmelite	Male	7
Carthusians	Monastic	Carthusian	Male	9
Cistercian Nuns	Nuns	Benedictine	Female	21
Cistercians	Monastic	Benedictine	Male	15
Clarisses	Second order	Saint Clare	Female	11
Crutched Friars	Canons regular	Augustinian	Male	16
Dominicanesses	Second order	Augustinian	Female	6
Dominicans	Mendicant	Augustinian	Male	15
Female Tertiaries	Female third order	Franciscan	Male	167
Friars Minor	Mendicant	Franciscan	Male	14
Knights Hospitallers	Military	Order of Saint John	Male	19
Male Tertiaries	Third order	Franciscan	Male	26
Observant Franciscans	Mendicant	Franciscan	Male	26
Premonstratensian Canonesses	Canonesses regular	Augustinian	Female	26
Premonstratensians	Canons regular	Augustinian	Male	16
Secular canons	Secular canons	Collegiate Church	Male	77
Sisters	Lay sisters	No rule	Female	120
Sisters of the Common Life	Lay sisters	No rule	Female	23
Tertiaries of St Dominicus	Female third order	Munio of Zamora	Male	7
Teutonic Order	Military	Teutonic Order	Male	21

Table 2.10: Small orders excluded from the analysis sample with assigned type, rule, and sex. Last column refers to the maximum number of observed foundings. The observations relating to these orders were included in the computation of category density measures.

Order	Type	Rule	Sex	Max. N
Antonines	Canons regular	Augustinian	Male	1
Beghards	Lay brothers	No rule	Male	4
Canonesses Regular of St Victor	Canonesses regular	Augustinian	Female	2
Canonesses Regular of the Holy Sepulchre	Canonesses regular	Augustinian	Female	2
Canons Regular of the Holy Sepulchre	Canons regular	Augustinian	Male	4
Carmelite Sisters	Second order	Carmelite	Female	2
Caulites	Monastic	Caulite	Male	2
Friars of the Sack	Mendicant	Augustinian	Male	3
Hermits of St William	Monastic	Benedictine	Male	3
Hospital Brethren	Lay brothers	No rule	Male	3
Hospital Sisters	Lay sisters	No rule	Female	4
Hospitaller Nuns	Female military	Order of Saint John	Female	2
Knights Templars	Military	Knights Templar	Male	2
Knights of St Lazarus	Military	Augustinian	Male	2
Magdalenes	Nuns	Augustinian	Female	4
Pied Friars	Mendicant	Augustinian	Male	1
Teutonic Order women convent	Female military	Teutonic Order	Female	2

2.E Dutch Monastic Census: Multilevel Bass model

Table 2.11: Multilevel diffusion models.

	Baseline Model	Density (orders)	Density (houses)
$N_{\text{t-1}}$	0.015**	0.022**	0.017**
	(3.108)	(2.918)	(2.897)
$N^2_{\text{t-1}}$	−0.001**	−0.001**	−0.001**
	(−5.579)	(−4.468)	(−3.737)
$N_{\text{type},t-1}$ (orders)		0.035*	
		(2.201)	
$N_{\text{t-1}} \times N_{\text{type},t-1}$ (orders)		−0.004**	
		(−3.390)	
$N^2_{\text{t-1}} \times N_{\text{type},t-1}$ (orders)		0.000**	
		(5.436)	
$N_{\text{rule},t-1}$ (orders)		−0.017	
		(−1.219)	
$N_{\text{t-1}} \times N_{\text{rule},t-1}$ (orders)		0.002	
		(1.167)	
$N^2_{\text{t-1}} \times N_{\text{rule},t-1}$ (orders)		−0.000	
		(−1.214)	
Female order		0.074	−0.002
		(1.419)	(−0.026)
$N_{\text{t-1}}\times$ Female		−0.003	0.003
		(−0.303)	(0.238)
$N^2_{\text{t-1}}\times$ Female		0.000	0.000
		(0.212)	(0.092)
$N_{\text{type},t-1}$ (houses)			0.000
			(0.265)
$N_{\text{t-1}} \times N_{\text{type},t-1}$ (houses)			0.000
			(0.012)
$N^2_{\text{t-1}} \times N_{\text{type},t-1}$ (houses)			0.000
			(0.204)
$N_{\text{rule},t-1}$ (houses)			0.000
			(0.101)
$N_{\text{t-1}} \times N_{\text{rule},t-1}$ (houses)			−0.000
			(−0.136)
$N^2_{\text{t-1}} \times N_{\text{rule},t-1}$ (houses)			0.000
			(0.281)
Constant	0.076**	0.038	0.051
	(2.733)	(0.523)	(1.560)
$N \times T$ (order-years)	9433	9433	9433
N (orders)	36	36	36
log-likelihood	-4070.779	-4028.560	-4041.415

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. Unstandardized regression coefficients with t-values in parentheses. Inference based on unstructured variance-covariance matrix with cluster-robust standard errors.
Source: Own data. Calculations using Stata 17.

2.F Awareness and adoption

The appropriateness of Rossman's (2014) model can be questioned. He discusses awareness of the innovation as a central scope condition for spread via exogenous influence. "Adoption can never outpace awareness, and so a constant hazard for adoption presupposes an exogenous force (such as a marketing campaign or a decree from the central state) creating awareness". Hence, "categorical density may be a necessary but not sufficient condition for rapid diffusion of an innovation" (Rossman, 2014: 63). My argument assumed that awareness of new religious movements was not just the result of word of mouth but was created by charismatic leaders as well as institutional forces of church and state. However, diffusion models can be modified as to theoretically separate awareness from adoption (Mahajan and Peterson, 1985: 44–47). The resulting model bears some similarities with the dynamic model discussed in Section 2.1.4.

The relevant population is divided into three subgroups: 1) potential adopters who are unaware of the existence of a religious movement 2) potential adopters who are aware but have not yet joined 3) members/adopters. The diffusion of information increases the number of aware potential adopters over time. I will make the simplifying assumption that the total population of potential adopters U in the social system is constant over time. At time t there are A_t aware of the existence of a religious movement. Knowledge spreads endogenously via word of mouth

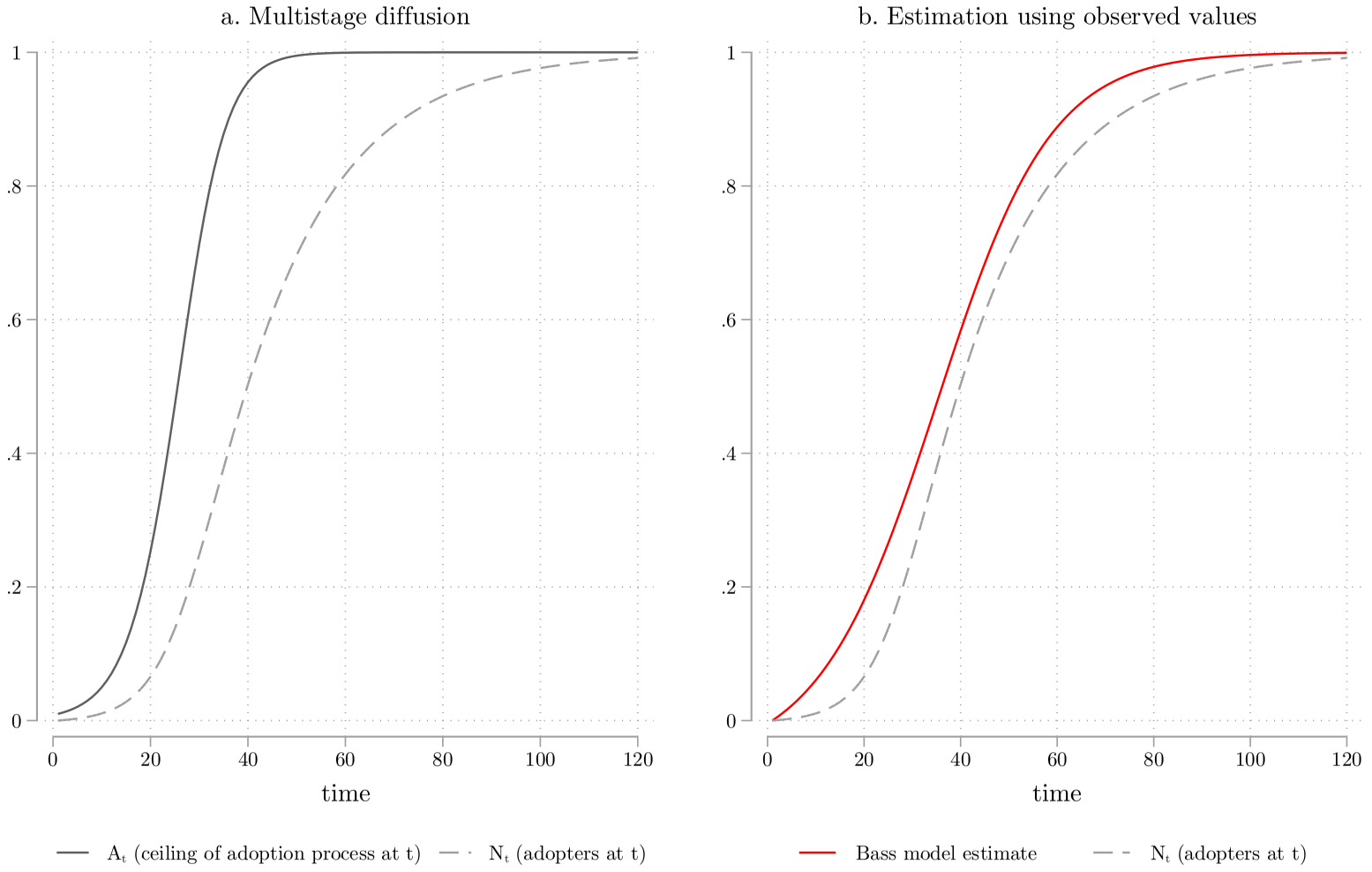
$$\left(\frac{dA_t}{dt}\right) = bA_t(U - A_t).$$

b is the rate of information diffusion. Because the movement is perceived as legitimate within a religious traditions, adoption is independent of the number of prior adopters. Once aware of its existence, a fixed proportion of A_t joins every period

$$\left(\frac{dN_t}{dt}\right) = a(A_t - N_t).$$

We can think of that proportion as being entirely determined by the movement's spiritual appeal to individuals. The resulting adoption function is a mixture of the confined exponential and logistic model (see Figure 2.16a) whose exact shape is dependent upon the relative speed of the two processes. The curve differs from the Bass model due to the necessarily sigmoid initial phase. The Bass model can only approximate the trajectory (see Figure 2.16b) but estimation will usually yield non-zero point estimates of external and internal influence. Future research could explore the explanatory power of such a model vis-à-vis the Bass model.

Figure 2.16: Simulated multistage diffusion process.



3 Blessings of a strict father

The sociology of religion has a long-standing interest in the determinants of the success of religious movements. One central aspects pertains to the commitment of members. As Stark (1996: 138) notes, "for a religious group, as with any organisation, *commitment is energy*" (emphasis in original), i. e. commitment is a necessary condition for effective collective action. Many aspects of religious practices (e. g., church services and other rituals) are a collective experience and hence a form of joint utility production. The *average* level of participation and involvement determines the payoff to individual participants. Therefore, it is crucial to deter "free-riders" from joining. Extensive scholarship in the sociology of religion relates commitment and engagement to the strictness of religious rules. Strictness here refers to "a separate and distinctive life style or morality in personal and family life, in such areas as dress, diet, drinking, entertainment, uses of time, sex, child rearing, and the like" (Iannaccone, 1994: 1189). Strict lifestyles naturally deter free-riders. At the same time, prohibitions, taboos and ritual requirements limit individualistic consumption opportunities of engaged members, helping them to coordinate their time investments towards joint religious activities. However, this explanation raises the question of how successful religious movements maintain the observance of a strict lifestyle.

Orders constitute a specific form of religious movements and were for many centuries a "source of spiritual renewal and breeding ground for religious entrepreneurs" within the Catholic Church (Finke and Wittberg, 2000). Due to various spiritual and organizational innovations, historical orders are a comparable but nonetheless differentiated class of organized religious movements whose success is to be explained by sociological theories of religion (Wittberg, 1994, 2007). The well-documented history of Christian orders allows us to study their development over a long period of time which makes them a fertile ground for testing theories about the effectiveness of organizational principles. Orders exemplify the relevance of maintaining internal strictness. To join an order was to seek salvation and the realization of ascetic ideals within the most supportive context of other co-religious. Furthermore, the collective religious experience was inseparably linked to a thoroughly collective lifestyle, including the management of common resource pools.

Orders faced (and still face) collective actions problems at two different organizational levels. First, individual monasteries are local representatives of larger religious movements. The general reputation of the order affects the ability of houses to attract potential members

and donors who favored monks living an exemplary life according to Christian ideals as envisioned in the *Regula Benedicti* and other foundational documents. However, there is an incentive for a monastic community to "free-ride" and benefit from an order's reputation while neglecting their own rule observance, e. g. consume material resources for private pleasure. The conduct of individual communities contributes to the reputation of the entire order and hence misconduct may lower the attractiveness of other houses as well. This is one reason for the desire to enforce uniform observance among an order's houses. Second, lax observance of the monastic rule can decrease individual participation in joint activities and affect a community's ability for collective action. Dysfunctional houses are less attractive to potential donors and members vis-à-vis other houses by the same or other orders.

In spite of these threats, orders constitute "successful" religious movements that have survived for many centuries. For example, the Benedictine monasteries in southern Germany and Switzerland studied by Rost et al. (2010) had an average lifespan of 463 years (Rost et al., 2010: 95). The governance principles of religious orders are considered the prime explanation for the longevity of monastic communities (Rost et al., 2010; Inauen et al., 2010). The balance of monastic governance regarding participation and control as well as the common knowledge and understanding of objectives contributed to their permanent success. A recent study by Finley (2021) provides the most direct quantitative evidence to date that the organizational structure of historical orders was conductive to the compliance with strict monastic rules. Her research attempts to test a particular monitoring mechanism: the "filial" visitation system of the Cistercian order. However, there are problems with Finley's approach. First and foremost, she uses data from 18th century France even though the traditional visitation system fell apart during the 15th and 16th century (Müller, 2016: 76–79).

Nonetheless, the effectiveness of orders' internal systems of visitations is a promising research topic which can potentially shed light on the relevance of organizational principles on the long-term success of religious movements. Like Finley, this chapter focuses on the Cistercians because their prototypical filiation system is considered to have been astonishingly effective in enforcing uniform discipline across houses in all of Europe (e. g. Burton and Kerr, 2011: 82 ff.). As the same time, I will broaden the focus by comparing the Cistercian system to the systems of visitation of two other major branches of Western monasticism: the Cluniacs and Carthusians.

In the case of religious movements, "success" may include multiple dimensions such as the extent of geographical expansion or the founding rate of new communities. In the following, I will address the remarkable stability and longevity of monastic communities. Variation in the extent of external control may have caused variation in the stability of communities. Therefore, I will focus on the ultimate outcome of discipline – the survival or dissolution of monasteries.

Using data on all 722 documented Cistercian abbeys founded before the 16th century, I will exploit variation within the organizational structure to predict differential dissolution rates of abbeys. Moreover, I can compare the results for the Cistercian case with those of the 221 Carthusian houses as well as 1,038 Cluniac houses founded before 1500. Both orders institutionalized different systems of visitations. Hence, the analysis covers the observation period 900–1500 with data on a total of 1,981 monasteries, representing almost all documented houses of three of the most important monastic movements.

In the next section, I will provide a short history of organizational innovations with regard to visitation structures of medieval orders. Section 3.2 spells out the theoretical model as well as its application to the cases at hand. Testable predictions will be presented in Section 3.3 before I briefly discuss relevant research with a special focus on Finley (2021) in Section 3.4. Methods and datasets are explained in Section 3.5. Section 3.6 contains descriptive as well as multivariate results. Lastly, Section 3.7 discusses the findings as well as weakness of the research design. In the end, my results point to the effectiveness of certain forms of visitations but are negative or ambiguous with regard to a subset of the predictions. Most surprisingly, the Cistercian system of filial visitation, albeit the most prominent example in the literature, does not seem to reduce dissolution risk. The chapter concludes with a discussion of alternative explanations as well as avenues for further research.

3.1 Monastic systems of visitation

In the 10th century, Western monasticism was more or less uniformly Benedictine. However, there was no "Benedictine order," just autonomous and autarkical communities as well as a general notion of the broad movement of Christian monasticism. Over time, various reform movements within Benedictine monasticism as well as altogether new orders were founded, often in reaction to a perceived decline of traditional communities, that increasing incorporated elements of centralized organization.

The first step in that direction of increasing uniformity and strictness of observance by means of organizational integration was the congregation of Cluny. Originally a reform movement that aimed to purify the Benedictine model from aberrancies, it became the nucleus of a far-spanning federation of monasteries under the supervision of the abbey of Cluny (Lawrence, 2015: 76). As a rule, new foundations as well as reformed monasteries became priories (dependent and subordinate houses) of the latter.

The introduction of hierarchy and dependence among the houses as well as the papal exemption from episcopalian jurisdiction were novelties. However, Cluny did not lay down a charter of constitutional principles and was hence solely acting based on its construction of the *Regula Benedicti* whose framework was insufficient to further integrate the organizational network:

> It was a vast spatial extension of St Benedict's idea of a monastery as a family community living under the personal direction of a father-abbot [...] [A]ny real supervision of such a huge congregation was obviously beyond the capacity of one man. [...] *The Cluniac empire lacked an effective organization because it was not the outcome of any clearly formulated design* (Lawrence, 2015: 86; emphasis added).

Until the 12th Century, the visitation of houses was the responsibility of the abbot of Cluny. However, "the task was manifestly too big for one man" since "he cannot have visited, even once, more than a fraction of all the monasteries nominally under his control" (Constable, 1976: 19–20).[1] Moreover, the organizational structure was complicated by deviations from the ideal, since many Cluniac houses had "daughter houses" of their own (see Figure 3.2) and it took centuries for a clear division of responsibilities to emerge. The congregation of Cluny thus became a "ramshackle empire" (Lawrence, 2015: 86) that failed to achieve a high level of internal discipline and organizational uniformity.

Like the beginnings of Cluny, Cistercian reform was motivated by a desire to return to the imagined strictness of original Benedictine monasticism. This included, amongst other things, the reintroduction of manual work as a duty for every monk, strict seclusion from the outside world, and a preference for simple aesthetics in architecture. The Cistercians, who at the height of their expansion in the 14th century had almost 700 houses all over Europe, went beyond Cluny in that they developed systematic organizational principles, they then laid down in the *Carta Caritatis*. Of course, those principles were not the result of one initial master plan, but rather the systematization of practical experiences that accumulated during the first decades of their existence (Berman, 2000). The Cistercians were confronted with the same kind of problems the Cluniac federation had already faced (Lawrence, 2015: 170):

> The Rule of St Benedict assumes that every abbey is an autonomous society governed by its own elected paterfamilias. The problem that faced the founders of Cîteaux and successors was how to reconcile this autonomy with the need to preserve standards and ensure uniformity of observance – to keep the original ideal from erosion as new foundations proliferated, many of them in distant lands and less advanced cultures.

The success of the whole Cistercian project was dependent on their public image as the clearest manifestation of monastic ideals. Scandalous behavior in one monastery was likely to affect the overall image of the order. Moreover, individual dissenters or free riders who did not abide by the order's rule or failed to contribute enough to the spiritual life of the

[1] According to my data, there were at least 520 houses associated with Cluny at the beginning of the 12th century.

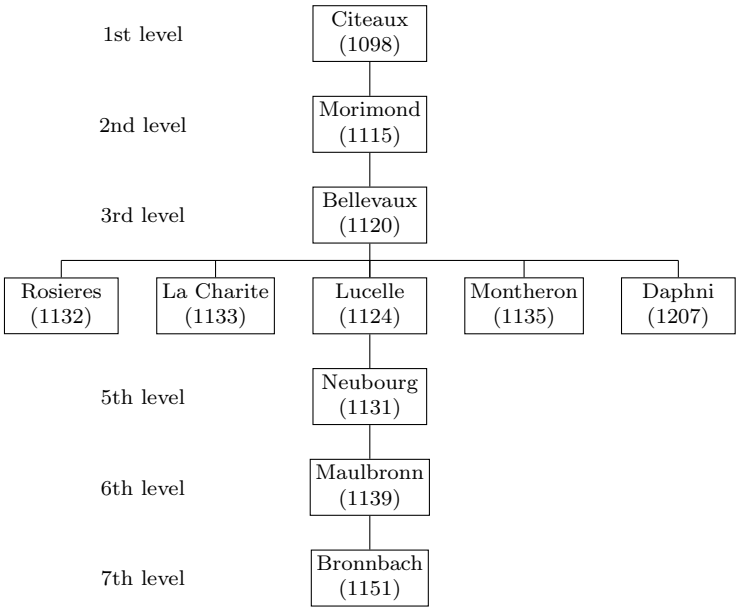


Figure 3.1: Cistercian Genealogical Hierarchy. Exemplary branch of the Cistercian "family tree" with year of foundation in parentheses (Snyder, 2009: 47).

community threatened the overall high level of engagement and hence the attractiveness of their monastery. In other words, the order needed to solve collective actions problems.

Cistercian visitations were based on the so-called filiation system. The *Carta* defined a specific relationship between monasteries and the houses they founded (Jamroziak, 2012; Lawrence, 2015: 166–179). The abbot of the "mother house" (father abbot) should visit the "daughter houses" at least once a year. His responsibility was to monitor its spiritual and economic conditions. Father abbots were not allowed to intervene in the internal affairs without good reason. Daughter houses were independent and elected their own abbots under the supervision of the father abbot. The filiation system resulted in a hierarchical, acyclical tree network whose basic elements are the dyadic mother-daughter relationships (Figure 3.1). Cîteaux, at the top of the family tree, was visited by the "proto-abbots" of the four primary abbeys, the oldest daughter houses founded by Cîteaux.

The five branches, or families, that derive from those oldest houses constituted organizational subdivisions. For instance, tax collection was organized along those generational lines, with every mother house demanding a certain amount from its daughter houses, who in turn had to collect a specified share from their dependencies. The maximum path length from top (Cîteaux) to a lower monastery was 8. As can be seen in Figure 3.3, some related houses were geographically close, while other daughter houses were long distance foundations. It is unlikely that the father abbot could exercise his control function regularly when he had to travel thousands of kilometers. Moreover, there is considerable variation regarding the "procreational success" and the resulting power of abbeys. Of the 722 abbeys in my dataset,

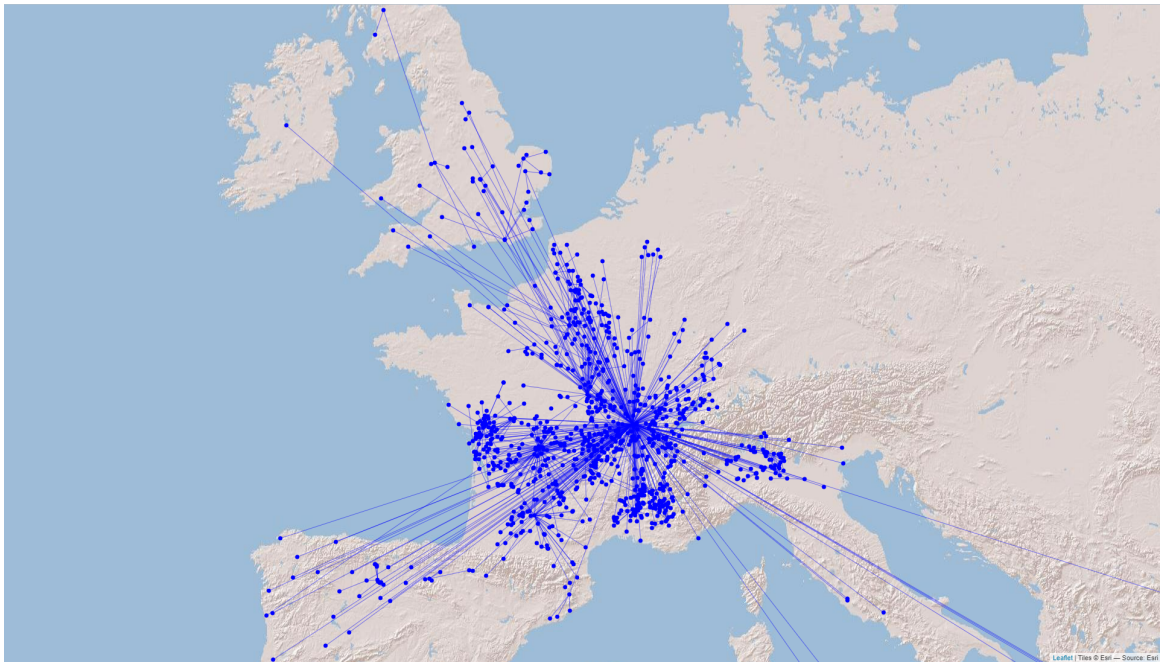


Figure 3.2: Static representation of the Cluniac network (900-1500). The map shows the position of 1038 monasteries founded before 1500, regardless of the year of dissolution. The network ties represent ties to the (immediate) original mother house – i. e. mother house at foundation or initial affiliation with the Cluniac order. The dominant position of the Abbey of Cluny is clearly visible.

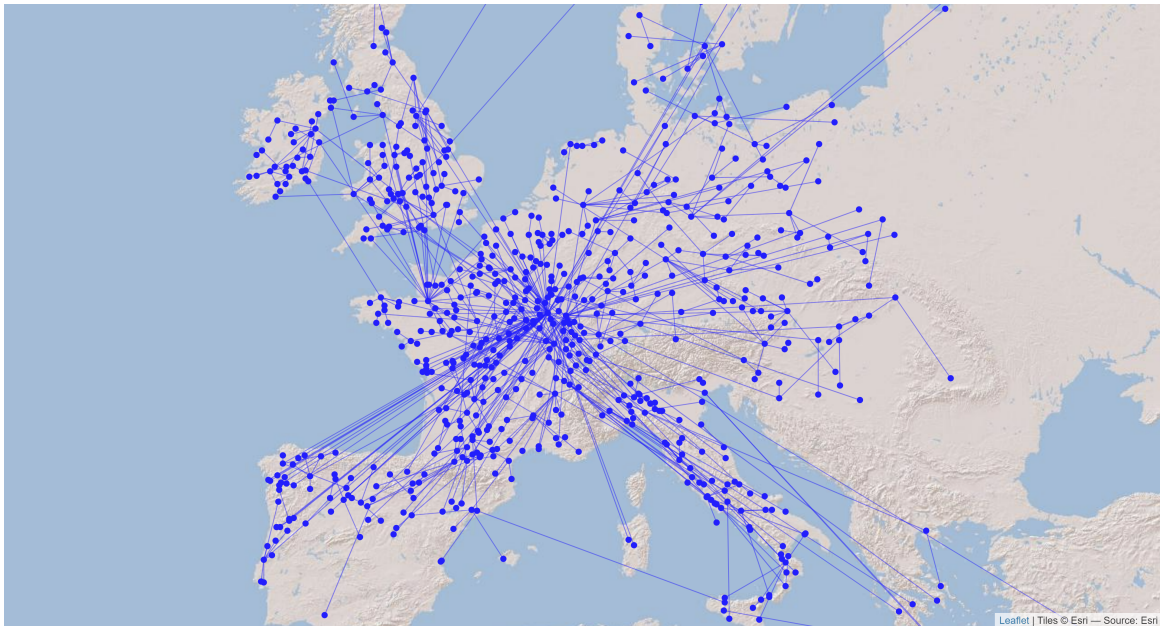


Figure 3.3: Static representation of the Cistercian network (1100-1500). The map shows the position of 722 abbeys founded before 1500, regardless of the year of dissolution. The network ties represent ties to the original mother house – i. e. mother house at foundation or initial affiliation with the Cistercian order. The Cistercian network is less centralized than the Cluniac network.

494 never founded own daughter houses, while Clairvaux established 80 direct foundations (11 % of all abbeys founded until 1500). Nonetheless, comparing the Cluniac (Figure 3.2) with the Cistercian (Figure 3.3) network, it is apparent that the Cistercian network was more decentralized. Almost a third of all Cluniac houses were immediate houses of Cluny but only 3.5 % of Cistercian abbeys were immediate daughters of Cîteaux.

The organizational structure was complemented by a second important innovation: all abbots were expected to meet annually in Cîteaux for the General Chapter. They would report on the status of their own house as well as that of their daughter houses. The assembly then discussed punishments for reported misconduct or outlined new regulations. Lawrence (2015: 174) emphasizes the significance of this innovation:

> [The General Chapter] represented something new, not only in the monastic tradition, but in the polity of medieval Europe. It made the Cistercians an international order with a cosmopolitan and partly representative legislature.

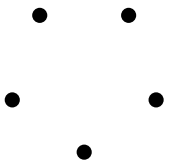
Historians have suggested that the flexible structure of the filiation system and General Chapter helped the order to cope with the rapid expansion during the twelfth and 13th century. It has been praised as "one of the masterpieces of medieval planning [...] a system complete in itself, wholly autonomous, equipped with a thorough organization for internal supervision [...] the first effective international organization in Europe, more effective even than the papal organization" (Southern, 1970: 255).

In the 14th and 15th centuries, the traditional system began to function worse and gradually disintegrate. Attendance at the General Chapter declined (Müller 2016: 70–76; Cygler 1998: 112–116) and the European-wide filiation network lost its significance. The latter was partly replaced by semi-independent regional congregations (Müller 2016: 76-79; Lekai 1977: 126). This regionalization was related to the development of territorial states which weakened the integrative function of Cistercian institutions.

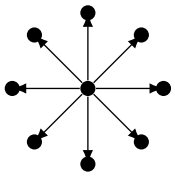
Comparison and later developments

Multiple Cluniac reforms were inspired by the Cistercian model and transformed the *federation* of Cluny into an *order* with a higher degree of internal organizational control (Oberste, 1996: 280–283). Beginning in 1132, several assemblies were convened, which can be considered as precursors of a General Chapter (Cygler, 1998: 326). The Cluniacs later adopted the Cistercian model of an institutionalized General Chapter. Moreover, the reforms introduced elements that were unknown to the Cistercian constitution, e. g. the creation of territorial provinces for the purpose of effective visitations. However, their system of visitation never achieved the clearly delineated structure of the Cistercian model. In total, there were least three sometimes competing authorities (Oberste, 1996: 310–311):

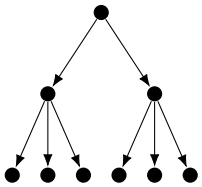
Figure 3.4: Overview of ideal-typical systems of visitation.



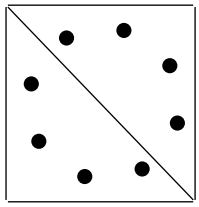
Original Benedictine houses were autonomous organizational units. Visitations were conducted by church (e. g. episcopal) authorities (if at all).



The Cluniac model was highly centralized. The Abbot of Cluny initially had direct authority over all houses. After several reforms, visitors were appointed by the General Chapter in Cluny.



Cistercians introduced a multilevel hierarchy – the filiation system. Daughter houses were visited by their "father abbot". Reprimands for serious misconduct were imposed by the General Chapter.



Orders like the Carthusians and Premonstratensians introduced visitation systems organized in provinces. Such systems were later adopted by many other orders as well.

1. The abbot of Cluny retained the prerogative to visit all monasteries personally. Even after the institutionalized of other control mechanism, the abbot of Cluny often conducted visitations himself. For example, between 1259 and 1313 he personally visited the province of France thirteen times. Furthermore, he could delegate his right to personal representatives. Starting in 1301, a subset of his personal delegates, the *visitatores generales*, were assigned to visit remote provinces.

2. Even though many priories within the order of Cluny were immediate houses, directly dependent upon Cluny, there were also mediate houses, i. e. foundations by Cluniac abbeys or priories other than Cluny itself (Oberste, 1996: 272–279). The abbots or priors of those houses claimed the right to visit the daughter houses and sometimes delegated this duty to deputies.

3. The *carmerarii* (provincial administrators) were assigned by the General Chapter or

the abbot of Cluny to conduct visitations. Beginning in 1233, the General Chapter appointed own visitors to provinces as part of the regular procedure. Only they were required to report to the General Chapter in Cluny and only those visitations were required to be conducted with regularity and completeness.

Over time, visitations by the abbot of Cluny as well as by the father abbot of dependent houses became less important in comparison with the General Chapter and the visitators appointed by it, making the internal workings of the order less dependent on personal relationships.

The Carthusians are a monastic order that was founded, like the Cistercians, at the turn of the twelfth century. They were not a reform movement within Benedictine monasticism and instead represent a monastic tradition *sui generis* incorporating elements of eremitic life (Lawrence, 2015: 145–146). The Carthusian system of visitations developed over time and constitutional consolidation took longer than with the Cistercians. The institution of a General Chapter was introduced in the first half of the 12th century and was held regularly at least since 1155 (Cygler, 1998: 233). This meeting of all priors (superiors of Carthusian monasteries) appointed visitors to all charterhouse (Carthusian monasteries). Initially, the visitations took place every leap year (later biannually: Cygler, 1998: 255) and a written report had to be filed to the General Chapter (Cygler, 1998: 236–237). Since the beginning of the 14th century, the order was divided into provinces. Visitations were conducted by provincial visitors appointed by General Chapter (Cygler, 1998: 268). However, the system was still highly centralized because almost all important matters were decided by the General Chapter (Cygler, 1998: 298–299). In summary, the General Chapter was the most important institution until 1300, after which it was supplemented by the provinces of the Order as a mediating administrative layer. Figure 3.4 gives an overview of the ideal-typical elements of medieval systems of visitation.

3.2 Theory and model

The need for systematic visitations can be elaborated using the canonical religious club good model first introduced by Iannaccone (1992, 1994). The survival of religious groups depends on committed members. However, there is always the risk of "free-riding" by individual members. In the case of monasteries, members were involved in joint spiritual and productive activities. The utility derived from most spiritual activities (e. g. church service and rituals) depends on the average quality of participation and hence the inputs of all individuals (Iannaccone, 1992: 276–277). There is only an incentive for committed individuals to join and stay in a monastery as long as the average participation is high. Uncommitted individuals have an incentive to join because of the material conditions in

well-run monasteries. If uncommitted members crowd-out committed members, religious life in monasteries ceases to exist because they indulge in private consumption. The reputation of the monastery will decrease and its sole purpose will be to serve the material interests of uncommitted members. This, in turn, increases the risk of mismanagement of the common resource pool because members with purely material interests have an incentive to maximize their individual gain (Iannaccone, 1994: 1186). All in all, lax observance increases the risk of dissolution because 1) the monastery will be unable to attract committed members as well as the support of wealthy patrons due to its reputation 2) the management of collective resource pools will be more difficult if all members are materially self-interested 3) Church authorities will withdraw support from sinful communities and dissolve them by decree. Even if a lack of discipline and commitment is not the direct cause of dissolution, healthy monastic communities with high internal cooperation and good reputation are very likely *more resilient* to exigencies like wars, plagues, or famine that threaten their survival.

Strict rules and excessive demands of sacrifice have two effects that alleviate the danger: First, prohibitions on consumption and secular activities (e. g. sexual abstinence, fixed daily schedule etc.) force members to coordinate their time-use towards common religious activities, increasing their average quality and therefore the utility derived from participation. Under certain conditions, the utility derived from the higher quality collective religious goods outweighs the loss of individual secular consumption opportunities (Iannaccone, 1992: 278–279). Second, stigma and sacrifice screen out uncommitted aspirants from joining the order in the first place because the "cost" of adhering the rules is greater than the utility derived from material amenities. An implication of the club good model is that some of the exact prescriptions of monastic asceticism are probably accidental. They survived a process of cultural evolution because they were adaptive and helped to stabilize a form of collective religious life that is necessarily at risk of being exploited by free-riders.

Iannaccone's model does not elaborate the monitoring of strict norms. He merely remarks that general rules of sacrifice and stigma are "less difficult to monitor than direct inputs to the group" and that larger groups "face higher monitoring costs and so have more difficulty enforcing distinctive behavioral requirements" (Iannaccone, 1992: 288). Thus, aside from group size, his model largely abstracts from the costs of sanctioning other members and specifically the exact institutional mechanisms which might underlie norm enforcement. As explained in the previous section, Christian orders complemented the internal enforcement of norms with external visitations of houses. Monasteries and their abbots that failed to enforce norms internally were reprimanded by the order. However, visitations and the sanctioning of rule violations are themselves costly and introduce a second-order free rider problem (Heckathorn, 1989). For example, a Cistercian father abbot has an incentive to shirk his duty and visit the daughter houses less regularly than prescribed by the Cistercian constitution. More specifically, the empirical tests assumes that visitations were less likely to be conducted,

the higher costs associated with traveling to the respective houses.[2]

Aside from the monastery-level consequences of deviations from ascetic ideals, the latter may also had a destabilizing effect on the order as a whole (a global effect). Instances of misbehavior in one monastery could damage the reputation of all communities of the same order. The perspective is shifted from the monastic community as a club of individual members to the order as a club of monastic communities. Hence, it appears rational that the orders' concern about uniform observance among their communities was a major reason for the creation of systems of visitations (Oberste, 1996: 390). The argument is in line with Finley's (2021) application of the club good model to the Cistercians. She considers "each monastery as an individual club member with the abbot as the sole decision-maker for that monastery" and defines "religious participation as required behavior in the Benedictine Rule (alms-giving, communal prayer, religious instruction,etc.)" (Finley, 2021: 322). What remains unclear from her account is why the refusal to participate in the production of a spiritual good such as communal prayers lowers the utility of other monastic communities who were often hundreds or even thousands of kilometers away. Recognizing the link between the local production of spiritual goods and the collective reputation of orders closes the logical gap. All monasteries benefit from higher collective reputation because it helps them to attract the resources (e. g. membership and patronage) necessary to secure the survival of the community.

Viewing abbots as the primary decision makers is plausible since, according to the Benedictine Rule, monks had to "obey in all things the command of the abbot" (McCann, 1969: 30–31, 154–5). He represented and managed the abbey and had the power to punish monks. From this power follows another monastery-level advantage of external monitoring: "a restrain on the arbitrary rule of abbots" (Lekai, 1977: 28). There are numerous historical accounts of abbots misusing monastic property for personal gain as well as abbots mistreating inferior monks. The abbot is elected for life by the convent. Once elected, it was very difficult to formally remove him. Since the abbot's actions are easily observable for other monks within the community, this does not constitute a principle-agent problem with asymmetric information or hidden action (Arrow, 1985). But the monks can have deficient information about the suitability of candidates *ex ante*. Relevant information may only be revealed *ex post*, when costs of removal are high. The visitation system and the formal power of the General Chapter to vote on the removal of unfit abbots guaranteed accountability. As France (2012: 81) remarks, "the Cistercians had devised a mechanism whereby autocratic excesses could be curbed." Therefore, regular visitations are expected to increase the quality

[2]Burton and Kerr (2011: 93-94) give examples of abbeys struggling to visit faraway daughter houses: "In 1259 it was alleged that the abbot of Bellevaux, Burgundy, had not visited his daughter house of Depheni in Greece for ten years. By the 13th century the abbot of Fountains (Yorkshire) was struggling to visit in person his Norwegian daughter house of Lyse."

of abbatial leadership.

3.3 Hypotheses

The models implies predictions regarding differences between as well as within orders. The successful enforcement of uniform conduct affects an order's stability compared to other orders. A test for such aggregate effects between orders would require, first, to establish that an order is, in fact, able to maintain high internal discipline among its houses; second, that this order exhibits a in general higher stability (lower dissolution rate) compared to other orders. Such a test requires comparable data for different orders. I will tentatively compare the three orders' dissolution rates. The result, however, must be taken with a grain of salt because of the sources used to construct the respective datasets differ in important respects.

The second, monastery-level effect can be tested employing variation in the assumed regularity of visitations *within* orders and will be the main focus of the empirical test. Even though the direct effects of visitations will perhaps remain unobservable given the scarcity of historical data, I expect survival chances of monasteries to vary depending on the costs of visitation because rule enforcement was, on average, less strict in difficult to visit monasteries. The relationship of travel costs and survival thus provides and indirect tests of the effectiveness of visitation mechanisms.

Combining the comparison of monastic systems of visitation from section 3.1 with the theoretical model as well as additional assumptions about the measurement of travel costs, it is possible derive a set of testable predictions.[3]

3.3.1 Global predictions

A first set of predictions relates to general differences between orders as well as over-time changes in the stability of monastic communities:

- Historians ascribe the most effective system of visitations to the Cistercians. It was established early in the order's history and based on clearly articulated principles.

[3]It is well known in the philosophy of science that theories are never tested in isolation. Instead a theory of interest is tested in conjunction with auxiliary theories needed to make the derivation to observations, auxiliary theories about instruments and measurement, and *ceteris paribus* assumptions (Meehl, 1990: 109). Although the predicament of a conjoint test is a general property of scientific methodology, it is particularly obvious in the case of historical research which, due to the scarcity of data, often relies on proxy measures and indirect tests. What is being tested in the present study, as well as by Finley (2021), is a conjunction of 1) Iannaccone's club good model (not directly tested) 2) an extension of this model involving the costs of external monitoring 3) assumptions connecting the organizational structure of historical orders in the period under study to this model 4) assumptions about the measurement of relevant constructs. In the case of Finley's research, 3) is doubtful. However, a falsification of the hypotheses derived in this is section can result from the inadequacy of any of the four components.

However, the Cistercian system of visitation disintegrated during the late Middle Ages (Lekai, 1977: 126).

- The Carthusians are generally considered a particularly strict order. Over time, their General Chapter became a powerful institution complemented by an effective provincial system of visitation. It generally recognized that hey "never relaxed strict observance of their original rule" (Wittberg, 1994: 33).[4]
- The Cluniac system of visitation was probably the least effective. However, the decentralization in the later Middle Ages made visitations and administration more effective.

Therefore, I expect the Cistercians and Carthusians to exhibit higher stability compared to Cluniacs because they were more effective at imposing discipline within their communities and thereby minimizing collective action problems:

H_1: Cistercian and Carthusian communities dissolved at a lower rate than Cluniac communities.

With regard to changes over time, the Cistercian system started to fail during the late Middle Ages while both the Carthusian and Cluniac system improved after various internal reforms:

H_2: The Cistercian dissolution rate increases over time.

H_3: The Carthusians dissolution rate decreases over time.

H_4: The Cluniac dissolution rate decreases over time.

3.3.2 Within predictions

Predictions regarding differences in the regularity and effectiveness are based on the salient features of respective systems identified earlier:

- For the Cistercians, the strictness of monitoring was determined by the travel costs to the General Chapter as well as from mother house to daughter house. Starting in the 14th century, the system's two central elements gradually lost their significance because absence from the General Chapter became to rule and the rise of regional congregations within the order.
- For the Carthusians, the Grand Chartreuse (the order's origin) became the meeting point of the order's abbots during the 12th century. After 1300, both the travel costs to the General Chapter as well as the travel costs within provinces possibly prohibited abbots and visitors from carrying out their duties.

[4] A famous dictum is *Cartusia numquam reformata, quia numquam deformata* (The Charterhouse [was] never reformed because [it was] never deformed).

- For Cluny, visitations by the abbot of Cluny as well as visitations of mediate houses by father abbots of filiations were the most important monitoring mechanism before the reforms of the 12th century. Therefore, the travel costs from Cluny to all dependent houses and the travel costs in mother house-daughter house-dyads are hypothesized to influence the regularity of visitations. Furthermore, for the time period after 1200, the system changed and both types of travel costs are predicted to matter less. The travel costs to and from Cluny are still important because of the requirement to attend the General Chapter as well as because of visitations carried out by the abbot of Cluny himself. However, since the system was less centralized due to complementary mechanisms, the relative importance is hypothesized to decline. Moreover, abbots of filiations within the order were forced to accept the authority of visitations conducted in the name of the General Chapter. Thus the importance of monitoring by mother houses is expected to decline in relative terms over time.[5]

Since comprehensive information on European medieval transportation networks is lacking for the period of 900–1500, air-line distances between the locations of monasteries will be used as approximate measure of travel costs. Therefore, all testable hypotheses take on of three general forms:

H_{GC} The greater the distance between a monastery and the order's origin (Cîteaux, La Grande Chartreuse, Cluny), the higher the rate of dissolution.

H_{MH} The greater the distance between a monastery and its mother house, the higher the rate of dissolution.

H_{PV} The greater the average distance to other monasteries in a province, the higher the rate of dissolution.

Hypothesis H_{GC} reflects two different monitoring mechanisms: the main mechanism, for all three orders, is attendance at the General Chapter. For Cluniac houses, it additionally reflects the likelihood to be personally visited by the abbot of Cluny.

Table 3.1 summarizes the predictions for all three orders. The exact operationalization of the different travel cost indicators will be presented in section 3.5.2.

3.4 Previous research

Iannaccone originally tested his model using contemporary data on denominational differences regarding church attendance, financial contributions and the frequencies of prayers

[5] Because the General Chapters appointed provinces visitors, it is likely that travel costs in provinces mattered, too. However, I was not able reconstruct provincial membership for all Cluniac houses. The mechanism, thus, cannot be tested in the present study.

Table 3.1: . Summary of the pattern predicted with regard to visitation distances. The expected strength of the relationship indicated by + or ++ can only be compared within orders (e. g. the effect of higher travel costs between a Cluniac mother house and its daughter house decreases after 1200).

	Distance to Mother House	Distance to Origin/General Chapter	Distance to houses in province
Cistercians 1098–1350	++	++	
Cistercians 1351–1500	+	+	
Cluny 910–1200	++	++	
Cluny 1201–1500	+	+	(+)
Carthusians 1084–1300		+	
Carthusians 1301–1500		+	+

(Iannaccone, 1992). In accordance with his hypotheses, members of stricter "sect-like" denominations show higher participation in all three dimensions.

Evidence from other historical periods provide some empirical support for the general prediction that strictness is correlated with the survival chances of religious groups. Sosis and Bressler (2003), using data on 83 communes in nineteenth-century America, found that utopian religious communes with more costly requirements were less likely to dissolve. For reasons very similar to Iannaccone's model, they argue that "[t]hose communes that demand the most of their members will be the most successful at overcoming problems of collective action and will consequently have the highest rates of survivorship."

Finke (1997) studies the reasons for the decline in membership of Catholic religious communities in the second half of the 20th century. Women religious communities that did not support the increase in individual liberties after the Second Vatican Council had, on average, more new members in formation (the "training period") than communities who did support the reforms. A case study by Gaynor et al. (1991) about a twentieth-century female order in the US likewise concludes that to solve the problem of low recruitment, the convents have to increase cohesion through compliance and collective rituals – requirements that had been relaxed due to private demands for more personal freedom. However, the studies so far have not dealt with the aspect of norm enforcement.

Rost et al. (2010) analyze the survival rates as well as the reasons for closure of all 134 Benedictine abbeys that ever existed in Baden-Württemberg, Bavaria, and German speaking Switzerland. They report that 26.5 % of the 125 reported closures were related to "agency problems." According to the authors, the relatively low rate of agency related failures as well as the absence of such closures since the end of 18th century indicate the effectiveness of Benedictine governance. "External governance mechanisms" like visitations – the focus of the present study – contribute to the observed stability (Rost et al., 2010: 96, 101). However, the study design cannot differentiate between the effects of internal (e. g. socialization) and

external governance mechanisms. What is more, some of the definitions regarding agency problems can be criticized (Smith, 2009: 8).

A recent paper by Finley (2021) is the most direct attempt to quantitatively study the importance of monastic systems of visitation. Drawing on the work of Iannaccone (1992), she studies "free-riding" behavior of monastic communities and how it was prevented through strict monitoring. Finley's theoretical argument is very similar to the theory presented earlier in Section 3.2. Travel costs of visitations (for the visitor) and General Chapter attendance (for the monastery's abbot) were higher for monasteries in more distant and harder-to-reach locations. Thus, distant and inaccessible monasteries were less likely to be visited regularly, and their abbots attended the General Chapter less often. Absence of monitoring made it difficult to punish misconduct and hence incentivized deviant behavior like immoral economic activity.

She tests these predictions in the context of eighteenth-century France. Economic activity is measured by the land value per acre of Cistercian properties which were confiscated and auctioned during the French Revolution. The assumption is that increased economic activity will be reflected in higher agricultural investments. To measure travel costs, she uses a digitized map of the eighteenth-century French transportation network. She computes the "least cost path" along existing routes between the visiting and visited abbeys as well as between every monasteries and Cîteaux, where the General Chapter was held. The distance is weighted by means of transportation – i. e. possible routes are divided into 5-kilometer sections and the costs of traveling each section depend on whether it is 5 km of a road or a river, etc. Finley's results are in line with her hypotheses: higher travel costs for visitors and higher travel costs to Cîteaux both correlate with land value, even after controlling for local market characteristics and other possible confounders.

There are at least four problems regarding Finley's interpretation of the Cistercian organizational structure as well as neglected aspects of the historical context: 1) A mischaracterization of the visitation network; 2) anachronistic explanatory reference to the visitation network; 3) the adequacy of the dependent variable; and 4) the role of the commendatory abbots.

1. Finley (2021) characterizes the Cistercian system of visitations as follows (p. 321):

   > The first enforcement mechanism, Annual Visitation, included the yearly visitation of a monastery from the head of its filiation, one of the five proto-abbots. The original mother-house, Citeaux and her four original daughter-houses (Clairvaux, La Ferte, Morimond and Pontigny) comprised the five proto-abbots that served as the heads of their respective filiations. [...] all other houses belonged to one of the five filiations and would be visited by their respective proto-abbot.

However, this seems to be a misconception. Historians agree that the "father immediate" was responsible for his daughter houses. Since many daughters of the primary abbeys founded own daughter houses (which founded another "generation," and so on ...) the visitation network was hierarchical and much less centralized:

> The Cistercian Order was constituted not only by the General Chapter and the power of the Primary Abbeys and Cîteaux, but also by the network of connections between individual houses. *Carta Caritatis* formalised the crucial bond between mother and daughter houses. Father abbots were obliged to make yearly visitations to the daughter houses in order to maintain uniformity of practice and discipline and to oversee the election of abbots. [...] The filiation system was hierarchical. The hierarchy between abbeys was organized according to "generations" from each proto-monastery in Burgundy, its direct daughter houses, their daughters and so on. (Jamroziak, 2012: 70-72)

It was thus never intended and never practiced that the proto-abbots conduct all annual visitations themselves. Without an explicit permission by the General Chapter, it was even forbidden to interfere with the affairs of "grandchildren" houses (Oberste, 1996: 69). If Finley's construction of the central explanatory variable is in fact based on a misunderstanding of the original medieval filiation system, this seems highly problematic because the "travel costs" from the primary abbey to the individual monasteries are unlikely to be a good proxy for the regularity of visitations.[6]

2. Similarly concerning, Finley takes the persistence of essentially medieval institutions for granted. During the 16th century, abbeys not already belonging to regional congregation were organized into provinces and annual visitations in the provinces were conducted by a so-called provincial vicar (Lekai, 1977: 127). During the early modern period, the visitation system was no longer functioning as originally conceived. Moreover, it is known that the General Chapter met only eight times in the period 1699–1786 (Casey, 2012: 55). Therefore, it is questionable whether the travel costs to Cîteaux really matter due to the disciplining consequences of General Chapter attendance. Both travel costs as computed by Finley are likely correlated with many unobserved geographical features. Without a solid theoretical reason it seems doubtful to construe (even robust) correlations as evidence for the effects of a still-existing underlying organizational structure.

3. There are also some concerns about the choice of the dependent variable – land value

[6]The General Chapter of 1786 agreed upon a revised constitution that in fact granted the proto-abbots more authority over their respective filiations but this reform coincided with the suppression of religious orders just four years later (Lekai, 1977: 165).

per acre as a proxy for agricultural investment (as a proxy for lax observance). The most common complaint about monastic communities was not excessive investment in productive means, but rather extravagance, an abbot who is a "*dilapitator*, a squanderer of the abbey's resources" (Dobie, 2015: 146) or unsustainable levels of debt (Lekai, 1977: 304–305). Other common abuses mentioned by Burton and Kerr (2011: 92) such as disruption, malice and conspiracies against the abbot, sodomy, sorcery, the presence of women, and falconry are likewise more related to consumption and insubordination. Since *consumption* rather than *investment* was the fundamental concern, more regularf visitations would probably not have led to lower agricultural investments. For Kieser (1987) the Cistercian predicament was that the rational organization of work processes pioneered by them in combination with their characteristic frugality led to the accumulation of wealth. Investment was seen as more virtuous than consumption but "economic success deprived the order of its ascetic credibility" (Kieser, 1987: 119). Paradoxically, the public perception of avarice was in part the result of the strict enforcement of internal norms against personal consumption.

4. Of the 237 Cistercian monasteries in pre-revolutionary France, only 35 were governed by regular abbots (Lekai, 1977: 166). The others were under the rule of unelected commendatory abbots. Intended as a temporary institution to support the administration of a monastery during times of abbatial vacancy, this instrument was later abused by ecclesiastical as well as worldly powers (Ott, 1908). Beginning in the 14th century first the pope and later the French king gave monasteries *in commendam* as a way to gratify loyal allies. The position as commendatory abbot was attractive because the holder was entitled to revenues from the economic activities of the monastery. Later commendatory abbots were only responsible for economic management without having to fulfill the spiritual duties that usually come with this office (Lekai, 1977: 157, 329). Thus, during the Ancien Régime, a large share of the nominally Cistercian monastic estates was not under the controls of the Cistercians at all. It also demonstrates once more the disintegration of the original visitation network based on the authority of father abbots.

The main strength of Finley's study is the attempt to construct a valid measure of travel costs based on a detailed map of the historical transportation networks. However, the historical evidence casts doubt on the assumption that the travel costs between monasteries mattered for reasons of visitation frequency and General Chapter attendance. The order's internal structure during the Ancien Régime in France was quite different from the constitutional ideal of Middle Ages (Lekai, 1977: 157–167). Therefore, a convincing test of the monitoring mechanism will have to focus on earlier periods, when the organizational structure still resembled its initial conception.

3.5 Methods and data

3.5.1 Methods

The dissolution rates of monasteries will be estimated using methods from event history analysis (Cleves et al., 2008). Descriptive analyses will utilize simple Kaplan-Meier estimates of the survival function, i e. the probability of a monastic community to survive until a certain age. The multivariate models estimate a discrete-time hazard rate of dissolution

$$h(t) = P(T = t_i | T \geq t_i)$$

with t referring to the age of monastic community i measured in discrete time periods (decades[7]). More specifically, Cox models (Cleves et al., 2008: 129 ff.) of the general form

$$h_i(t|\boldsymbol{x_{it}}) = h_0(t) \exp(\beta_1 \text{distance}_{it} + \boldsymbol{x_{it}\beta})$$

will be estimated. The index refers to monastic community i at time t, β_1 represents the coefficient of the main explanatory variable, $\boldsymbol{x_i\beta}$ represents a matrix of controls, and $h_0(t)$ the baseline hazard. Cox models are "semi-parametric", i. e. they only estimate parameters of covariates influencing the hazard rate, but do not provide a parametric estimate of the baseline hazard. The benefit is increased flexibility because the baseline hazard function does not have to be specified. They are feasible as long as the *proportional hazard assumption* (PHA) is satisfied, i. e. all covariates have a proportional influence on the baseline hazard function. The exponentiated coefficients of the Cox model can be interpreted as hazard ratios

$$\exp(\beta_1) = \frac{h(t|\text{distance} + 1, \boldsymbol{x_{it}})}{h(t|\text{distance}, \boldsymbol{x_{it}})}.$$

To allow a more intuitive interpretation of the effect sizes, the model estimates will be complemented with graphical displays of predicted survival functions for selected values of the main independent variables.[8] For the Cluny data it will be necessary to estimate stratified Cox models (Cleves et al., 2008: 152–155) in order to avoid violation of the PHA.

[7] Medieval dates referring to events like founding or dissolution are recorded with such uncertainty and measurement error, that not much would be gained by further disaggregating the unit of time. Given the long time span covered by the analysis (600 years), all relevant information is conserved by using decades instead of years.

[8] It should be noted that Cox hazard ratios can only be interpreted as causal quantities under strong and unrealistic assumptions (Martinussen, 2022). I use them mainly as descriptive tool for conditional relationships even though they should not be used to make counterfactual statements. However, contrasts between survival functions, i. e. differences in the survival probability up to a certain age, are causally meaningful (Martinussen, 2022: 256).

The baseline hazards in those models are allowed to differ by region:

$$h_i(t|\boldsymbol{x_{it}}) = h_{01}(t)\exp(\beta_1 \text{distance}_{it} + \boldsymbol{x_{it}\beta}), \text{ if } i \text{ is in France,}$$
$$h_i(t|\boldsymbol{x_{it}}) = h_{02}(t)\exp(\beta_1 \text{distance}_{it} + \boldsymbol{x_{it}\beta}), \text{ if } i \text{ is outside France.}$$

In order to test the hypotheses about the changing effect of systems of visitations, I will estimate models including interaction effects of the distance measures and time dummies corresponding to the junctures indicated by Table 3.1. For example, the respective models of the Cistercian dissolution rates include a time dummy that equals 1 for the periods after 1350 and 0 otherwise:

$$h_i(t|\boldsymbol{x_{it}}) = h_0(t)\exp(\beta_1 \text{distance}_{it} + \beta_2 \text{after1350}_{it} + \beta_3 \text{distance}_{it} \times \text{after1350}_{it} + \boldsymbol{x_{it}\beta}).$$

3.5.2 Dataset and variables

Cistercian Data

The nucleus of the dataset on the Cistercians is based on the work of Snyder (2008).[9] He compiled the founding dates and genealogical lines as documented in Janauschek (1877) and Pacaut (1993), then added the geographical coordinates for every monastery. I corrected mistakes in his data using additional sources and included previously missing abbeys as well as abbeys founded between 1401–1500. Furthermore, I complemented the dataset with information on the dissolution dates.

The basic information about Cistercian abbeys (date of foundation, date of dissolution, geographical location) is documented in several printed gazetteers (e. g. Becking, 2000; Jürgensmeier and Schwerdtfeger, 2005; Peugniez, 2001; Rasmussen, 2015). I also relied on digitized databases such as the English Monastic Archives (2015), Germania Sacra Online (2018), or the website of the Cistercian Abbey *Certosa di Firenze* (Cistercian Monks of Florence, 2018). Georeferencing was done in two ways: either automatically based on a list of location names using the Google Maps API[10] (with additional plausibility checks) or manually by looking up places in Google Maps as well as Wikipedia's GeoHack database. The panel dataset used in the analyses includes 22,663 observations (abbey decades) for 722 abbeys, covering foundations in the period 1100–1500.

Carthusian Data

The list of all charterhouses (Carthusians monasteries) was taken from the database on the Analecta Cartusiana webpage (Analecta Cartusiana, 2022). The Analecta Cartusiana

[9] Parker Snyder kindly provided me with his data upon request.
[10] More specifically, using the `geocode()` function provided by the R-package `ggmap`.

is a series of books on the history and spirituality of the Carthusian monks. Entries on monasteries do not contain the coordinates of monastic sites. All locations of monasteries founded before the 16th century were geocoded manually based on the information provided in the database (e. g. by looking up the location in Google Maps). When historical sites were not easily identifiable, I consulted additional materials such as historical maps or more detailed descriptions of the location. In the few cases in which I was unable to research the exact location, I used the coordinates of the respective municipality as given by Google Maps. The data contain information on 221 charterhouses that were founded before the 16th century, resulting in 3,522 observations (charterhouse decades).

Cluniac Data

Both due to a relative scarcity of research as well as the nature of the Cluniac reform itself, it is much more difficult to find comprehensive compilations of membership on the level of individual houses. The locations of all "Cluniac sites" were taken from the Clunypedia mapping project which seems to be the most comprehensive source on historical membership in the order of Cluny (Clunypedia, 2022). Aside from the coordinates, the Clunypedia database already contains foundation and dissolution dates as well as information on the filiation (the mother house). I downloaded all database entries as of 2022 and kept sites classified as priory, abbey, or college. The cleaned dataset has entries on 1,038 monastic communities that were founded or reformed by Cluny up until 1500 and contains 39,344 (house decade) observations.

Foundation and Dissolution

The outcome in event history analyses is the dissolution of a monastery. The analysis "clock" starts at the decade of foundation. The foundation date is either the year of the actual foundation or the year a previously existing monastic community changed its affiliation to the order. The records of dissolution dates usually reflect official acts of ecclesiastical law. For the purpose of this analysis, a prolonged period of vacancy is a more relevant event than the official dissolution of a long abandoned abbey because the former more directly reflects a decline in the stability of the monastic community. Hence, if available, I used the dates referring to the extinction of a monastic community as "dissolution" dates.

There are two additional events that can result in a monastery being coded as "dissolved": First, a change of affiliation to another order and, second, the "degradation" of a Cistercian abbey to a priory. The latter kind of event is only relevant for Cistercians. Cluniac houses could be either an abbey or a priory. While Cluniac priories were nominally part of a larger monastic community (most often Cluny itself), a Cluniac prior (the superior of a Cluniac house) had responsibilities and powers very similar to an abbot. All regular Cistercian

houses, however, were abbeys. Being degraded from an abbey to a priory meant the *de facto* dissolution of the local monastic community and its integration into the community of the abbey to which it had to submit.

Visitation Distances

The main explanatory variables are three distance measures intended to capture the travel costs of the respective visitation mechanism. All distance-based measures were calculated using the haversine formula.[11]

The first variant is the *distance between a monastic daughter house and its mother house*, which is just the airline distance between two coordinates. The distance is time-varying for those (rare) cases whose mother house changed or was dissolved. If it was not reported which monastery took over the responsibility of visitation, I set the distance to the mother house equal to the distance to the order's origin (Cîteaux or Cluny) for the years after the mother houses' dissolution. The second variant is the *distance to the General Chapter*. Again, this is just the airline distance between each monastery and its order's origin (the meeting place). For the Cistercians, the correlation between the two measures is 0.439 and for Cluniac houses it is 0.694. This reflects the more centralized nature of the Cluniac organizational network. The third variant is the *average distance to other monasteries in the same province* (ADP). Due to a lack of data on Cluny's provinces for the time period under study, this variable could only be computed for the Carthusians. For a charterhouse i in province p with a total of $N_p(t)$ charterhouses at time t, the ADP equals the average of all dyadic airline distances

$$\text{ADP}_{it} = \frac{1}{N_p(t)} \sum_{i \neq j} \text{distance}(i, j) \qquad \text{for} \;\; i, j \in N_p(t).$$

This measure is time-varying due to the changing composition of provinces. If a charterhouse was the only (in all respective cases: the first) monastery in a province, the single house was a assigned a value equal to its distance to the General Chapter. However, 55 of the 63 observations are charterhouse-decades in the period pre-1300, before provincial visitations were officially established.

Number of parental daughter houses/houses in province

For the Cistercians and Cluniacs, the number of the (surviving) daughter houses of the monastery's mother house – i. e. the time-varying out-degree of the mother houses or the number of surviving "siblings"– is a relevant control variable. Mother houses with many daughter houses had higher total monitoring costs. Historical evidence suggests

[11] As implemented in the `distHaversine()` function provided by the `geosphere` R-package.

that they were struggling to visit all dependent houses (Lekai, 1977: 50).[12] Obviously, if daughter houses were experiencing low internal discipline because they had been neglected by overburdened father abbots, this would constitute additional evidence in favor of the presumed mechanism. However, the number of daughter houses is likely correlated with other characteristics such as influence and power within the Cistercian organization. It is also correlated with general time trends.[13] For Carthusians, this variable is replaced by a count of the of houses in a given province. Although provinces were, compared with filiations, more equal with regard to their size (with a mean of 9 and a maximum of 18), it may still have been more difficult to visit all the monasteries of a large province compared to a small one.

Geographical control variables

There are several ways to control for the confounding effects of a monastery's location. For instance, it would be possible to include regional "fixed-effects", i. e. dummies for every region. Unfortunately, due to the lack of delineated political territories during the Middle Ages, it is far from clear what the natural geographical unit would be.[14] Another possibility is the inclusion of longitude and latitude as covariates. However, this strategy is sensitive to assumptions about the functional form and often results in models that violate the proportional hazard assumption. Moreover, it might cause overcontrol bias because coordinates are strongly correlated with the distance to the General Chapter (i. e. distance to one single geographic location per order). Therefore, I estimate models that include several proxy measures that are intended to capture the effects of geographical differences. The altitude of every monastery's location is used as a proxy for environmental conditions.[15] Moreover, I compute the average terrain ruggedness as described by Nunn and Puga (2012) using the ruggedness data provided on their webpage.[16] It is essentially a measure based on height variation. For every cell in a grid, it computes the difference in elevation to the eight neighboring grid cell in every major compass direction. The terrain ruggedness index for every cell is then given by the square root of the sum of squared differences (Nunn and Puga, 2012: 22). I use the average ruggedness of a five kilometer radius around every monastery. High ruggedness is a proxy for a secluded and possibly less arable terrain.

[12] For instance, it would have been impossible for the abbot of Clairvaux to visit all 80 daughter houses, creating problems reminiscent of early Cluny. The amended *Carta Caritatis posterior* (Cistercian constitution) thus allowed for visitations to be carried out by abbatial delegates.

[13] See Figure 3.14 in the Appendix.

[14] The Cox models for Cluniac dissolution rates are stratified by a categorical variable, indicating whether a monastery is located within the borders of modern France. This anachronism is an inductively found comprise in order to make the models conform with the proportional hazard assumption.

[15] The altitude is retrieved from the topo30 data using coordinates and the `GNgtopo30()` function in the R-package "geonames".

[16] See https://diegopuga.org/data/rugged/.

Table 3.2: Descriptive statistics by order.

	N	Mean	SD	Min	Max
Carthusians					
Distance to GC (km/100)	3522	4.57	3.36	0.00	17.26
Distance to houses in province (km/100)	3522	1.48	1.16	0.01	12.61
Altitude	3522	423.66	405.37	−2.00	1,448.00
Terrain ruggedness	3522	95.47	101.30	0.00	533.71
Avg. dist. to 3 cities (km/100)	3522	0.60	0.21	0.12	1.16
No. of houses in province	3522	8.84	3.59	1.00	18.00
Latitude	3522	46.93	3.31	36.65	59.26
Longitude	3522	6.57	5.07	−8.39	21.92
Cistercian houses in 50 km radius	3522	2.55	1.70	0.00	8.00
Carthusian houses in 50 km radius	3522	2.59	2.12	1.00	11.00
Cluniac houses in 50 km radius	3522	8.70	11.83	0.00	40.00
Cluniacs					
Distance to MH (km/100)	39344	1.42	2.16	0.00	30.75
Distance to GC (km/100)	39344	2.96	2.25	0.00	30.75
Altitude	39344	299.37	251.10	1.00	1,494.00
Terrain ruggedness	39344	60.81	68.94	0.00	495.81
No. of daughter houses	39344	0.91	9.59	0.00	287.00
Avg. dist. to 3 cities (km/100)	39344	0.64	0.20	0.10	1.20
Out-degree of mother house	39344	92.84	117.66	0.00	287.00
Latitude	39344	46.22	2.17	31.78	55.84
Longitude	39344	3.32	3.36	−8.67	35.39
Cistercian houses in 50 km radius	39344	2.77	2.09	0.00	9.00
Carthusian houses in 50 km radius	39344	0.81	1.59	0.00	10.00
Cluniac houses in 50 km radius	39344	20.00	12.69	0.00	53.00
Cistercians					
Distance to MH (km/100)	22663	2.61	3.11	0.03	29.18
Distance to GC (km/100)	22663	6.58	3.85	0.00	30.69
Altitude	22663	236.81	243.39	1.00	1,585.00
Terrain ruggedness	22663	48.62	64.66	0.00	574.69
No. of daughter houses	22663	1.00	3.82	0.00	80.00
Avg. dist. to 3 cities (km/100)	22663	0.65	0.27	0.11	3.92
Out-degree of mother house	22663	15.64	24.38	0.00	80.00
Latitude	22663	47.97	4.47	31.74	63.58
Longitude	22663	4.29	7.52	−9.69	35.88
Cistercian houses in 50 km radius	22663	3.32	1.98	1.00	12.00
Carthusian houses in 50 km radius	22663	0.55	1.19	0.00	11.00
Cluniac houses in 50 km radius	22663	6.44	9.70	0.00	55.00

To account for differences between rural and urban regions, I created a variable that measures how far a monastery was located from important medieval towns. I relied upon a list of 577 "major towns in 1200" in the *Digital Atlas of Roman and Medieval Civilizations* (Campbell et al., 2022b) but manually corrected mistakes in the localization. I take the average distance to the three nearest towns because the objective is to create a measure of the general character of the respective region (i. e. urbanized vs. remote).

Competition and cooperation

Another set of three covariates indicates the presence of other monasteries. New foundations were competing for the same resources such as arable land, donations by noblemen, or potential members. Dense colonization and the resulting competition could have lowered the survival chances of individuals abbeys. To model this, I generate separate variables with the counts of the three orders' monasteries within a 50 km radius. The number of communities of the same order might not capture competition but opportunities for cooperation and more importantly is probably correlated with being located at the center or the periphery of the order's distribution area.

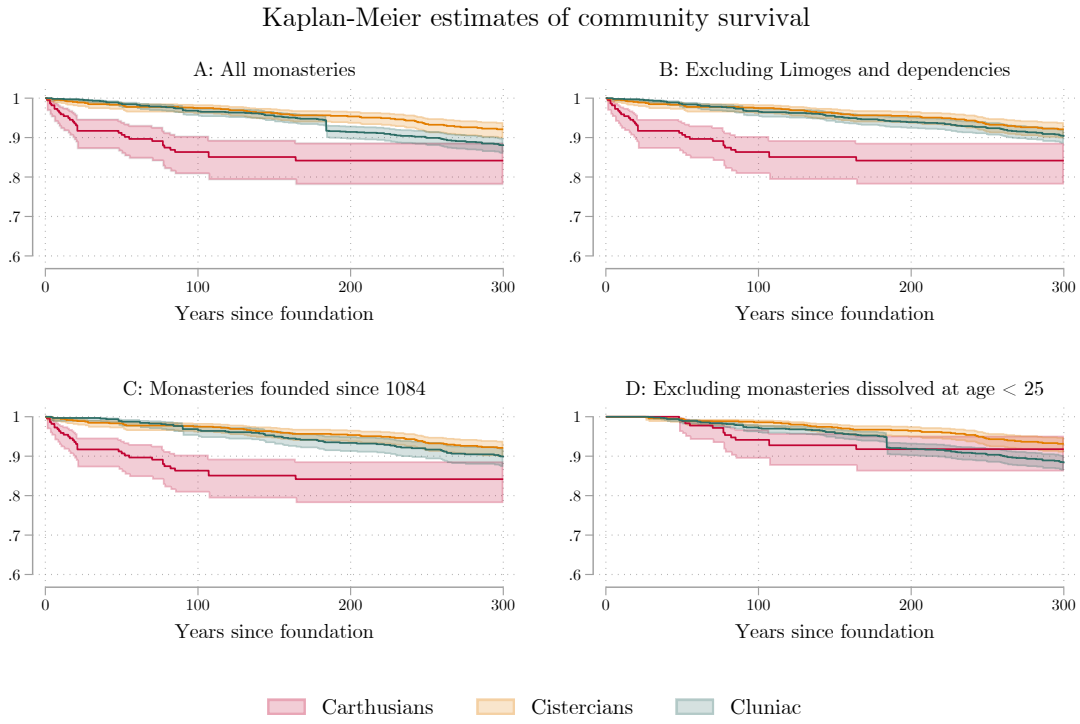
Descriptive statistics for the complete dataset are presented in Table 3.2. Appendix 3.A provides some information of the selection of control variables.

3.6 Results

3.6.1 Descriptive global results

Figure 3.5 tests H_1 by comparing the overall survival rates of the three orders under study using a standard Kaplan–Meier estimator. Subfigure A contradicts the expectation that Cluniac houses dissolved at a higher rate than Cistercian and Carthusian houses. To the contrary, the Cistercian and Cluniac survival curve is very similar for the first 180 years of a monastery's existence while Carthusian communities seem to be at a high risk of dissolution during the initial years after foundation. The divergence of Cistercian and Cluniac houses at ca. 180 years is entirely explained by the exit of the Abbey of Saint Martial in Limoges and its dependent houses (i. e. mediate priories to Cluny): those monasteries affiliated with and separated from the Federation of Cluny at the same time. If excluded, there is also no difference between the Cistercian and Cluniac survival rate (Subfigure B). Subfigure C restricts the sample to houses founded since 1084 – the foundation of the Carthusian order. It thus excludes all Cluniac houses founded before the existence of the other two orders which might differ due to period effects not relevant to the theory under scrutiny. Again, there is no apparent difference between the Cluniac and Cistercian order. Lastly, Subfigure D excludes all houses that were dissolved during the first 25 years of their existence. In this

Figure 3.5: Comparison of survival rates of Cistercian, Cluniac and Carthusian communities.



subsample there is no difference in the survival chances among the three orders after 180 years. The higher dissolution rate of Carthusian houses might be an artifact of the datasets used. It is possible that the Carthusian data is more comprehensive and that short-lived Cistercian and Cluniac foundations are not equally likely to be included the analysis sample. Regardless of whether the higher dissolution rate of Carthusians reflects actual differences or whether Limoges and its dependencies should be included, the totality of the evidence contradicts the prediction that Cluniac houses were at a higher risk of dissolution compared to the other orders. Therefore, H_1 is falsified.

Figures 3.6 and 3.7 present results on the relative survival of monastic communities by order and centuries. Higher dissolution rates notwithstanding, the Carthusians grew until the end of the Middle Ages. The Cistercian expansion stagnated from the 13th century onward, and the number of houses of Order of Cluny even decreased in the late Middle Ages. In line with the expectations about the weakening system of visitation, the fraction of Cistercian dissolutions increases monotonically over time. For the Carthusians, there is a steep decline in dissolutions from the 12th to the 13th century, in line with the establishment of stricter internal controls. However, the fraction of dissolved charterhouses increases again during the next two centuries without reaching its prior peak. The decrease for the Cluniacs in the 14th

Figure 3.6: : The number of monastic communities that survived or were dissolved by order and century. The counts include surviving monasteries from prior centuries as well as monasteries that were founded during the respective century.

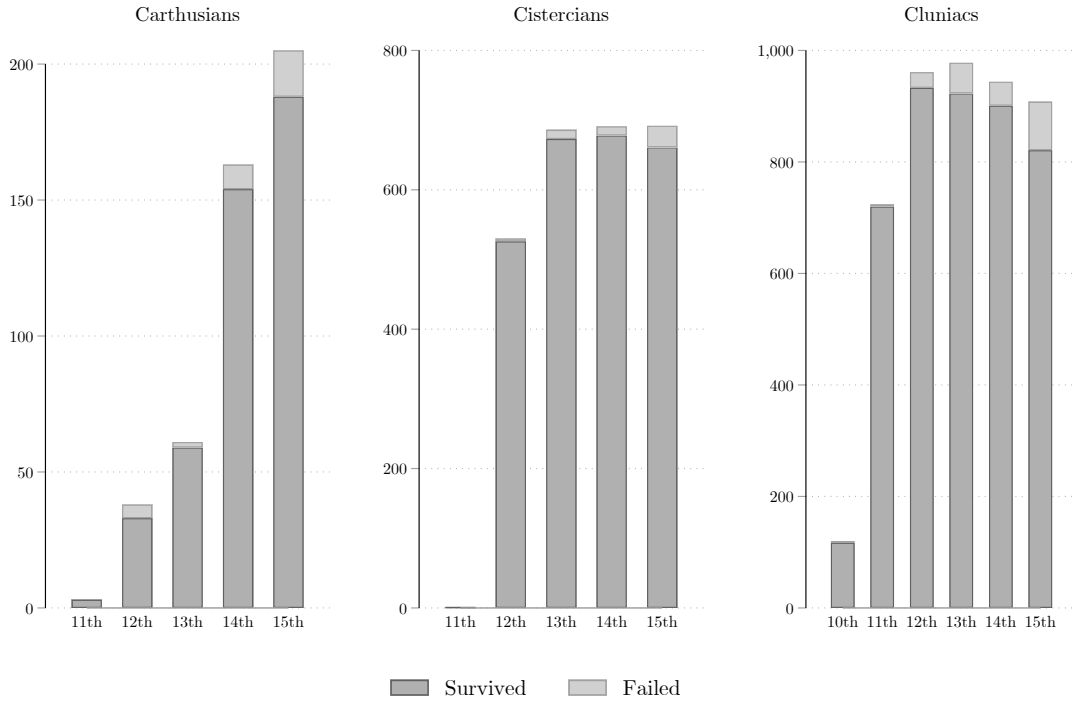


Figure 3.7: : The fraction of dissolved monasteries by order and century based on counts from Figure 3.6.

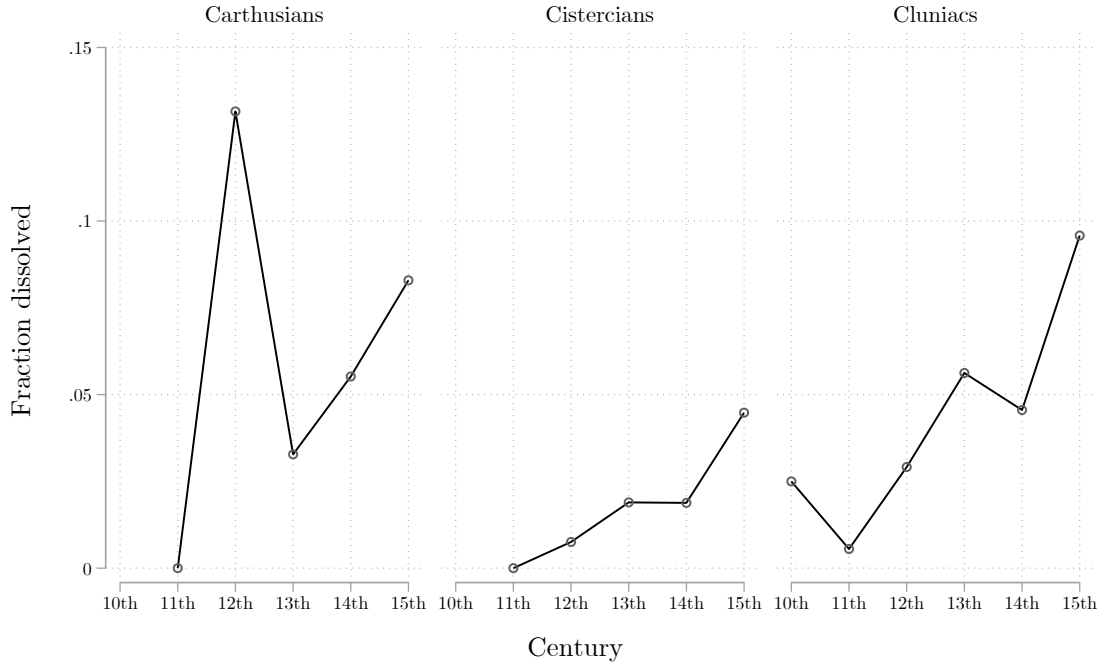


Table 3.3: Mean distance (km) to General Chapter (GC) and mother house (MH) by order and dissolution status.

	N	%	GC	MH
Carthusians				
Dissolved > 1500	188	85.07	564	
Dissolved ≤ 1500	33	14.93	626	
Cluniacs				
Dissolved > 1500	820	79.00	279	127
Dissolved ≤ 1500	218	21.00	467	272
Cistercians				
Dissolved > 1500	661	91.55	655	247
Dissolved ≤ 1500	61	8.45	1152	439

century is less pronounced and more temporary. The fraction of dissolved monasteries in the 15th century is in line with the previous trend. I interpret the pattern to be compatible with H_2 and H_3 but not H_4.

3.6.2 Descriptive monastery level results

A simple comparison for two relevant distance measure between monastic communities that were dissolved before 1500 and those that survived independently until the 16th century (Table 3.3), reveals a pattern partly consistent with the hypothesized relationships as expressed in H_{MH} and H_{GC}. Monastic communities that averted dissolution were, on average, closer to their mother houses as well as closer to the location of the General Chapter.[17] This pattern is consistent across all three orders. Figure 3.8 graphically compares the distribution of distance measures of houses by dissolution status. The mean differences for the Cistercians and Cluniacs can partly be attributed the subgroup of far-away houses, founded during the Crusades, in Greece and the Levant. However, it is obvious that the distributions of dissolved houses, especially considering the distance to the General Chapter, are shifted to right regardless of outliers.

Visually inspecting the geographical distribution of dissolved monastic communities (Figure 3.9) clearly indicates clustering for the Cistercians as well as Cluny. The majority of Cistercians dissolutions documented in the dataset occurred at the periphery of Roman Christian territory (e. g., Ireland or Eastern Europe) as well as in Italy. The observed geographical pattern is only consistent with the theoretical arguments brought forward in this article if they are explained by the structure of the visitation network: taking the

[17] I take the distance to mother house at foundation, thus ignoring the few cases in which the mother house changed later in a community's existence.

Figure 3.8: Distribution of *distance to mother house* (at the time of foundation) and *distance to General Chapter* by monastery status. Houses that were dissolved before the year 1500 are red and houses that survived the Middle Ages are blue.

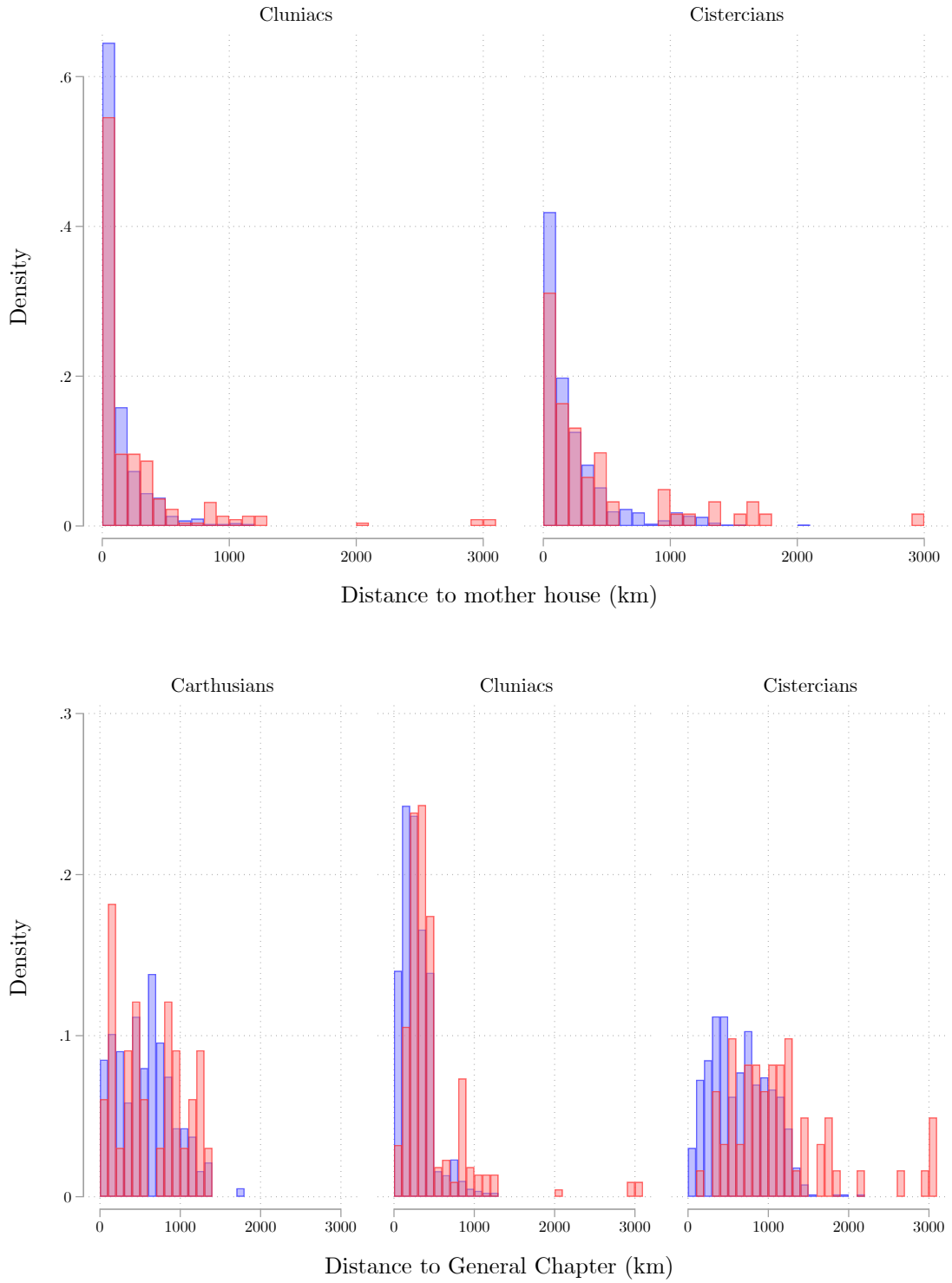
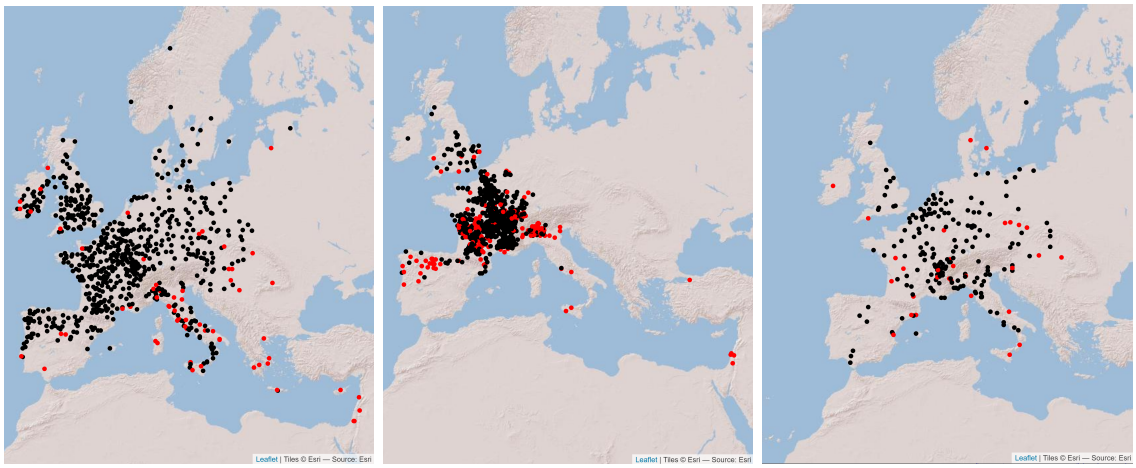


Figure 3.9: Geographical distribution of dissolved houses (red) by order: Cistercians (left), Cluny (center), Carthusians (right).



example of Italy, the average distance of Cistercian abbeys to their mother houses was 331 km, higher than the overall mean (263 km). This moderate difference likely does not account for the clustering of dissolutions in Italy. Cluniac priories and abbeys were geographically much more concentrated in France as well as neighboring regions. Nonetheless, dissolutions seem to cluster in regions such as northern Italy or northern Iberia.

3.6.3 Dissolution rates

In the following, I will model the dissolution rates of each order separately. Stepwise model building is carried out by always first including only the main predictor variables while controlling for century dummies, in the next step excluding outlier monasteries (Greece and Middle East), and lastly including the set of relevant control variables. A second set of models tests predictions about the changing effectiveness of the three visitation mechanisms by including interaction effects with time dummies.

Cistercians

Table 3.4 shows the results of multivariate Cox models for Cistercian abbeys. The first three models estimate the effect of the distance to an abbey's mother house, the next three estimate the effect of the travel costs to the General Chapter, and the last three models include both distance variables simultaneously. When estimating separate models for both distance measures without controls and based on all observations (OCist 1 and OCist 4), the results are in line with expectations. The higher the monitoring costs, the higher the dissolution rate of Cistercian monastic communities. For example, increasing the distance to an abbey's mother house by 100 km increases rate of dissolution by a factor of 1.127. An

Table 3.4: Cistercian dissolution rates: results of discrete-time Cox models.

	OCist 1	OCist 2	OCist 3	OCist 4	OCist 5	OCist 6	OCist 7	OCist 8	OCist 9
Distance to MH (km/100)	1.127**	1.061	1.071				1.012	0.998	1.028
	(4.772)	(1.488)	(1.566)				(0.458)	(−0.058)	(0.575)
Distance to GC (km/100)				1.214**	1.162**	1.131**	1.209**	1.162**	1.126**
				(9.469)	(4.708)	(3.736)	(8.221)	(4.534)	(3.452)
Out-degree of mother house			0.984			0.991			0.988
			(−1.510)			(−0.972)			(−1.113)
Avg. dist. to 3 cities (km/100)			0.170**			0.144**			0.142**
			(−2.667)			(−2.980)			(−3.000)
Cistercian houses in 50 km radius			0.699**			0.757*			0.762*
			(−3.332)			(−2.543)			(−2.468)
Carthusian houses in 50 km radius			0.863			0.864			0.863
			(−1.163)			(−1.174)			(−1.183)
Cluniac houses in 50 km radius			1.034**			1.035**			1.035**
			(3.470)			(3.575)			(3.577)
Period dummies	✓	✓	✓	✓	✓	✓	✓	✓	✓
Excluding abbeys in Syria/Greece		✓	✓		✓	✓		✓	✓
Controls: Altidude & Ruggedness			✓			✓			✓
Abbeys	722	711	711	722	711	711	722	711	711
Abbeys × decades	22663	22546	22546	22663	22546	22546	22663	22546	22546
Chi^2	47.730	36.375	73.888	92.823	52.953	83.201	93.028	52.956	83.515
Log-likelihood	−369.696	−309.702	−290.945	−347.150	−301.413	−286.289	−347.047	−301.411	−286.132
Global test of PHA (p-Value)	0.496	0.283	0.047	0.648	0.558	0.054	0.588	0.540	0.080

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. The table shows exponentiated coefficients (hazard ratios) of discrete-time Cox proportional hazard models and their z-values in parentheses. Breslow method was used to account for tied events. The global test of the proportional hazard assumption (PHA) is a Schoenefeld residuals test of the model as a whole. Source: Own data. Calculations using Stata 17.

abbey that is located 100 km farther away from the order's origin in Cîteaux is 1.214 times more likely to be dissolved in any given decade. Both coefficients are significant at 1 %-level and are therefore unlikely to be observed if the null hypothesis ($\beta = 0$) were true.

However, the effect of the distance to the mother houses is not robust to changes in the model specification. Excluding the very remote monasteries in Greece and the Middle East diminishes the estimated hazard ratio (from 1.127 to 1.061) and renders it insignificant ($p = 0.137$). This is strong evidence that the effect is driven by a few abbeys that were founded and dissolved under very specific historical circumstances. The distance to Cîteaux is more robust to alternative specifications. Excluding outliers as well as including controls reduces the size of the estimated hazard ratio but it remains meaningfully large as well as statistically significant at the 1 %-level. This is even true for the models including both distance measures (OCist 7 to 9). Thus there is stronger evidence for the relevance of regular General Chapter attendance than for the relevance of regular visitations by the farther abbot. The Schoenefeld residual tests indicate that three controls violate the proportional hazard assumption, namely altitude as well as the number of Cistercian and Carthusian houses. A more flexible specification that includes interaction terms between the respective covariates and the century dummies removes the assumption violation while leaving the coefficients of interest unaffected (results not shown).

Figure 3.10 shows predicted survival functions for abbeys based on model OCist 6. With other coviarates set to their mean, abbeys that were located relatively close to Cîteaux (1st decile of the distance distribution) had a survival probability of 98 % 300 years after their foundation. In contrast, abbeys at a distance six times as large survived the first 300 years after their foundation with a probability of about 93 %. Given the high stability of Cistercian monastic communities in general, the difference is substantial but unlikely to fully explain the variation within the order.

Lastly, I want to note that two control variables exhibit robust and theoretically plausible associations (models OCist 3, OCist 6, and OCist 9). First, the number of Cluniac houses in a Cistercian abbey's environment predicts a higher dissolution rate. This might indicate that both orders were competing for membership and resources. Second, the greater the average distance to the three closest cities, the lower the rate of dissolution. There are several possible interpretations but is generally contended that the Cistercians preferred remote locations (the metaphorical desert). Hence, seclusion might have indeed stabilized monastic communities. While it is generally not warranted to causally interpret coefficient estimates of covariates that have been merely included to adjust for potential confounding (Keele et al., 2020), both associations can be viewed as starting points for a more thorough investigation.[18]

[18]The causal assumptions outlined in Figure 3.14 in Appendix 3.A do not explicitly prohibit it in the case at hand.

Table 3.5: Cistercian dissolution rates: results of discrete-time Cox models. "Until 1350" are the main effects in the regression equation. "After 1350" are the combined effects of main and interaction terms.

	OCist 10	OCist 11	OCist 12	OCist 13	OCist 14
Distance to MH until 1350	1.148**		1.001	0.944	0.973
	(4.413)		(0.039)	(−0.666)	(−0.302)
Distance to MH after 1350	1.099*		1.028	1.021	1.050
	(2.357)		(0.613)	(0.417)	(0.919)
Distance to GC until 1350		1.249**	1.248**	1.196**	1.159**
		(8.892)	(8.083)	(3.282)	(2.764)
Distance to GC after 1350		1.153**	1.141**	1.144**	1.108*
		(3.834)	(3.171)	(3.214)	(2.405)
Period dummies	✓	✓	✓	✓	✓
Excluding abbeys in Syria/Greece				✓	✓
Controls: Altidude & Ruggedness					✓
Abbeys	722	722	722	711	711
Abbeys × decades	22663	22663	22663	22546	22546
Chi^2	48.464	96.169	96.532	53.847	84.400
Log-likelihood	−369.330	−345.477	−345.296	−300.966	−285.689
Global test of PHA (p-Value)	0.643	0.862	0.922	0.909	0.239

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. The table shows exponentiated coefficients (hazard ratios) of discrete-time Cox proportional hazard models and their z-values in parentheses. Breslow method was used to account for tied events. The global test of the proportional hazard assumption (PHA) is a Schoenefeld residuals test of the model as a whole. Source: Own data. Calculations using Stata 17.

Table 3.5 tests the hypotheses regarding the *changing effects* of travel costs summarized in Table 3.1. The expectation was that both the travel costs from mother house to daughter house as well as the travel costs to Cîteaux started to matter less during the second half of the 14th century due to the disintegration of the traditional organizational structure of the Cistercian order.[19] The baseline models including only one distance variable, all observations, and no control variables are consistent with the hypotheses. Both travel cost measures exhibit smaller coefficients after 1350. However, only the distance to the General Chapter is robustly in line with expectations across all model specifications. Model OCist 14 includes both main predictors with interaction and controls as well as excludes abbeys in Greece and Middle East. Until the second half of the 14th century, holding everything else constant, a Cistercian community that was located 100 km farther away from Cîteaux was

[19] Based on the equation

$$h_i(t|\boldsymbol{x_{it}}) = h_0(t)\exp(\beta_1 \text{distance}_{it} + \beta_2 \text{after1350}_{it} + \beta_3 \text{distance}_{it} \times \text{after1350}_{it} + \boldsymbol{x_{it}\beta})$$

Table 3.5 gives the main effect $e^{\hat{\beta}_1}$ ("until 1350") as well as the combination of main and interaction term $e^{\hat{\beta}_1+\hat{\beta}_3}$ ("after 1350").

1.159 more likely to be dissolved. The hazard ratio decreases to 1.108 in the late Middle Ages, although the difference is not statistically significant. The small decrease in the effectiveness of General Chapter attendance constitutes only very weak evidence that the over time increase of dissolutions documented in Figure 3.7 can be attributed to the weakening of Cistercian institutions.

Cluny

The stepwise analysis of Cluniac dissolution rates follows a similar approach as previously in the Cistercian case (see Table 3.6). The main explanatory variables of interest are the same as before. However, all models are stratified by a regional dummy variable indicating whether a monastery was located within the borders of contemporary France.[20]

The distance to a monastery's mother house increases the hazard of dissolution by 8 % ($p < 0.01$) in the basic model. However, the positive effect almost completely vanishes once the five houses in the Middle East are excluded. Moreover, the model fit improves because the null hypothesis of proportional influence cannot be rejected based both the global Schoenefeld residual test as well as the Schoenefeld residual test of the distance to mother house-coefficient. Again, as with the Cistercians, there is scant evidence that lower travel costs from mother to daughter house lead to more regular visitations, improved discipline and, ultimately, more internal stability. However, the result is less surprising because visitations carried out by mother houses were not as central as in the Cistercian organizational constitution.

The coefficient of the distance to Cluny is positive and significant in all models. The hazard ratio varies from 1.127 (without controls and including distant houses) to 1.075 (with controls and without distant houses). It slightly increases in size if both distance measures are included. Figure 3.11 illustrates the effect with predicted survival functions based on model Cluny 6. After 400 years, the difference in the survival probability of French houses close to Cluny (93 km) compared to French houses rather distant (638 km) is less than five percentage points. The survival function of non-French houses visibly diverges after 250 years. The difference in the survival probabilities between close and distant houses is about 14 percentage points – almost three times the difference for French houses. For Cluniac communities, it is not possible to discern the two separate mechanism that potentially cause the association between distance to Cluny and dissolution rates (see Section 3.1). It may reflect the propensity of a monastery's superior to regularly attend the General Chapter as well as the propensity of the abbot of Cluny (or his deputies) to personally visit the monastery.

[20] The stratification might cause overcontrol bias since it captures some of the variation in the relevant distance measures. Therefore, the model coefficients can be considered conservative estimates.

Figure 3.10: Predicted Kaplan-Meier survivor function based on estimates from model OCist 6 in Table 3.4. The model-based predictions compare the survival function, *ceteris parius*, at varying distances to Cîteaux (i. e. varying travel costs to the General Chapter).

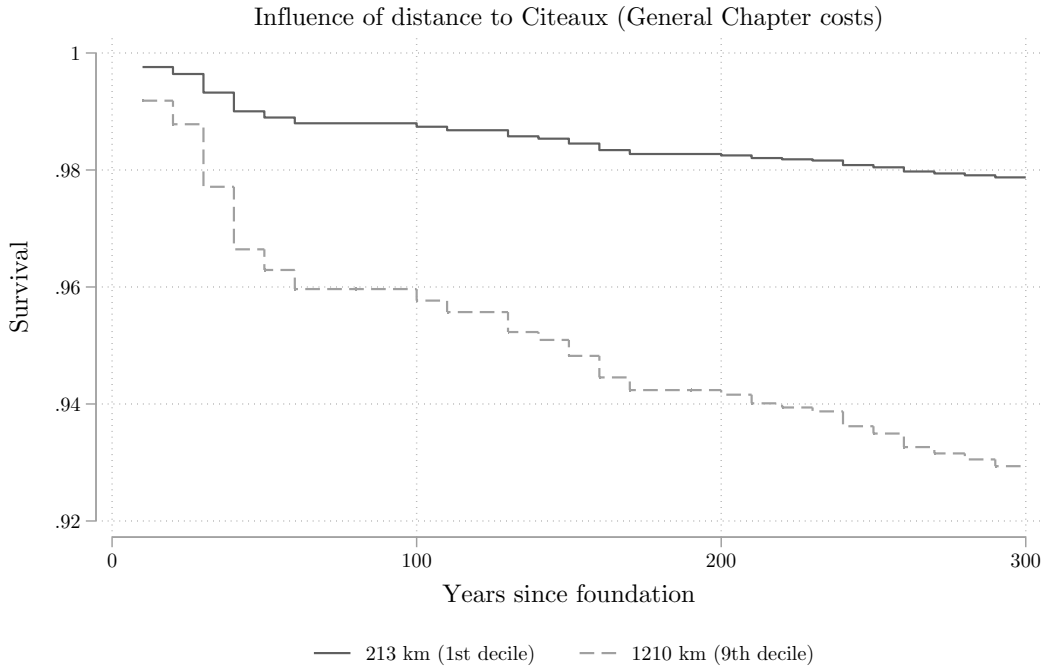


Figure 3.11: Predicted Kaplan-Meier survivor function based on estimates from model Cluny 6 in Table 3.6. The model-based predictions compare the survival function, *ceteris parius*, at varying distances to Cluny (i. e. varying travel costs to the General Chapter as well as visitation costs faced by the abbot of Cluny).

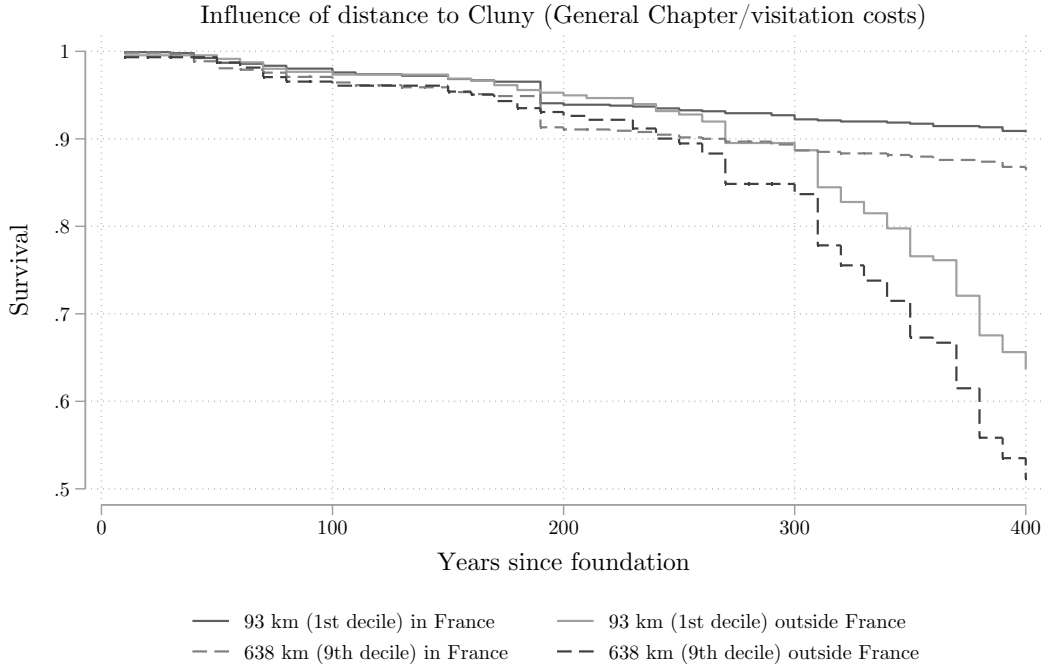


Table 3.6: Cluniac dissolution rates: results of discrete-time Cox models.

	Cluny 1	Cluny 2	Cluny 3	Cluny 4	Cluny 5	Cluny 6	Cluny 7	Cluny 8	Cluny 9
Distance to MH (km/100)	1.080**	1.018	1.016				0.993	0.977	0.949
	(3.733)	(0.656)	(0.408)				(−0.229)	(−0.728)	(−1.065)
Distance to GC (km/100)				1.127**	1.076*	1.075+	1.134**	1.094*	1.116*
				(5.389)	(2.181)	(1.829)	(3.443)	(2.215)	(2.080)
Out-degree of mother house			1.000			1.000			1.001
			(−0.191)			(0.051)			(0.824)
Avg. dist. to 3 cities (km/100)			1.287			0.951			0.951
			(0.676)			(−0.126)			(−0.127)
Cistercian houses in 50 km radius			1.090*			1.091*			1.091*
			(2.443)			(2.457)			(2.463)
Carthusian houses in 50 km radius			0.971			0.973			0.973
			(−0.599)			(−0.564)			(−0.566)
Cluniac houses in 50 km radius			0.990+			0.990+			0.990+
			(−1.667)			(−1.661)			(−1.662)
Period dummies	✓	✓	✓	✓	✓	✓	✓	✓	✓
Excluding houses in Middle East		✓	✓		✓	✓		✓	✓
Controls: Altidude + Ruggedness			✓			✓			✓
Stratified by France (yes/no)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Houses	1038	1033	1033	1038	1033	1033	1038	1033	1033
Houses × decades	39344	39293	39293	39344	39293	39293	39344	39293	39293
Chi^2	20.072	10.367	23.730	31.198	14.640	26.879	31.250	15.167	28.015
Log-likelihood	−1222.98	−1201.39	−1194.71	−1217.42	−1199.25	−1193.13	−1217.39	−1198.99	−1192.56
Global test of PHA (p-Value)	0.039	0.763	0.246	0.908	0.987	0.208	0.540	0.751	0.239

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. The table shows exponentiated coefficients (hazard ratios) of discrete-time Cox proportional hazard models and their z-values in parentheses. Breslow method was used to account for tied events. The global test of the proportional hazard assumption (PHA) is a Schoenefeld residuals test of the model as a whole. Source: Own data. Calculations using Stata 17.

Table 3.7: Cluniac dissolution rates: results of discrete-time Cox models. "Until 1200" are the main effects in the regression equation. "After 1200" are the combined effects of main and interaction terms.

	Cluny 10	Cluny 11	Cluny 12	Cluny 13	Cluny 14	Cluny 15	Cluny 16
Distance to MH until 1200	1.163**		1.200	1.261+	1.225	1.376**	
	(6.547)		(1.355)	(1.792)	(1.489)	(3.744)	
Distance to MH after 1200	0.981		0.950	0.949	0.925	0.982	
	(−0.633)		(−1.490)	(−1.505)	(−1.530)	(−0.442)	
Distance to GC until 1200		1.174**	0.969	1.151	1.176		1.426**
		(6.541)	(−0.221)	(0.891)	(1.006)		(3.441)
Distance to GC after 1200		1.039	1.075+	1.084+	1.102+		1.045
		(1.092)	(1.733)	(1.908)	(1.810)		(1.064)
Period dummies	✓	✓	✓	✓	✓	✓	✓
Excluding houses in Middle East				✓	✓	✓	✓
Controls: Altidude + Ruggedness					✓	✓	✓
Stratified by France (yes/no)	✓	✓	✓	✓	✓	✓	✓
Houses	1038	1038	1038	1033	1033	1033	1033
Houses × decades	39344	39344	39344	39293	39293	39293	39293
Chi^2	41.382	40.026	44.390	29.666	42.474	38.754	35.674
Log-likelihood	−1212.32	−1213.00	−1210.82	−1191.74	−1185.33	−1187.19	−1188.73
Global test of PHA (p-Value)	0.966	0.711	0.811	0.944	0.476	0.556	0.224

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. The table shows exponentiated coefficients (hazard ratios) of discrete-time Cox proportional hazard models and their z-values in parentheses. Breslow method was used to account for tied events. The global test of the proportional hazard assumption (PHA) is a Schoenefeld residuals test of the model as a whole. Source: Own data. Calculations using Stata 17.

I briefly note that the number of Cistercian abbeys in the vicinity of a monastery is associated with a higher dissolution rate. An additional Cistercian abbey within a 50 km radius increases the hazard rate by about 9 %. This finding mirrors the increase in Cistercian dissolution rates predicted by the number of Cluniac houses close to Cistercian abbeys. Taken together, inter-order monastic competition for scarce resources seems to be another likely mechanism that may help to explain regional differences in dissolution rates.

The Cox models in Table 3.7 include interaction terms in order to test predictions regarding the changing relative importance of the monitoring mechanisms. As summarized in Table 3.1, the coefficient of both distance measures is expected to decline after 12th century reforms. While the General Chapter was formally institutionalized, the monastic federation became more decentralized and less dependent on Cluny. The dyadic relationships between mother houses and their filiations lost importance because mother houses had to accept visitors appointed by the General Chapter. Basic models Cluny 10 and Cluny 11 seem to confirm the hypotheses. In fact, according the hazard ratio estimates, both kinds of travel cost ceased to matter after the 12th century. This pattern is largely stable across model specification although the effects are smaller and not (or marginally) significant when modeling both distances simultaneously. Columns Cluny 15 and Cluny 16 estimate models with control variables separately for both interactions because the distance variables are highly correlated ($r = 0.665$).[21] They again confirms the hypotheses about the waning importance of central (Cluny) and direct (mother house) monitoring.[22] However, contrary to the very small hazard ratio estimates, both mechanisms were expected to remain somewhat relevant after 1200.

Carthusians

The analysis of the Carthusian data largely follows, *mutatis mutandis*, the same approach used for the Cluniac and the Cistercian monastery data. Since Carthusian monasteries did not maintain "filial" bounds to daughter houses, the second main explanatory variable besides the distance to the General Chapter is the average distance to other monasteries in the same province (ADP). Carthusian visitations were organized in provinces and remote communities, that were harder to reach from other charterhouses in the same province, were presumably visited less regularly. The complexity of the stepwise setup is reduced due the fact that it is unnecessary to estimate models containing only the main effect of the average distance to other houses without the period-interaction effect. In contrast to other visitation mechanisms that existed in a rudimentary fashion from the orders' inception,

[21] One reason is simply that for many monasteries the mother house is identical to the orders origin, i. e. they are immediate houses of Cluny.

[22] The Schoenefeld residuals test after model Cluny 3 did not indicate that it is necessary to model the effect of distance to mother house as time-varying (test of the respective coefficient: $p = 0.978$).

Table 3.8: Carthusian dissolution rates: results of discrete-time Cox models.

	OCart 1	OCart 2	OCart 3	OCart 4	OCart 5	OCart 6	OCart 7	OCart 8
Distance to GC (km/100)	1.093	1.084						
	(1.629)	(1.334)						
Distance to GC until 1300			1.308**			1.309^{+}	1.221	1.185
			(3.013)			(1.870)	(1.337)	(1.084)
Distance to GC after 1300			1.006			0.955	0.933	0.872
			(0.094)			(−0.641)	(−0.864)	(−1.518)
Mean distance in province until 1300				1.896	1.651	0.999	1.074	1.084
				(0.867)	(0.668)	(−0.007)	(0.490)	(0.116)
Mean distance in province after 1300				1.587*	1.489^{+}	1.300^{+}	1.411*	2.058*
				(2.166)	(1.758)	(1.858)	(2.027)	(2.362)
No. of houses in province		1.037			1.023		1.048	1.012
		(0.611)			(0.386)		(0.790)	(0.188)
Avg. dist. to 3 cities (km/100)		4.963^{+}			4.554^{+}		6.207*	5.203^{+}
		(1.854)			(1.722)		(2.083)	(1.837)
Cistercian houses in 50 km radius		0.895			0.886		0.892	0.881
		(−1.001)			(−1.030)		(−1.029)	(−1.075)
Carthusian houses in 50 km radius		1.094			1.096		1.111	1.101
		(0.871)			(0.893)		(1.036)	(0.940)
Cluniac houses in 50 km radius		0.966			0.973		0.974	0.978
		(−1.538)			(−1.218)		(−1.148)	(−0.988)
Period dummies	✓	✓	✓	✓	✓	✓	✓	✓
Controls: Altidude + Ruggedness		✓			✓		✓	✓
Exclude provinces of size 1				✓	✓			✓
Charterhouses	221	221	221	219	219	221	221	219
Charterhouses × decades	3522	3522	3522	3459	3459	3522	3522	3459
Chi^2	6.853	19.719	12.347	8.233	19.504	14.754	27.648	23.231
Log-likelihood	−165.27	−158.84	−162.53	−153.30	−147.67	−161.32	−154.88	−145.81
Global test of PHA (p-Value)	0.943	0.848	0.967	0.984	0.960	0.977	0.955	0.980

+ p ≤ 0.1, * p ≤ 0.05, ** p ≤ 0.01. The table shows exponentiated coefficients (hazard ratios) of discrete-time Cox proportional hazard models and their z-values in parentheses. Breslow method was used to account for tied events. The global test of the proportional hazard assumption (PHA) is a Schoenefeld residuals test of the model as a whole. Source: Own data. Calculations using Stata 17.

official provincial visitations were carried out by the Carthusians only from the 14th century onwards. Robustness checks exclude observations if there were no other houses in the same province, rather than geographically restricting the sample. The latter is unnecessary because the absence of outlier-houses in far-away regions (see Figure 3.9).

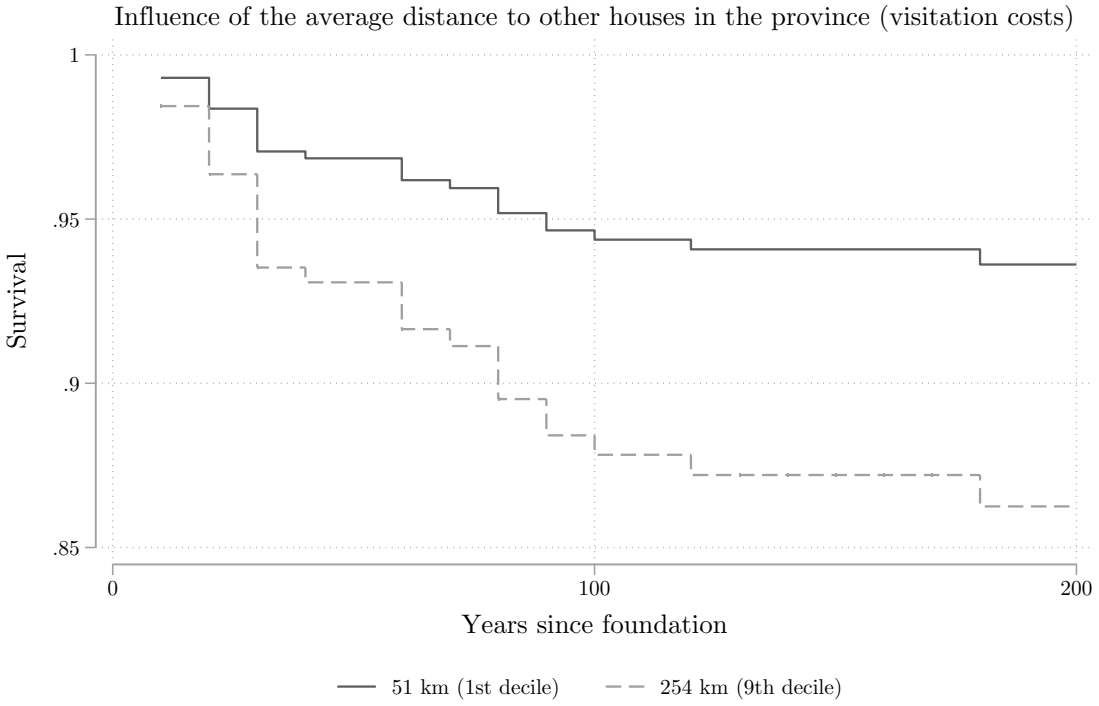
The first two Cox models in Table 3.8 (OCart 1 and OCart 2) reveal that the hazard ratio for an increase in the distance to the General Chapter (1.084 with controls) is comparable to the hazard ratio estimated using the Cluniac data (1.075), but does not reach the 10 %-significance level. Estimating a time-varying effect (OCart 3) eliminates the association between dissolution rate and distance to the General Chapter for the period after 1300. This is somewhat surprising and runs counter to the hypothesis of a persistent General Chapter effect (Table 3.1). There is a strong and significant association for the period before 1300, even though the size and significance of the hazard ratio decrease once travel distances within provinces are accounted for. The evidence regarding the average distance to other houses in models OCart 4 and OCart 5 is mixed. Contrary to expectations, the hazard ratio for the period before 1300 is larger than after 1300. However, the small z-values indicate high uncertainty. The effect for ADP pre-1300 vanishes when including both distance measures with interaction terms. The association for the earlier period is very likely the result of a correlation between ADP and the distance to the General Chapter. The effect of travel distances within provinces after 1300 is robust to the inclusion of controls (OCart 7) as well as the exclusion of observations for which the distance measure could not be calculated because there were no other charterhouses in the province (OCart 8). Hence, the analyses of the Carthusian data provides evidence in favor of the relevance of provincial visitations. The predicted survival curves in Figure 3.12 illustrate the findings: Based on model OCart 5, an increase from 51 km to 254 km in the mean distance to other charterhouses of the same province reduces the survival probability 200 years after foundation by about eight percentage points.

Closeness to other orders does not predict higher hazard rates. This complements the finding that either Cistercian nor Cluniac monasteries were more likely to be dissolved if there were close to Carthusian houses. However, a greater average distance to medieval cities is associated with higher dissolution rates even though the Carthusians were an eremitic order who valued seclusion. This finding casts doubt on the interpretation of the corresponding hazard ratio for the Cistercians presented earlier.

3.7 Discussion

To summarize, the evidence regarding the global predictions is mixed. The analysis of dissolution rates did not confirm the predictions about the ordering of stability. While the Cistercians appear to have been the most stable order, the difference to the Cluniac commu-

Figure 3.12: Predicted Kaplan-Meier survivor function based on estimates from model OCart 2 in Table 3.8. The model-based predictions compare the survival function, *ceteris parius*, at varying average distances to other charterhouses in the same province to (i. e. varying travel costs for provincial visitors).



nities is small and largely driven by one particular historical case (Limoges). Conventionally presumed differences in the strictness and effectiveness of visitation thus do not translate to measurably different rates of dissolution. Carthusian monasteries were dissolved at a higher rate, especially during the first years of their existence, again contradicting my expectations. However, it has to be stressed again that the comprehensiveness of the datasets might differ. Comprehensiveness is determined by the availability of historical sources, the cumulative research effort that has been directed toward a particular order as well as the data collection procedure for each database. Future studies can improve on the current effort by examining and validating the comparability of data sources for different orders. Differences in the effectiveness of visitation systems should translate into differences in stability among religious movements.

Hypotheses regarding time trends were partially confirmed. The incidence of Cistercian dissolution increases over time while the Carthusian order seems to consolidate somewhat with the introduction of reforms during the 13th century. The slightly rising dissolution rates of Carthusian monasteries in the 14th and 15th century might be attributed the overall

decline of Western monasticism during this period. Monastic orders faced strong competition from new forms of religious life, especially the mendicant orders (Wittberg, 1994: 34). The Cluniacs experience a one-time reduction but exhibit an otherwise consistent trend toward higher dissolution rates.

The distance to an order's origin was associated with higher dissolution rates across all three cases. General Chapter attendance and (for Cluniacs) oversight by the order's highest authority is stronger than the monitoring function of filiation systems. The importance of the distance to the origin decreases over time for all orders. For the Cluniacs, starting in 1200, both distance measures show no association with the hazard of dissolution. On the one hand provincial visitation might have replaced the other kinds of visitations. On the other hand the constantly increasing dissolution rates of Cluniac communities indicate that all mechanism of internal control were failing during the Late Middle Ages. It would be necessary to reconstruct provincial membership of houses in order to test these competing interpretations. Since it was not possible to collect these data for the present evaluation, it remains a desideratum of future research to expand the project accordingly. For the Carthusians, it seems like provincial visitations became the dominant means of internal discipline during the 14th and 15th centuries, deflating the relevance of General Chapter attendance. As mentioned in Section 3.1, the General Chapter remained a focal institution of the order. Therefore, it was expected that more regular attendance of the abbots would result in higher internal discipline. Moreover, while the Carthusian dissolution rates during the 14th and 15th centuries stayed below the previous maximum, the sharp reduction during the 13th century predates the introduction of the system of provincial visitations. Thus, congruence between monastery level and order level findings in limited but can be attributed to the institutionalization of the General Chapter as well as accompanying introduction of visitations before the establishment of provinces.

The fact that provincial visitations were effective in the Late Middle Ages, at a time when filial visitations by mother houses were not (anymore), can help to explain why the Cistercians – but also the Premonstratensians (Oberste, 1996) as well as mendicant orders (Little, 1919) – adopted a provincial division of administration. At least since the rise of the territorial states, the organization in regional units proved to be the an effective organizational innovation that diffused among the various competing orders. It can thus can be considered an example of isomorphic change and highlights the interdependence of religious and state institutions. The fact that there is more evidence for the effectiveness of General Chapter attendance than the filial visitation systems is likewise consistent with adoption of the former institution, but not the latter by most other major orders.[23]

Overall, the results are consistent with the theory that orders were able to stabilize their

[23]E.g. Premonstratensians held their first General Chapter in 1128, the Augustinian Canons in 1215, the Dominicans in 1243, and the Franciscans in 1260 (Aston, 2001: 31-33).

communities by implementing and maintaining effective monitoring mechanisms. Furthermore, they provide indirect evidence of the relevance of strict rule observance for the survival of religious groups. The strictness and uniformity of monastic life – that was to be supported by institutionalized visitations – was thus not just an end in itself, but contributed to the longevity of monastic communities. At the same time, the study highlights the importance of devising institutions that minimize the monitoring costs in order the reduce second-order free-riding problems (Finley, 2021). This focus on the organizational-level mechanism goes beyond the scope of the original club good model of religion (Iannaccone, 1992) that largely ignored the question of how religious groups monitor the adherence to the supposedly beneficial rules and prescriptions. Future research should focus on the link between the extent of free-rider problems, monitoring costs and the relative success of religious movements. The design of the present study does not warrant predictions of comparative dissolution rate for a counterfactual situation in which the orders would have been able to eliminate or minimize the relevant monitoring costs. Future studies might be able to credibly model and estimate such counterfactual predictions.

The most important deviation from the theoretical expectations is the weak and uncertain statistical relationship of dissolution rates to the distance to Cistercian mother houses. Historians generally consider the Cistercian filiation system to have been the most effective and most rationally planed institutions of internal control (see Section 3.1). At the same time, the respective distance measure is potentially less correlated with confounding factors compared the distance to Cîteaux – despite the effort to control for other influences – and thus more credible. The distance to a single location in Burgundy might be confounded by, for example, cultural (dis-)similarity with the region of an order's origin, whereas the dyadic distances vary much less uniformly across European regions.

3.7.1 Ideal and reality

There are reasons to doubt the effectiveness of the Cistercian visitation system and thus explain the failure to observe robust statistical relationships. For example, Berman (2000) challenges whether medieval Cistercian sources accurately depict the order's internal structure. "[F]iliation trees reflect a frequent medieval image, showing the medieval fascination with noble and even biblical genealogies" and at the same time "imply an organization that could not actually have worked very well for visitation" due to the unequal distribution of daughter houses among the abbeys (Berman, 2000: 104). In the above analyses, the out-degree of the mother house – a measure of the father abbot's alleged burden of visitation – was not associated with a higher hazard rate (Table 3.4). To the contrary, the estimated hazard ratio was smaller than one (albeit not statistically significant). However, to the extent that the filial system of visitation as a whole was dysfunctional, an estimate based on variation

among Cistercian abbeys might not be particularly informative.

Figure 3.13 shows the unequal distribution of daughter houses. As can be seen in the log-log plot on the right, the degree distribution is *prima facie* consistent with a scale-free network, reflected in the alignment of the data points in a straight line. Such a distribution can plausibly be the result of a process called *preferential attachment* in the literature on network dynamics. In this model a "network grows by the addition of a single new vertex at each time-step, with m edges connected to it. The other end of each edge is connected to one of the vertices already in the network, chosen at random with probability proportional to degree" (Newman et al., 2011: 336). That means that he Cistercian network structure could have arisen from a process of pure cumulative reputation formation. This hypothesis in conflict with other interpretations of the network structure, for instance, Snyder's (2009: 43) reading of the "spatial and temporal patterns" of the network, revealing "tactics and strategies not mentioned or elaborated in the written record." But if there was not much of a plan to the expansion of the Cistercian network because growth was driven by the cumulative advantage of a few monasteries – whose attractiveness as mother houses was probably related to the desire of new foundings to attach themselves to a "noble genealogy" — then it should not be surprising that the filial network was an ineffective means of enforcing observance. Unfortunately, it is very difficult to confirm the existence of a power-law empirically, particularly with the small sample size at hand (Clauset et al., 2009). A goodness-of-fit test using the Kolmogorov-Smirnov statistic at least cannot rule out that the degree distribution follows a simple power-law with exponent $k = -2.14$.[24]

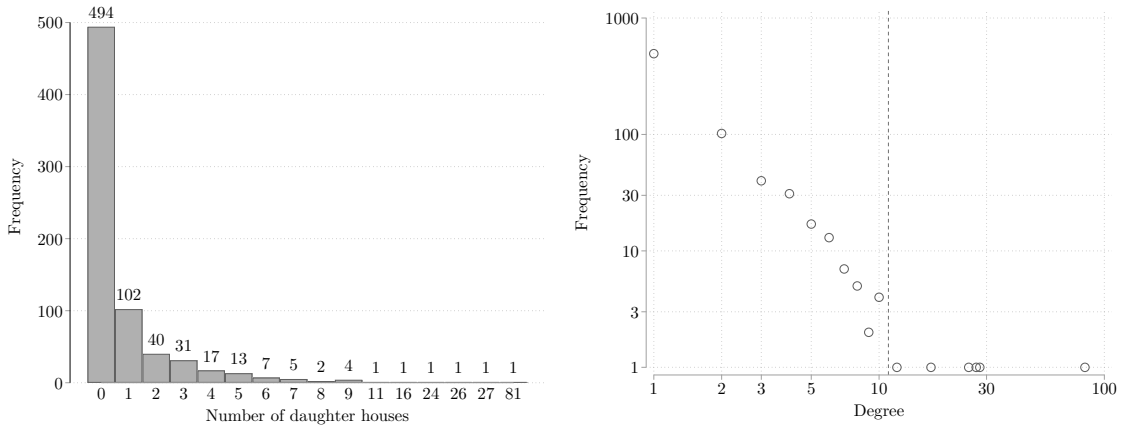
3.7.2 Additional problems and weaknesses

A methodological weakness of the present study is the small number of dissolution events for Cistercians (61) and Carthusians (33). This limits the credibility of Cox models as it significantly undercuts the number of events per covariate commonly considered necessary[25], although sign and the significance of the estimates of interest in general do not depend on the inclusion of controls. The broad conclusions, therefore, remain unaffected, even if the we restrict ourselves to the interpretation of the more parsimonious models. However, the study possibly lacks the statistical power to reliably detect small effects – e. g. the distance to mother house in the Cistercian case – especially if the predictor variable is correlated with

[24]First, a best-fit estimate of the power-law exponent was obtained by estimating a non-linear regression of the form $y = \alpha x^{-k} + \varepsilon$ with x being the degree and y its respective frequency. In a second step, the null hypothesis that the observed degree distribution follows a power-law with exponent $k = 2.14$ was tested using a simulation based routine implemented by Jann (2008). Exact p-values were approximated by Monte Carlo simulations (100, 000 runs). The p-value was 0.666 including all observations and 0.811 excluding the distribution's tail with degrees that were only observed once (values to right of the line in Figure 3.13).

[25]However, Vittinghoff and McCulloch (2006) argue based on simulation studies that the often cited number of ten events per variable is very likely too conservative and can be relaxed.

Figure 3.13: Distribution of daughter houses among Cistercian abbeys (left) and log-log plot of node degree (right). The count is based on the total number of communities ever founded by an abbey.



other distance measures.

A more general criticism concerns the adequacy of the dependent variable, i. e. whether deteriorating conditions in the monastic communities increased the likelihood of dissolution enough for the latter to be used as a proxy measure. The most direct way to engage with the criticism is to qualitatively examine records of known circumstances of dissolutions, though, the exercise does not result in a conclusive answer. An attempt was made to gather information on the reasons of dissolution of the 61 Cistercian houses that were dissolved before 1500. This was only possible for about half the dissolved abbeys and even in those cases the available facts are often rudimentary. For some communities the reasons pertain to internal conditions. For instance, in 1232 Glangrach (or Glanawydan) was reduced to a grange of Dunbrody because Stephen of Lexington, abbot of Clairvaux, found it to be too poor and lacking in personnel (Cistercians in Yorkshire Project, 2011). The General Chapter decided for a similar reason to reduce Santo Spirito della Valle del Fico to a grange (Cistercian Monks of Florence, 2018: entry *Santo Spirito della Valle del Fico*). Based on the available facts in the secondary literature, it is uncertain whether the situation of those abbeys was the result of mismanagement or a lack of discipline but it at least plausible. In other cases, the evidence is clearer: Palazzolo was so indebted due to bad economic management that sacred furnishings and liturgical vestments had to be sold. The abbey was later donated to the Carthusian order (Crielesi, 1997: 14).

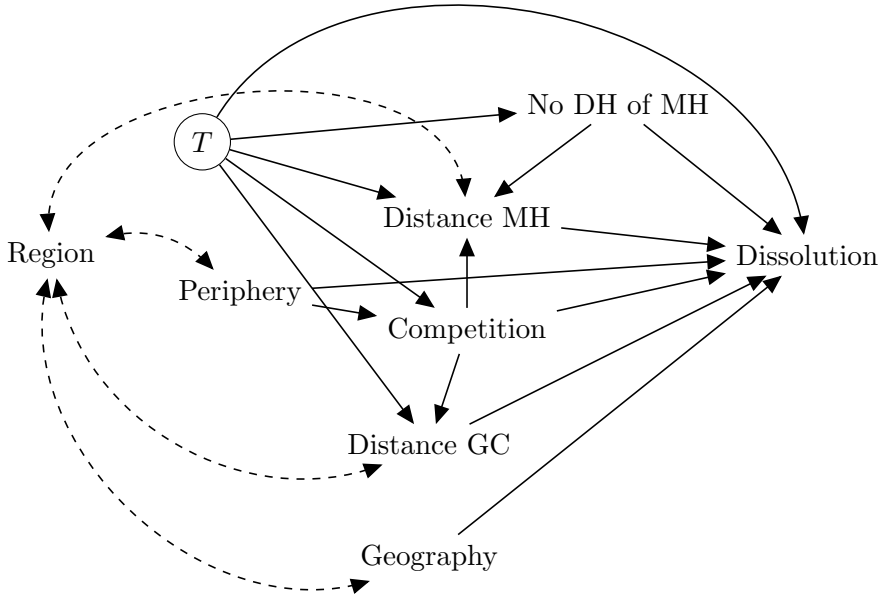
Some strong exogenous factors relating to political events or persecution very likely rendered the internal state of the monastic communities irrelevant: Most prominently, monasteries founded in the Middle East during the crusades (e. g. Salvatio, Trinitas de Refech, Belmont, Saint-Jean-aux-Bois) had to be abandoned after the end of the Crusader

States. Similarly, most Cistercian monks fled Greece after the end of the Frankish rule in the region (abandoning Chortaïton, Isova, Sanctus Archangelus, and Zaraka). However, even in these cases there is some variation in timing. Daphni abbey, for example, survived the end of the Frankish rule in Greece in 1276. It was abandoned only much later during the coming of the Turks in 1458 (Panagopuolos, 1979: 62). More generally, I content that one cannot just point to exogenous events as explanations because there was observable variation in resilience. For instance, in times of war monasteries were often looted and burned down. Some were rebuilt, like Czikador in Hungary after the tatar invasion (Ollig, 2001), while others never recovered from (partial) destruction, e. g. the Czech abbey Hradiště after the Hussite Wars. The internal condition before such plights very likely mattered. Even though the proximal cause of such dissolutions was exogenous, the potential for absorbing such external shocks was certainly related to prior management, the discipline and reputation of the monastery.

Unfortunately, it is very difficult to supplement the analysis of dissolution rates with more direct evidence on misconduct in monasteries. Though some visitation reports have survived and give insight into the historic practice of visitors (e. g. Oberste, 1996: 98 ff.), these records are not just incomplete but have an obvious endogeneity problem: stricter control might encourage compliance but at the same time it is likely to uncover more instances of misbehavior. Hence, dissolution rates remain the best proxy measure of the consequences of irregular visitation in the Middle Ages.

3.A Sketch of a causal model

Figure 3.14: Generic DAG sketching the assumptions of the identification strategy. The circle indicates that general societal changes T are an unobserved construct.



The estimated Cox models adjust for a number of control variables with the goal of eliminating possible sources of confounding. While the available data impose restrictions on the research design, the inclusion of theoretically derived covariates nonetheless subjects the causal hypotheses to a stricter test compared to a purely descriptive analysis. Figure 3.14 sketches the causal assumptions as a *directed acyclic graph* (or simply "DAG"; for details of this particular notation: Morgan and Winship, 2014: 77–130). Solid arrows indicate the direction of causal relationships. Dashed, double-headed arrows indicate causal dependencies among variables that are not fully spelled out in the graph.

The geographic distance to a mother house or to the General Chapter might be correlated with other characteristics of a region that influence the likelihood of dissolution. One likely causal path of a monastery's location, aside from differences in the geography, runs thought being located at the "periphery" of European monasticism, i. e. whether the monks face an environment where monasticism is not yet entrenched in the local culture or that is even hostile towards monastic communities. Moreover, being at the periphery possibly reduces the intensity of religious competition for members and resources among different orders. The inclusion of period effects is necessary to control for other unobserved societal and

institutional changes (T), unrelated to the theorized mechanisms, that might influence the spread of an order and the rate of dissolution. Lastly, the size of a filiation, i. e. the number of daughter houses for which a mother house has the duty of visitation, may influence the regularity of visitations. Controlling for geographic features, competition, a peripheral location, the filiation size, and general time trends eliminates sources of spurious causality and allows the estimation of the distance (travel cost) effects.

4 Can't see the forest for the IVs

Max Weber's Protestantism thesis (Weber, 2005) is very likely the most famous sociological contribution to the literature on economic development. Economists, and economic historians in particular, increasingly pay attention to the possible influence of cultural and religious factors on the Industrial Revolution as well as economic development in general. Accordingly, there have been a number of attempts to test Weber's suggestion that Protestant asceticism played a role in the emergence of early capitalism (Becker et al., 2016: 3–4, 17–18).

In a recent publication, Andersen, Bentzen, Dalgaard and Sharp (hereafter ABDS) set forth an alternative view on the cultural origin of capitalist work ethics. They hypothesize "that the cultural virtues emphasized by Weber had a pre-Reformation origin in the Order of Cistercians" and that the latter "encouraged growth by instigating the kind of cultural change that Weber attributed to Protestantism" (Andersen et al., 2017: 1757). The empirical test of their hypothesis combines several pieces of evidence. 1) ABDS show a statistical association between the locations of medieval Cistercian monasteries and population growth of English regions during the early modern period (1377–1801). 2) Furthermore, an instrumental variable approach provides evidence that this is, in fact, a causal relationship. 3) Additionally, they can show contemporary value orientations regarding hard work and thrift to be correlated with the intensity of historical Cistercian presence throughout European regions. 4) Lastly, historical Cistercian presence in Europe is associated with contemporary employment levels as well.

ABDS's study is remarkable for their hypothesis regarding the wide-spread diffusion of Cistercian values is not just altogether new, the findings, moreover, suggest a rather strong effect that persists today. If we take the study at face value, it is more than a mere footnote in the history of economic development but gives rise to an important research program on the question of how Catholic orders shaped the value orientations of European populaces. Thus, it is not surprising that the paper is well-cited and has already been picked up in books targeted at a popular audience (Henrich, 2020).

Unfortunately, there are reasons to doubt the story as told by ABDS. Just consider Figure 4.1 which is based on the Figure 3 by Andersen et al. (2017: 1772).[1] It is descriptive but

[1] I was not able to replicate the exact numbers using the data and do-file provided in the journal's supporting information (see lines 5–8 in "uk_county.do" in supplement Data S1). Since all other results are easily replicable using the material provided by the authors, I suspect the figure is based on an earlier version of the dataset.

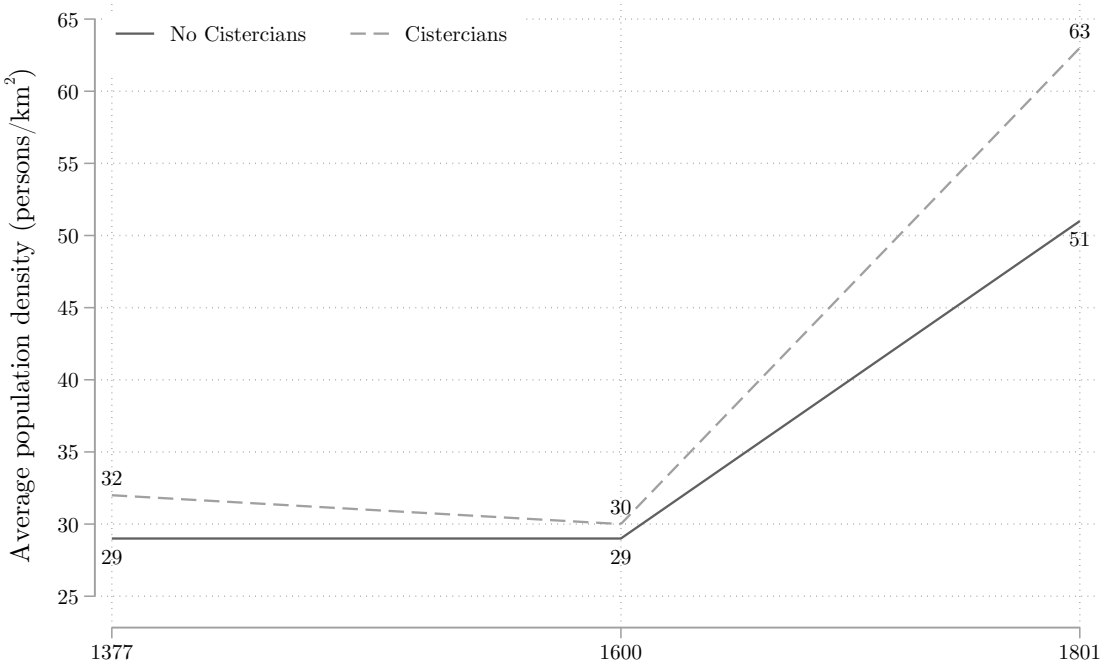


Figure 4.1: Average population density (Persons/km^2) in areas where at least one Cistercian monastery was found to areas without Cistercian monasteries. Figure and description correspond to Figure 3 by Andersen et al. (2017: 1772) with minor numerical discrepancies.

nonetheless summarizes the main finding with regard to England well. ABDS take population growth as an indicator for unobserved productivity growth based on the assumption that more productive regions were able to sustain a greater population. A change in the "work ethic," therefore, affects productivity which, in turn, affects population growth. As can be seen, however, differential growth is only observable for the 1600–1801 period, although the last Cistercian house was disestablished in 1540 during the Dissolution of the Monasteries under Henry VIII. Final exposure to the treatment predates any measurable effect by at least several decades, whereas initial exposure the Cistercians dates back to the 12th century when the majority (ca. 75 %) of all the Cistercian houses in England were founded.[2] ABDS rationalize this time lag with a model of the diffusion process (Andersen et al., 2017: 1766-1767). Under somewhat reasonable assumptions, it can take up to 25 generations of 20 years (500 years in total) for the share of the population, that adopted the Cistercian values, to increase from 1 % to 50 %. Furthermore, "[t]he spread of the new cultural values follows an S-shaped trajectory: the process is slow to begin with but accelerates over time and ultimately

[2] According to the dataset, based on the English Monastic Archives, provided by the authors in the supporting information S1 Data.

levels off." Hence, it could take centuries before the more productive sub-population is large enough to be reflected in average growth differences among regions.

This reasoning is sound but it amounts to an unfalsifiable thought experiment. The interpretation of the divergence as a consequence of historical Cistercian presence is only credible if there are both strong theoretical reasons to suspect Cistercian cultural influence as well as a robust causal effect based on plausible assumptions. Contrary to Andersen et al. (2017: 1760, Fn 6) response to an anonymous referee's strong judgment that the "claim that the Cistercians were precursors to the Protestant Ethic is simply incorrect," this disagreement cannot be resolved empirically if "empirical" is, rather narrowly, equated with econometric analyses of available quantifiable data. Historical scholarship is empirical evidence, too, and many of the assumptions underlying ABDS's statistical models are justified with regard to their interpretation of "qualitative" historical facts. In the following, I will re-assess the theoretical and empirical claims by ABDS. Based on my reading of the relevant scholarship, I regard the hypothesis about the Cistercian cultural influence as highly speculative. The actual content of the Cistercian doctrine did not lend itself to easy adoption by the surrounding population and there is no historical evidence of such value diffusion. Moreover, there are reasons to reconsider their empirical results as well. For instance, the most severe and direct test of their hypothesis – the IV regression analysis – can be criticized for the questionable operationalization of the instrument. The IV analysis rests on the assumption that royal forests aided the foundation of Cistercian settlements. ABDS use a dichotomous instrument. A county, the unit of analysis, is coded as containing royal forests if the share of its area classified as royal forest is greater than zero. This strict cut-off leads to a number of counties with less than one percent forest area as being coded one, leaving only 5 von 40 counties with a zero-coded IV. The main results are not robust to slight variations in the operationalization of the royal forest indicator.

The general problem is a combination of a speculative theory and indirect tests based on scarce historical data, resulting in many "researchers degrees of freedom" (Simmons et al., 2011). This problem of intransparent but consequential analytical decision has long been recognized. Already Leamer (1983) advised to report the entire range of estimates that result from alternative specifications. In economics, some proponents of the so-called "credibility revolution" hoped that a shift to "design-based studies" would make observational studies more robust because sensitivity analyses could be "targeted at specific threats to validity" (Angrist and Pischke, 2010: 18). "Since the nature of the experiment is clear in these designs, the tack we should take when assessing validity is also clear" (Angrist and Pischke, 2010: 19). However, recent evidence suggests that p-hacking and questionable research practices are worryingly prevalent in studies using the most common research designs for causal identification (Brodeur et al., 2020a). IV designs in particular seem to suffer from substantial p-hacking or selective reporting (Brodeur et al., 2020a: 3642–3643).

In line with recommendations from economics (Brodeur et al., 2020b) as well as the growing literature on model uncertainty and specification searching inspired by the social science replication crisis, I conduct a systematic robustness check using *specification curve analysis* (Simonsohn et al., 2020). In my re-analysis I, first, identify the universe of plausible models based on all analytical decision that cannot be deduced theoretically. I then transparently present estimates of all models in a way that allows to identify the critical choices leading to confirmatory results. The re-analysis reveals that strong confirmatory results with regard to early modern England can only be obtained via a very specific set of decisions. These decisions are not derived from theoretical predictions and some – such as the operationalization of the IV – are outright problematic.

Notwithstanding the overall negative assessment, this chapter is not a clear-cut falsification. It neither intends nor succeeds in "disproving" the influence of a Cistercian work ethics. It rather urges researchers in the domain of economic history to be more careful in presenting far-reaching conclusions based on speculative theory and scarce historical data.

4.1 Theoretical and historical considerations

The following section is a re-assessment of the theoretical argument brought forward by Andersen et al. My intention is not to *disprove* their argument but rather to lay bare its highly speculative nature. Due to the inherently unsatisfying quality and availability of data in historical social research, we have to be guided by a strong theory in order to make causal claims. The sections concludes with a brief discussion of an alternative causal channel of Cistercian influence – the diffusion of technical and managerial skills – that can be tested vis-á-vis the values-based explanation of Andersen and colleagues.

4.1.1 Weber's Protestant Ethic

Weber (2005) hypothesized that Protestantism, and specifically Calvinism, was conductive to the development of capitalism. According to the Calvinist doctrine of double predestination, God chose some people for salvation and others for damnation. The individual cannot change his or her fate. However, Calvinists started to believe the inner-worldly behavior to be an indicator of otherworldly salvation. Self-confidence, a clearly felt calling, inner-worldly asceticism, and economic success were said to be such credible signals. The tireless ambition of believers to attain assurance of their own salvation fostered a rational and methodological conduct of life as well as the accumulation of wealth and, ultimately, as the unintended collective result, the economic system of modern capitalism.

Although *The Protestant Ethic* is one of the most well-known texts in social science, there is only very limited empirical support for its main hypothesis. Weber's argument

has been controversial in both social science and historical scholarship throughout the 20th Century (Becker et al., 2016: 3-4). Any systematic test is complicated by the fact that Weber himself was not entirely clear on the details of the main causal mechanism at work (e. g. Coleman, 1986: 1323) but there seems to be consensus that his theory implies regional differences with regard to economic development between regions with Catholic and (certain) Protestant majorities at some point in time. Studies looking for a correlation of religious denomination and indicators of economic growth in historical data either do not find any statistical relationship (Cantoni, 2015) or assert that the association can be explained by Protestants' higher investment in human capital (Becker and Woessmann, 2009). However, with the exception of Spater and Tranvik (2019), quantitative tests compared predominantly Lutheran regions with Catholic regions, thus disregarding Weber's emphasis on ascetic Protestant denominations like Calvinism and Puritanism.[3] Spater and Tranvik (2019) estimate a regression discontinuity at the border of two Swiss cantons and find some indirect evidence in favor of Weber's hypothesis. Swiss Calvinists in the canton of Vaud urbanized more rapidly than Catholics in the canton Fribourg, i. e. the cities in the former canton grew faster during the late 19th century and villagers were more likely to move to growing cities. The authors interpret this as eagerness to find productive work.

As Andersen et al. note, Weber also became interested in medieval monasticism as an early predecessor of modern rationality. Importantly, neither in the case of Protestantism nor in the case of monasticism was Weber simply focused on value orientation like "thrift" and "hard work" but on a possible *nexus of asceticism and rationality*[4] (see also Kaelber, 1998: 19–21). Andersen et al. (2017: 1761) cite the key passage:

> In the rules of St. Benedict, Still more so with the monks of Cluny, again with the Cistercians [...], [Christian asceticism] developed a systematic method of rational conduct with the purpose of overcoming the *status naturæ*, to free man from the power of irrational impulses and his dependence on the world and on nature. It attempted to subject man to the supremacy of a purposeful will, to bring his actions under constant self-control with a careful consideration of their ethical consequences. Thus it trained the monk, objectively, as a worker in the service of the kingdom of God, and thereby further, subjectively, assured the salvation of his soul. (Weber, 2005: 72)

The section in the *Protestant Ethic* on similarities between medieval and Puritan asceticism is at the same time unambiguous about their differences, which Weber deemed "evident." The

[3] Moreover, by the 19th Century, for which Becker and Woessmann (2009) and Spater and Tranvik (2019) have data, capitalism was already fully developed and had very likely long diffused beyond regions with a Protestant majority (Braun et al., 2012: 36).

[4] Rationality *sensu* Weber obviously differs from the more technical definition of rationality in economic decision theory.

difference "consisted in the disappearance of the *consilia evangelica* and the accompanying transformation of asceticism to activity within the world" because in traditional Catholic asceticism "the most important thing was the fact that the man who, par excellence, lived a rational life in the religious sense was, and remained, alone the monk" (Weber, 2005: 73). The way of life preached in ascetic teachings "was felt to be something higher than the everyday morality which sufficed as a minimum, and that this latter was not measured by such standards as Puritanism demanded" (Weber, 2005: 74) and hence "had, on the whole, left the naturally spontaneous character of daily life in the world untouched" (Weber, 2005: 101).

While Weber's theory itself is highly contested, it certainly cannot be used to derive the hypothesis that the Cistercian work ethic was conductive to economic development. Moreover, Weber explicitly connected the Protestant Ethic to wider societal trends and the emergence of a specific Capitalist Spirit. Andersen et al. make a much simpler argument: Cistercians values induced a change in the individual preferences for leisure which boosted the economic development in regions close to Cistercian monasteries. Because the authors do not connect this diffusion process to the emergence of a Capitalist Spirit and capitalism itself – a mindset and an economic system that, according to Weber, ultimately spread beyond Protestant regions and milieus – there is only a tenuous connection to Weber's actual theory.

4.1.2 Monastic "work ethic"

Weber as well as other authors who noted similarities between Cistercian values and "work ethics [...] propagated by Calvinist and other ascetic sects some hundred years later" (Kieser, 1987: 116) never theorized a connection to later economic development. The suggestion is entirely due to ABDS. While the idea is intriguing, how plausible is it in light of historical knowledge about the religious order and its relationship to society at large? There are two related questions. First, what was the exact nature of the Cistercian doctrine and did the Cistercians live up to their own ideal? Second, was the population surrounding monastic estates receptive to Cistercian work ideals?

In the beginnings of Cenobitic monasticism hard work was a means of subsistence. The introduction of division of labor within a community was a precondition for asceticism which initially "had been an elite form of living, suitable only for a talented few," to become "an organized religious movement" (Kieser, 1987: 105). Living from the fruits of their own work allowed ascetics to remain independent of society. The *Regula Benedicti* makes it clear that the monks' primary task is the work of God (*opus dei*) while manual labor is an economic necessity and duty to be performed happily. Securing salvation and increasing the *thesaurus ecclesiae* through spiritual activities were the raison d'être of monasticism. Monastic efforts of economic rationalization or the openness to new technologies are sometimes attributed to

a desire for minimizing working hours. According to this view, monks sought to reduce their work load in order to maximize time for prayer (Kieser, 1987: 114).

During the 11th Century, the Benedictine work requirements became purely symbolic. Cluniac houses behaved like the feudal lords of the time, relying on the work of serfs as well as tithes and other income generated from parish churches. At the same time, the share of ordained choir monks increased, causing further emphasis on liturgical duties and spiritual contemplation. The Cistercian reform movement was a direct reaction to the perceived decline of the old monasticism. The Cistercians emphasized manual labor and self-sufficiency. They renounced spiritual income from churches. Their preferred mode of economic organization was an "isolated and consolidated demesne farm" called a *grange* (Courtney, 1980: 44). In contrast to other orders who employed stewards or bailiffs to manage their estates, many Cistercian granges were directly administered by lay brothers (*conversi*) (Noell, 2006: 265). Autarky may have been motivated by a desire to minimize contact with the outside world but manual labor undoubtedly became an ascetic practice again (Kurze, 1980: 186).

However, there remain important differences between Weber's account of Protestant ethics and the Cistercian world view. The Cistercian attitude towards hard work was far from being unambiguous. Even Bernard of Clairvaux, one of the orders preeminent figures, found it difficult to reconcile monastic work requirements with the religiously higher value of the undisturbed contemplation of God (Kurze, 1980: 186). For Cistercians, work itself is never a "vocational calling" but rather one facet of a thoroughly otherworldly asceticism. As Sundberg (2019: 408) observes about contemporary Cistercians, the "monastic view on work [is] as something to perform indifferently, rather than to master, engage in, and exercise authority within." Monks are often ordered to perform a certain task by their abbot and rotation of duties is common to preserve the desired indifference (Sundberg, 2019: 408).

The accumulation of wealth, likewise, was a matter of concern. At one point, the order's General Chapter legislated (to no avail) that "all already established abbeys were strictly prohibited from the acquisition [...] of any land" as a reaction to public imputations of avarice (Lekai, 1977: 301). Eventually, the dilemma faced by both Puritans and monks – not being allowed to enjoy the wealth accumulated by hard labor and, thus, being forced to re-invest in ever more productive assets – perhaps contributed to the decay of the Cistercians during the Late Middle Ages. Economic success undermined its "ascetic credibility" (Kieser, 1987: 119; Southern, 1970: 260-261). In any case, the attitude towards wealth differed from Weber's characterization of the Puritans according to which "the faithful Christian must follow the call by taking advantage of the opportunity" (Weber, 2005: 108).

It is important to note that Cistercian spiritual leaders did not assign significance to the work ethic of lay people. For instance, Bernard of Clairvaux, who was also the most influential Cistercian writer in the order's history, in his sermon *Against the Most Wicked*

Vice of Ingratitude wrote about the labor of lay people:

> These secular people labor in the fashion of this world that passes away, laboring for their own immediate sustenance and that of their household. At any rate, their labor may not lead to damnation, but it scarcely lends to salvation, so even if they have maintained a moral foundation, in the end they will suffer loss of the transient goods upon which they built. (Bernard of Clairvaux, 2016: 152)

Moreover, Cistercians – in contrast to, for example, mendicant orders – de-emphasized preaching. As one Cistercian writer put it: "The duty of a monk is not to preach but to pray" (Burton and Kerr, 2011: 200). Surviving sermons likewise rarely "direct comments to life in the outside world" (Kienzle, 2012: 245). This is in accordance with the general statement that medieval asceticism was primarily concerned with the spiritual perfection of the monk. Therefore, it is unlikely that both the Cistercians actively promoted "work ethics" outside their monasteries and such idealistic elements of Cistercian thought, isolated from the context of a monastic life, would have made sense to the lay population at large. This is especially relevant because the authors occasionally write about *moral influences* (Andersen et al., 2017: 1768). The emphasis on the *moral* dimension would rule out the argument that the surrounding population, observing the economic success of Cistercians, adopted their attitude towards hard work for purely material reasons.[5]

ABDS's (2017: 1763) proposed mechanism of diffusion is essentially a model of population growth. But cultural change has to start with a small fraction of the population being directly influenced by Cistercian work ethics. Because there is "no evidence as to the exact nature of the contact with the surrounding lay populations" Andersen et al. hypothesize that initially "the ways of the Cistercians spread beyond the Order itself; by power of demonstration, by word of mouth, or both" (Andersen et al., 2017: 1762). The power of demonstration is a more plausible transmission channel if the Cistercian in fact lived up to their own ideals. However, in later centuries "choir monks and nuns only exceptionally [left] their enclosure to assist in the harvest" (Berman, 2012: 120) and the order gradually became more and more entangled with the feudal economy. Donkin (1963: 181–182) writes about the initial period of rapid expansion in the British Isles until 1152:

[5] Thomas (1964: 59) writes with regard to the early modern time:

> With the awareness of the economic importance of labour comes a new insistence upon the duty of every man to work. In a sense, this theme had been an element in Christianity from the start. It reached its peak in Protestantism, particularly Puritanism, but its origins lie in the Middle Ages, in the preaching of the Friars and Lollards. It did not, I believe, derive from monasticism, for although the early monastic founders had various motives for including labour as part of their régime, their most characteristic attitude was to regard work as a mortification of the flesh, a remedy for idleness, but not a productive good in itself. [...] It is in the religious teaching of the post-Reformation period, among Catholics perhaps as well as Protestants, that the positive merit of hard work is most cleary asserted.

> Over most of this short but extraordinarily active period the choir monks were directly involved in field labour; but thereafter, and until about the end of the 13th century, this was left almost entirely to lay brothers (*conversi*) and paid labourers. Later still, the monks began to lease by far the greater part of their estates, becoming mere *rentiers*

and this helps to explain

> [...] the surprisingly rapid change in the reputation and character of the Order—from extreme asceticism and an ability to survive in the most unpromising places, to avarice and great wealth in land.

It is doubtful whether the Cistercians in the Late Middle Ages were involved enough with the actual material production of the monastic estates in order to inspire the adoptions of their supposed "work ethic." Even though the Cistercians employed many lay people as workers and came into contact with the surrounding population in manifold other ways (Lekai, 1977: 378–399), what the latter observed with regard to the economic activity was mainly the superior organization and management of land (Lekai, 1977: 297).

4.1.3 Peasant life

The model of Andersen et al. predicts that once the preference for leisure declines, labor supply expands and fertility increases (Andersen et al., 2017: 1764). Hence their model assumes (1) labor supply to be a major constrain on medieval population growth (2) individual preferences for leisure to constrain the labor supply.

In the medieval agrarian economy, the demand for labor was determined by the cycle of the seasons (Thomas, 1964: 52). Pure leisure was confined to the holy days of the Church and these "[f]estivals occur at the slack periods of the agrarian year" (Thomas, 1964: 54). Kaelber (1998: 72), in his extensive study of medieval asceticism, remarks about the lay people working on monastic lands "there is little to suggest that their way of life differed from that around them. The people around them [...] were largely the peasantry but peasant life did not lend itself easily to the adoption of methodical and systematic conduct." It seems possible that there was little room for improved work ethics due to the "volatility of conditions in nature and the exigencies of agriculture" (Kaelber, 1998: 72). Hence, the central theoretical assumption of Andersen et al., that output was to considerable extent constrained by preferences for leisure, is conjecture.

In their illustrative models, ABDS assume the high work-ethic group to work 20 % more and cite the estimate by Clark and Werf (1998) that "the number of days worked per year (standard deviation in parenthesis) rose in England from 266 (4.8) in 1560–99 to 280 (12.9) in 1771. Factoring in the statistical uncertainty [...] a 20 % higher work effort may not be

unrealistic" (Andersen et al., 2017: 1766, Fn 17). It should be noted that the assumption of a 5 % higher work effort, as implied by the point estimates, changes the prediction of the diffusion model considerably. Assuming initial shares of 0.1 % or 0.01 % with high work ethic results in predicted shares of 0.3 % and 3.3 % of the population, respectively, with a high work ethic after 25 generations.[6] However, the exact numerical value is not as important as the fact that ABDS ignore Clark and Werf's overall conclusion. Weighing in on the debate whether the industrial revolution was preceded by an *industrious revolution* "which consisted of increased family labor per year" (Clark and Werf, 1998: 830), they examine historical data on the working hours of threshers and sawyers from the 13th to the 19th century. Although the evidence is "tentative and to some degree contradictory [...] on balance there is little sign of an industrious revolution" (Clark and Werf, 1998: 841). With regard to the early modern period, current research similarly suggests that "what has often been regarded as 'leisure' is better understood as unemployment and underemployment" (Griffin, 2020: 184). Hence, the increase in working hours at the onset of industrialization is likely the result of increasing labor demand.

Whereas the evidence concerning working hours is tentative and contradictory, there are hardly any sources on preferences and the general work ethics of the lower strata of medieval societies, especially where it did not intersect with the concerns of the upper classes. As Thomas (1964: 54) concludes: "What the free peasant working his own plot, as opposed to working for others, thought about it all [i. e. leisure and work, N. S.] I have no idea." Although there are textual sources of complaints about work performance, they were written from the perspective of manorial lords. Most peasants had to perform labor dues to the lord of the manor. "It seems clear at least that labor services were deeply unpopular with those who had to discharge them, and the unsatisfactory nature of their performance was one of the factors leading to commutation" (Thomas, 1964: 54). It seems likely that individual attitudes towards work were probably not the determining factor of productivity and population growth – especially during the time of the closest observance of the Cistercian rule, i. e. during the 12th and 13th century when the 'power of demonstration' was strongest

[6] The optimization problem at the individual level presented by ABDS is dispensable. The relevant macro dynamics (Andersen et al., 2017: 1766-1767) boil down to a simple model of viability selection (McElreath and Boyd, 2008: 19). Group H exhibits high work effort and group L low work effort. Then the share p_t of H at time (generation) t is given by

$$p_t = \frac{1}{1 + \left(\frac{n_{L,0}}{n_{H,0}}\right)\left(\frac{E(L)}{E(H)}\right)^t}$$

where $n_{H,0}$ ($n_{L,0}$) is the initial share of H (L) and $E(L)/E(H)$ represents the ratio of average work effort. Thus, the population share of group H assuming $n_{H,0} = 0.01$ and $E(L)/E(H) = 1/1.05$ will be a mere 3.3 % after 25 generations:

$$\frac{1}{1 + \left(\frac{1-0.01}{0.01}\right)\left(\frac{1}{1.05}\right)^{25}} = 0.033.$$

and before the end of traditional manorialism.

4.1.4 Alternative explanations of Cistercian influence

The point of the preceding discussion was to show the *highly speculative nature* of the explanation brought forward by Andersen et al.. Furthermore, many aspects of their theory – the exact mechanism of value transmission, the meaning of terms like "moral authority" etc. – remain elusive and in need of specification. Thus, *even if* there is in fact a correlation between Cistercian settlements and regional population growth patterns, it is necessary to complement this finding with more historical evidence to demonstrate the plausibility of the causal mechanism proposed by the authors.

Likelwise, *even if* an adequate research designs links population growth and Cistercian presence causally, there are still alternative explanations to be ruled out. The superior economic performance of Cistercian has been explained by their managerial skill, rational planning, and openness to new technology such water mills (e. g. Berman, 2012: 117–118). Burton and Kerr (2011: 187–188) stress the monks' role as "pioneers, entrepreneurs or disseminators of methods and techniques" bringing about economic change and consider the reorganization of the land as "[p]erhaps the Cistercians' most enduring legacy."

It might be that the spread of technological and managerial knowledge, independent of any ethical and theological doctrines, could explain a possible causal effect of Cistercian settlements on the growth of surrounding areas. Andersen et al. (2017: 1759) themselves acknowledge this possibility. I therefore propose to look for correlations between the presence of manors or granges owned by the Cistercians and later population growth as well. Although far from decisive, a strong correlation between population growth and grange locations – the centers of economic activity – rather than monasteries – the centers of spiritual activity – would give plausibility to the alternative causal channel as stated above.[7]

4.2 Empirical considerations

4.2.1 Operationalization

Andersen's et al. (2017) preferred operationalization of the main predictor is the Cistercian influence relative to other "moral influences". "Since the Church was the principal authority in matters of moral in medieval times, we construct π as the ratio of Cistercian monasteries, M_c, to all religious houses" (Andersen et al., 2017: 1768).

On a fundamental level, the assumption that work ethics were primarily shaped by

[7] Guerriero (2020) proposes a competing theory about the Cistercian influence on the local economies surrounding their communities. However, as I try to show in Appendix 4.F, her theory is based on a misreading of the historical evidence regarding the motives and mission of the Cistercian order.

the Church and not by, for instance, the mode of production (Fouka and Schläpfer, 2020) seems doubtful. The authors write that Cistercian work ethics spread to the surrounding population "by power of demonstration, by word of mouth, or both" (Andersen et al., 2017: 1762) which seems in line with the fact that Cistercians were not primarily concerned with preaching. But then the restriction to official religious authorities is not an obvious and self-explanatory choice. In principle, the peasant population could have imitated the "ethics" of any hard working group, religious or not.

However, the construct *Cistercian share* is problematic even if we accept the premise that moral influences were primarily ecclesiastical. ABDS use the English Monastic Archives[8] (henceforth EMA) as a source for information on religious houses. However, the EMA only covers monastic orders and regular canons. It does not cover mendicant orders, even though there were at least 54 Franciscan and 48 Dominican houses in medieval England (for comparison: there were 71 Cistercian houses).[9] ABDS also do not explain why they only include data on "major orders"[10] rather than all religious houses in the EMA. Most importantly, apart from religious orders, the Church was represented by the secular clergy such as secular canons and parish priests. ABDS do not consider their influence at all. Thus, in my view, it is not clear what the correct denominator would be. Restricting the denominator to an arbitrary selection of orders could unnecessarily exacerbate measurement error. Lastly, the indicator implicitly assumes the presence of other orders to be a contravening force although there is no reason to expect other religious orders to suppress the spread of an ethic of hard work among the peasant population.

For the reason stated, I contend that the main predictor should be based on the best available measure of absolute Cistercian presence (not relative to other orders). ABDS offer three operationalizations based on absolute presence: firstly, a dummy variable of Cistercian presence, taking the value 1 if there was at least one Cistercian house in a county, and 0 otherwise; secondly, the absolute number of Cistercian houses in a county; lastly, they use *Cistercian density*, i. e. the number of houses divided by the county area. All three measures seem preferable to the heavily assumption-laden Cistercian share. Moreover, ABDS omit several other equally plausible operationalizations. For example, it could be argued that the influence on the values of the local populace was greater in counties with long-lasting Cistercian presence. One way to construct a corresponding measure would be to compute the "life-span" of all monasteries (years from foundation to dissolution) and then sum those durations at the county-level (see Section 4.3). Since the theory is silent on the exact initial

[8] `https://www.ucl.ac.uk/history/research/english-monastic-archives`

[9] The number of Franciscan houses was computed from the dataset provided by Boranbay and Guerriero (2019). The source for the number of English Dominican houses is the *Digital Atlas of Roman and Medieval Civilization* (DARMC; Gibson et al., 2022). The respective DARMC map is based on Jedin et al. (1987: 59) and Bengtson and Milojčić (1995: 30).

[10] Augustinian canons, Benedictines, Cistercians, Cluniac monks, and Premonstratensians.

mechanism of cultural transmission, it is difficult or, perhaps, impossible to decided on the most appropriate measure of Cistercian influence. This has to be taken into account and is a strong motivation to perform a "specification curve analysis" in order to assess the robustness of the results systematically (Section 4.3.3).

4.2.2 Royal forests as instrumental variable

Andersen et al. (2017: 1777) use the presence of a royal forest in a county as an instrument for Cistercian settlements. They cite Donkin's (1963: 184) observation that

> there is a really significant connection with the Royal Forests; one-third of all the English [Cistercian] houses lay at first within or very near their bounds [...]. In these areas there was a good deal of land of low value for endowments; nonroyal landowners were gravely hampered by the forest laws; and, as elsewhere, prospective founders undoubtedly responded to the willingness of the early generations of monks to exploit rough, undeveloped country.[11]

They then construct a speculative argument that "[a]t the time of arrival the most secluded areas may well have been the forests owned by the Crown" and that "[t]hus, there may well have been a double coincidence of wants": Cistercians were searching for locations satisfying their "ascetic needs" while royal as well as non-royal landowners were hoping for material and spiritual benefits.

The authors use a map published by Bazeley (1921) to obtain data on the location of royal forests in the 13th century and code the presence of a royal forest in a historic county as a dummy variable (Andersen et al., 2017: 1777). They use this dummy as an exogenous regressor in the first stage to predict the Cistercian share. The authors also create a measure of the county area that was covered by royal forest in the 13th century as a share of the total county area (*forest share*) which they include as a control variable (as explained below).

According to the authors' coding, only 5 of 40 counties had no royal forests (cf. Figure 4.2a). The dummy coding is very coarse since the authors use a strict cut-off: e. g. 5 historic counties with less than 1% of their area classified as royal forests are coded as 1 (Kent, Suffolk, Sussex, West Riding of Yorkshire, Devon).[12] Such a coding is not warranted

[11] In light of more recent research, Donkin's quote is possibly an exaggeration. Jones (2010: 39) corrects the view that royal forests were about little else than "royal pleasure" by illustrating, with many examples, the diversity of the forest economy and its importance for local dwellers. According to Christopher Dyer, the enforcement of royal rights were only a minor impediment to the expansion of settlements. While royal interest in hunting "had some inhibiting effect on assarting," royal officials mainly "collected fines in the forest from those who poached the deer or assarted the woods; their activities annoyed the inhabitants, but did not prevent the clearance of new land" (Dyer, 2001: 20).

[12] Considering that Cistercians were granted rights in non-royal forest as well (Langton, 2015: 393), it could be argued that all forests and chases as identified by the more exhaustive survey by Langton and Jones (2010: Figure 1 reproduced in Appendix 4.B) should be used as the basis for measurement construction. In this case, all historic counties would have to be coded as including forests.

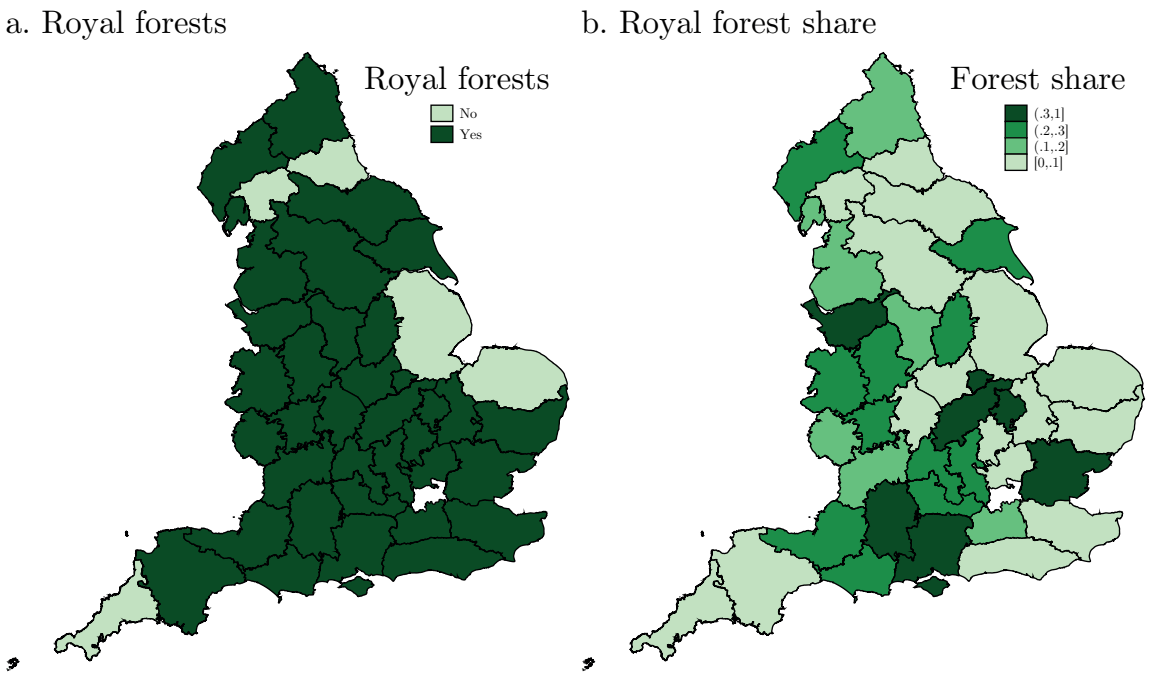


Figure 4.2: Counties with royal forests according to Andersen et al. (2017) based on data obtained from Bazeley (1921). The variable Rforest is dummy coded (left figure). The variable royal forest share (right figure) is a measure of the county area designated as royal forests in the 13th century.

by the precision of the map which is explicitly labeled a "Sketch Map." If we take the forest share variable at face value, the dummy coding still discards important information on the extent of the forests. Closer inspections of, for example, Sussex reveals that the only Cistercian house (Robertsbridge Abbey) was in the Eastern part of the county while the royal forest (0.03 % of the land area) was located at the western border (Figure 4.3). There are multiple counties with marginal forest shares and where Cistercians, albeit present, were located not even close to those forests. The first stage is likely to overstate the relationship between royal forests and Cistercian influence. A continuous metric would factor in that small forest shares are unlikely to affect the composition of monastic orders or the absolute number of Cistercian houses.

The rationale of the IV regressions is to alleviate the problem of endogeneity. The geographical distribution of Cistercian houses might correlate with later population growth for reasons altogether unrelated to the diffusion of work ethics. While the authors establish a historical association between Cistercian settlements and royal forests, they circumvent to explicitly state their reasons to assume that the geographical distribution of royal forests on the county level is (conditionally) uncorrelated with later population growth. The authors themselves are concerned with the possibility that the "use of Rforest as an instrument for the intensity of Cistercian presence [...] might capture resource growth" through deforestation

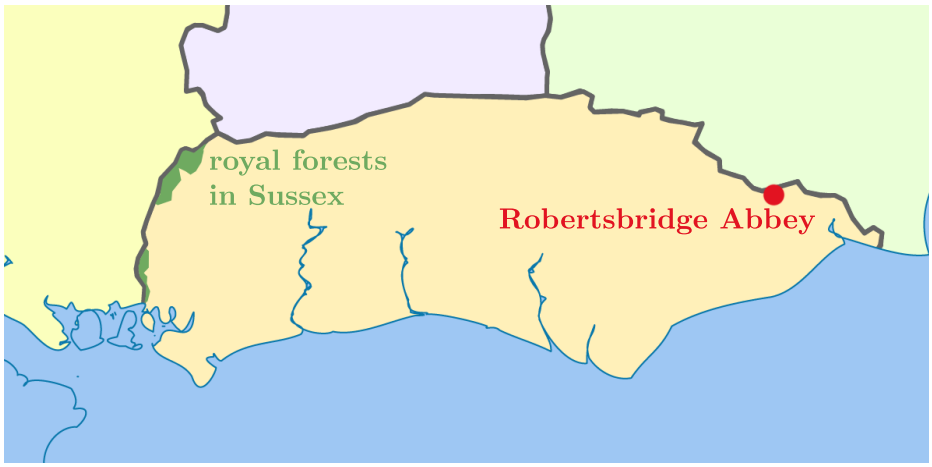


Figure 4.3: The locations of royal forests and Robertsbridge Abbey in the historic county of Sussex. Own work based on a map provided by Wikimedia user Dr Greg.(`https://commons.wikimedia.org/wiki/File:English\_counties_1851\_with\_ridings.svg`) provided under a Creative Commons Attribution-Share Alike 3.0 Unported license. Forest location drawn according to Bazeley (1921).

in later centuries (Andersen et al., 2017: 1777). To alleviate this cause for concern, they add *forest share* as well as a control variable for the suitability of land for pastorialism (Figure 4.4). The authors argue "adding forest share to the control set should make the excludability of Rforest in the second stage plausible." However, since we have no strong reason to believe that areas were randomly designated as royal forests, the five counties with a value of zero on Rforest could share many unobserved features.

Even under the strong assumption that the research design approximates a random experiment conditional on the instrument and the controls, a control group with as few as 5 observations (one-eighth of the total sample) very likely results in an underpowered first stage, i. e. a weak instrument (Staiger and Stock, 1997). The overly strict cut-off criterion for the dummy coding and the resulting small number of cases in the control group advise caution because the first stage might then just introduce new sources of spurious findings, especially if relevance is primarily assessed by significance testing (Gelman and Carlin, 2014).

Instead of using forest share as a control variable it seems even more (or at least equally) appropriate to substitute the Rforest dummy for it in the first stage. In light of the proposed causal channel, it seems reasonable to expect a larger forest area to increase the opportunities for Cistercian settlements and hence predict a larger Cistercian share of all houses. This might reduce the plausibility of the exclusion restriction but the minimization of measurement error is, in my view, an equally important concern.

Because the whole analysis relies on a small sample of 40 cases[13] and hence is susceptible to problems due to unreasonable first stage predictions in even a few cases, it seems desirable

[13]The sample size itself seems quiet problematic given the poor small-sample properties of the IV-estimator when the model is exactly identified (for an instructive simulation see the blog post by Millimet, 2019).

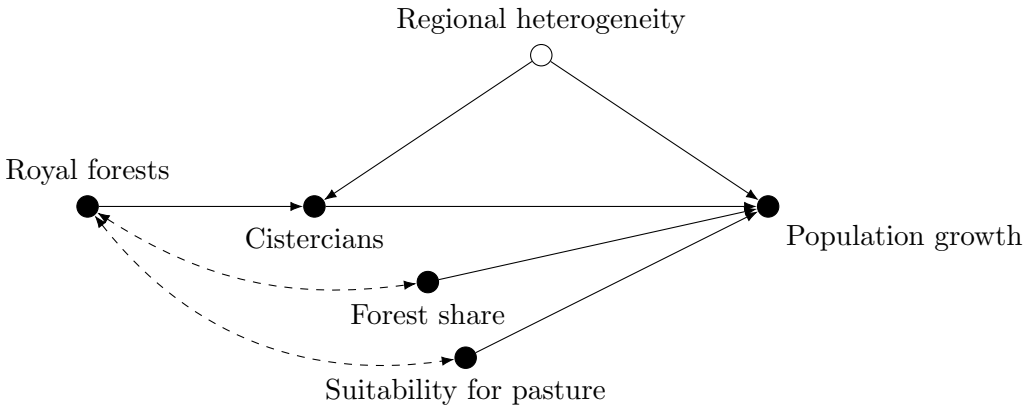


Figure 4.4: Directed acyclic graph summarizing the causal assumption of Andersen's et al. (2017) instrumental variable model. Notation following Morgan and Winship (2014: 77–130): Filled circles indicate observed covariates, hollow circles unobservables; solid, single-headed arrows represent directed causal relationships; dashed, double-headed arrows indicate causal dependencies among variables that are not fully spelled out in the graph.

to have a plausibility (or criterion validity) check. Fortunately, Donkin (1960) identifies all Cistercian houses that, based on Bazeley's work as well as various other historical sources, are known to have been located in royal forests (Donkin, 1960: 42–43 and Figure 1 therein).[14] I use the information provided in his compilation to construct a variable, a count of forest settlements on the county level, called *inforest*. According to my count, there were 19 Cistercian forest settlements located in 16 historic counties.[15] A list of the 19 houses is provided in Appendix 4.A. There is a medium to strong correlation between inforest and the forest share as well as between the share of Cistercian houses located in forests (based on inforest) and the forest share (Table 4.1). The correlation with Rforest is much weaker. None of the Cistercian forest settlements identified by Donkin (1960) were located in counties with less than 10 % forest area even though there were in total 16 Cistercian monasteries in those counties. Therefore, I have some reason to believe that the use of Rforest in the first stage overstates the influence of forests on Cistercian presence.[16]

[14] It should be noted, however, that Bazeley's (1921) map is somewhat outdated. For a more up-to-date survey of English medieval forests see the edited volume by Langton and Jones (2010), especially John Langton's paper "Medieval forests and chases: Another realm?" (Langton, 2010). He compares Bazeley's work with other maps and discusses the problems with the definition and demarcation of "royal forests." Likewise, Donkins work, according to himself, is preliminary "and more detailed work would be required to show precisely how many houses were founded within the bounds" (Donkin, 1960: 42).

[15] Donkin (1960: 42) gives a total of 20 forest houses. He appears to include Stanlow in his total count of forest settlements. However, the monks of Stanlow (Cheshire) later relocated to Whalley Abbey (Lancashire). The former became a grange of the new foundation. In the data used by Andersen et al. only the later location in Lancashire is included in the construction of their Cistercian influence measures.

[16] According to ABDS, their preferred interpretation for why the IV estimates exceed the OLS estimates is a reduction of attenuation bias because "indicators of Cistercian presence are imperfect indicators of the fraction of the population with 'Protestant ethics' " (Andersen et al., 2017: 1780). However, this interpretation seems doubtful given the measurement error in Rforest.

Table 4.1: Correlation matrix.

	Rforest	Forest share	inforest
Rforest	1		
Forest share	0.344	1	
Cist. houses located in forests (inforest)	0.284	0.650	1
Proportion in forests	0.279	0.632	0.826

One can question whether the 2SLS approach is in fact necessary. Following my arguments in section 4.2.1 an absolute measure of Cistercian presence is preferable to the relative measure of Cistercian share. If we believe Andersen's et al. arguments about the association between Cistercian houses and forests, then we could use inforest as a direct measure of exogenous Cistercian presence in counties. ABDS's IV analysis is based on the idea that the presence of royal forests altered the composition of monastic houses. Using inforest directly in an OLS model compares counties that happened to have "excess" Cistercian houses due to royal forests and counties without such exogenously caused Cistercian presence. Alternatively, if it is judged necessary to use Cistercian share as endogenous regressor, the Rforest IV in the first stage can be replaced by either the forest share of a county or the number of Cistercian forest settlement. Both seem preferable to the coarse, dummy coded variable.

4.3 Data and analysis strategy

4.3.1 English county data

The dataset used in the re-analysis is based on the data provided by ABDS (Andersen et al., 2017: Supplementary information Data S1). ABDS combine data from various sources on English historic counties including information on land quality, the extent of Roman roads, or suitability for pasture. The counties' population numbers are estimates taken from Campbell (2008). For more detailed information on the other variables, I direct the reader to ABDS's appendix. The upper part of Table 4.2 reproduces the summary statistics of selected variables from the original article (Andersen et al., 2017: 1771, Table 1). I added the following variables to the English county dataset (for details, see Appendix 4.D).

Inforest. As already described in Section 4.2.2, I add the number of Cistercian monasteries in every county that were located in royal forests according to Donkin (1960).

Rforest2. I modify ABDS's Rforest variable and assign counties with marginal forest shares of less than 5 % a value of 0.

Manors and granges. Furthermore, to test whether the association between the intensity of Cistercian economic activity and population growth is stronger and more robust than the

Table 4.2: Summary statistics: English historic counties.

	Mean	SD	Min	Max	N
Original variables					
Cistercian share	0.09	0.07	0.00	0.25	40
Religious houses	19.03	12.93	2.00	73.00	40
Population density 1377	31.55	11.83	8.98	52.98	40
Population density 1600	29.99	6.46	13.97	43.33	40
Population density 1801	60.45	24.82	20.92	143.77	40
Augustinian share	0.28	0.13	0.00	0.62	40
Benedictine share	0.31	0.16	0.00	0.67	40
Cluniac share	0.04	0.05	0.00	0.15	40
Premonstratensian share	0.05	0.09	0.00	0.50	40
Land quality	0.18	0.16	0.01	0.73	40
New variables					
Cistercian houses in forests	0.47	0.64	0.00	2.00	40
Rforest2	0.60	0.50	0.00	1.00	40
Manors (total)	180.82	95.41	11.00	395.00	40
Cistercian manors	37.13	38.43	1.00	168.00	40
Cistercian granges	10.30	10.49	0.00	48.00	40
CCCP	591.52	524.27	0.00	2421.00	40
Cistercian houses per pop.	0.02	0.02	0.00	0.06	40

relationship of the latter with Cistercian religious presence, I add the counts of Cistercian manors for every historic county from the English Monastic Archives. However, not all manors possessed by Cistercian houses were directly managed by monks or lay brothers. The superior economic efficiency and rational planning are primarily ascribed to directly managed granges (see Section 4.1.2). Hence, I create a second variable counting the number of manors with names containing the word "grange." This is, admittedly, a very rough measure likely to undercount granges due to the existence of different naming patterns. I generate equivalent variables for Augustinians and Premonstratensians based on the English Monastic Archives in order to carry out comparable analyses for those other orders.

Cumulative County-level Cistercian Presence (CCCP). As outlined in Section 4.2.1, CCCP tries to capture the importance of a long and continual Cistercian presence in a given county. For every monastery, its years of duration are calculated from the dates of foundation and dissolution. The years of duration of all monasteries within a county are then summed to produce a county-level variable.

Houses per 100k inhabitants. Another possible operationalization of Cistercian influence pertains to Cistercian presence relative to medieval population size. More monasteries per 100000 inhabitants in the year 1377 indicate a stronger Cistercian influence.

4.3.2 European data

The European-wide datasets have been supplemented with additional information on other religious orders. I added influence measures of three orders (Cluniac reform, Carthusians, Premonstratensians)[17] on the level of the NUTS2 regions. I use the same influence measures that ABDS generated for the Cistercian order: 1) the number of houses in a NUTS2 region; 2) the natural logarithm of the number of houses[18] 3) the number of houses divided by the area of the NUTS2 region (density) 4) a dummy coded variable for presence, taking the value 1 if there was at least one house.

Carthusians. The Carthusians are a monastic order that were founded, like the Cistercians, at the turn of the 12th century. They were not a reform movement within Benedictine monasticism and instead represent a monastic tradition *sui generis* incorporating elements of eremitic life (Hostie, 1983: 53). In contrast to the Cistercians, they have never been associated with the ideal of hard work due to their strict focus on contemplation. Thus they constitute a plausible placebo test: A positive statistical association of past Carthusian influence and contemporary work ethic would indicate that the research design is vulnerable to picking up spurious relationships. The data contains information on 232 Carthusians monasteries that were founded in the sample regions before the 16th century.[19]

Cluniac Reform. The Cluniac Reform (or Reforms) began in Cluny Abbey during the 10th century. It was a movement within Benedictine monasticism to restore traditional monastic life, similar to the Cistercians two centuries later (Hostie, 1983: 48). ABDS write that "similar [to the Cistercians, N. S.] values were found among the Cluniacs" (Andersen et al., 2017: 1761)[20] but their analyses show no relationship between Cluniac influence and population growth in England. Therefore, it seems worthwhile to include them in the European-wide analyses as well.

Premonstratensians. The Premonstratensians are an order of regular canons, founded in the early 12th century. The governance structure of the order was modeled in part on Cistercian principles (Hostie, 1983: 82–83). However, the Premonstratensians are not commonly linked to a strict work ethic. Like the Cluniacs, ABDS include them in their analyses of English historical data. For completeness, I include them in the European-wide analysis as well. There were 529 Premonstratensian houses founded before 1500 in the sample region.

[17] It would have been interesting to include Augustinian Canons as well because there seems to be a robust relationship with early modern population growth in England (see section 4.4.1). However, I was unable to find a suitable gazetteer recording Augustinian foundations in Europe.

[18] They add one to the count of Cistercian houses in each region to avoid zero values from dropping out.

[19] I only include monasteries that were founded before the 16th century because the focus is on the *pre-reformation roots* of work ethics. This effect is most plausible identified by the locations of medieval monasteries. Moreover, the locations of foundations after the reformation are strongly and negatively correlated with the spread of Protestantism.

[20] They cite Max Weber but he refers only to "rational life conduct" in general.

Table 4.3: Summary statistics: European NUTS2 regions.

	Mean	SD	Min	Max	N
Original variables					
Thrift (NUTS2 share/mean)	0.43	0.15	0.00	1.00	241
Hard work (NUTS2 share/mean)	0.47	0.25	0.00	1.00	241
Employment 2007 (log)	13.38	0.71	10.93	15.46	241
GDP 2007 (log)	10.44	0.81	8.30	13.14	235
Area (km^2)	15,323.06	15,266.23	173.00	92,961.00	242
Protestant share	0.29	0.36	0.00	1.00	241
Population 2007 (log)	14.21	0.71	11.73	16.27	242
Cistercian Density	0.00	0.00	0.00	0.00	242
Cistercian Houses	2.69	3.87	0.00	26.00	242
Cistercian Houses (log)	0.97	0.78	0.00	3.30	242
Cistercian Presence	0.74	0.44	0.00	1.00	242
New variables					
Carthusian Density	0.00	0.00	0.00	0.01	242
Carthusian Houses	0.87	2.21	0.00	28.00	242
Carthusian Houses (log)	0.41	0.56	0.00	3.37	242
Carthusian Presence	0.43	0.50	0.00	1.00	242
Cluniac Density	0.00	0.00	0.00	0.00	242
Cluniac Houses	4.49	14.77	0.00	152.00	242
Cluniac Houses (log)	0.72	1.10	0.00	5.03	242
Cluniac Presence	0.41	0.49	0.00	1.00	242
Premonstratensian Density	0.00	0.00	0.00	0.01	242
Premonstratensian Houses	1.93	3.12	0.00	27.00	242
Premonstratensian Houses (log)	0.75	0.75	0.00	3.33	242
Premonstratensian Presence	0.60	0.49	0.00	1.00	242

4.3.3 Analysis strategy

The following analysis replicates and improves upon the research designs used by ABDS. They present four types of analyses: 1) OLS estimates of the relationship between Cistercian presence and population growth in medieval and early modern England 2) IV estimates of the causal impact of Cistercian presence on population growth in medieval and early modern England 3) OLS estimates of the relationship between Cistercian presence and contemporary values regarding the importance of hard work and thrift in Europe 4) OLS estimates of the relationship between Cistercian presence and contemporary economic outcomes in Europe.

However, the speculative nature of the hypothesis under scrutiny, the lack of clear theoretical guidance with respect to operationalizations and model choices as well as the resulting need for *ad hoc* decisions suggest an approach that takes into account model uncertainty and "researcher degrees of freedom" (Simmons et al., 2011). Hence, I conduct a

systematic robustness analysis, a so-called descriptive *specification curve analysis* (Simonsohn et al., 2020). The basic idea is to compute and analyze *all* plausible model specifications with the aim of identifying *critical decisions* that lead to falsification or confirmation. If they correspond to the weakest part of the theory, i. e. confirmatory results can only be obtained with very specific (*ad hoc*) modeling choices, then the reader can weight the evidence accordingly. Similar approaches have been given different names such as "multimodel analysis" (Young and Holsteen, 2017) or "multiverse analysis" (Steegen et al., 2016). What they have in common is a desire to increase transparency given the often vague theories in the social sciences.

It is already common for empirical papers to include numerous robustness checks. Sprawling appendices notwithstanding, robustness checks are usually still an intentional selection from the universe of plausible models. Moreover, sometimes the reasons behind details of specification choices remain opaque. It is, for example, common to vary more than one model property at the same time in robustness checks, even though results may only be robust to specific combinations of deviations from the preferred specifications.[21]

It is important to stress that this is not a rejection of theory guided research. To the contrary, theory still constrains the range of plausible models. The first step is always to identify "the set of theoretically justified, statistically valid and non-redundant specifications" (Simonsohn et al., 2020: 1). However, it is just a matter of fact that theories are often insufficient to deduce the precise specification of statistical models or to choose among competing ways to measure a theoretical construct. The researcher is left with equally plausible subjective decisions. The weaker the theory, the stronger the need for increased transparency. At the same time, nothing prevents researchers from highlighting their preferred specifications.

4.4 Empirical analysis

The section proceeds as follows: The results of the specification curve analysis for the English dataset are presented in Section 4.4.1. Section 4.4.2 consists of a multiverse analysis for the contemporary European-wide dataset.

4.4.1 England: specification curve analysis

The dependent variable in all regression models for England is the natural logarithm of population growth. In ABDS's notation: $\Delta \log(L_{t+1}) = \log(L_{t+1}) - \log(L_t)$ for population

[21] For instance, when presenting alternative specifications for the effect on contemporary values of European citizens, ABDS use the area (km^2) of the NUTS2 region as a control for some operationalizations of Cistercian influence and – without providing a theoretical justification – the logarithm of the area for others (Table 6, p. 1786).

level L of county i and observation time t. This is equivalent to the change in the natural logarithm of population density.[22]

Instrumental variable regression

Table 4.4: Original and alternative reasonable specifications of the instrumental variable model.

Decision	Original specifications	Alternative Specifications
(1) Instrument	Rforest	Rforest2, forestshare, inforest
(2) Endogenous regressor	Cist. share, Cist. presence (0/1)	Cistercians (total) Cist. density, CCCP, Houses per population, Cist. manors, Cist. Granges
(3) Dependent variable	1290–1801, 1377–1801, 1600–1801	

The strongest evidence in favor of a causal relationship between Cistercian influence and regional development are the 2SLS regressions presented by ABDS (Table 4 in Andersen et al., 2017: 1779). In the first stage an endogenous indicator of Cistercian influence is predicted by the instrument Rforest. If π is the Cistercian influence in historic county i, the basic specification can be written as

$$\pi_i = \beta_1 + \beta_2 \text{Rforest}_i + \beta_3 \log(L_{it}/X_i) + \beta_4 M_i + \boldsymbol{Z_i'\beta} + \nu_i \tag{4.1}$$

where M denotes the total number of religious houses, $\log(L_{it}/X_i)$ population density at time t and $\boldsymbol{Z}_i$ is a vector of time-invariant controls for productivity (see also Figure 4.4). The second stage estimates the effect of the exogenous part of the indicator, $\hat{\pi}_i$, on population growth

$$\Delta \log(L_{t+1}) = \gamma_1 + \gamma_2 \hat{\pi}_i + \gamma_3 \log(L_{it}/X_i) + \gamma_4 M_i + \boldsymbol{Z_i'\gamma} + \varepsilon_i. \tag{4.2}$$

ABDS present results for six different IV specifications. Besides the Cistercian share, they also use a dummy of Cistercian presence as endogenous regressor. Furthermore, they vary the time frame of the dependent variable (see Table 4.4). For this systematic robustness check, I consider all four indicators of Cistercian influence introduced by ABDS as endogenous regressors as well as my four additional indicators (see Section 4.3.1). I also use three alternative instruments: Rforest2, inforest and forestshare (see Section 4.2.2). This gives a total of $4 \times 8 \times 3 = 96$ model specifications.

The results of the second stage regressions are shown in Figure 4.5. The first row are

[22] $\Delta \log(L_{t+1}) = \log(L_{it+1}/X_i) - \log(L_{it}/X_i)$ for population level L and area X of county i and observation time t.

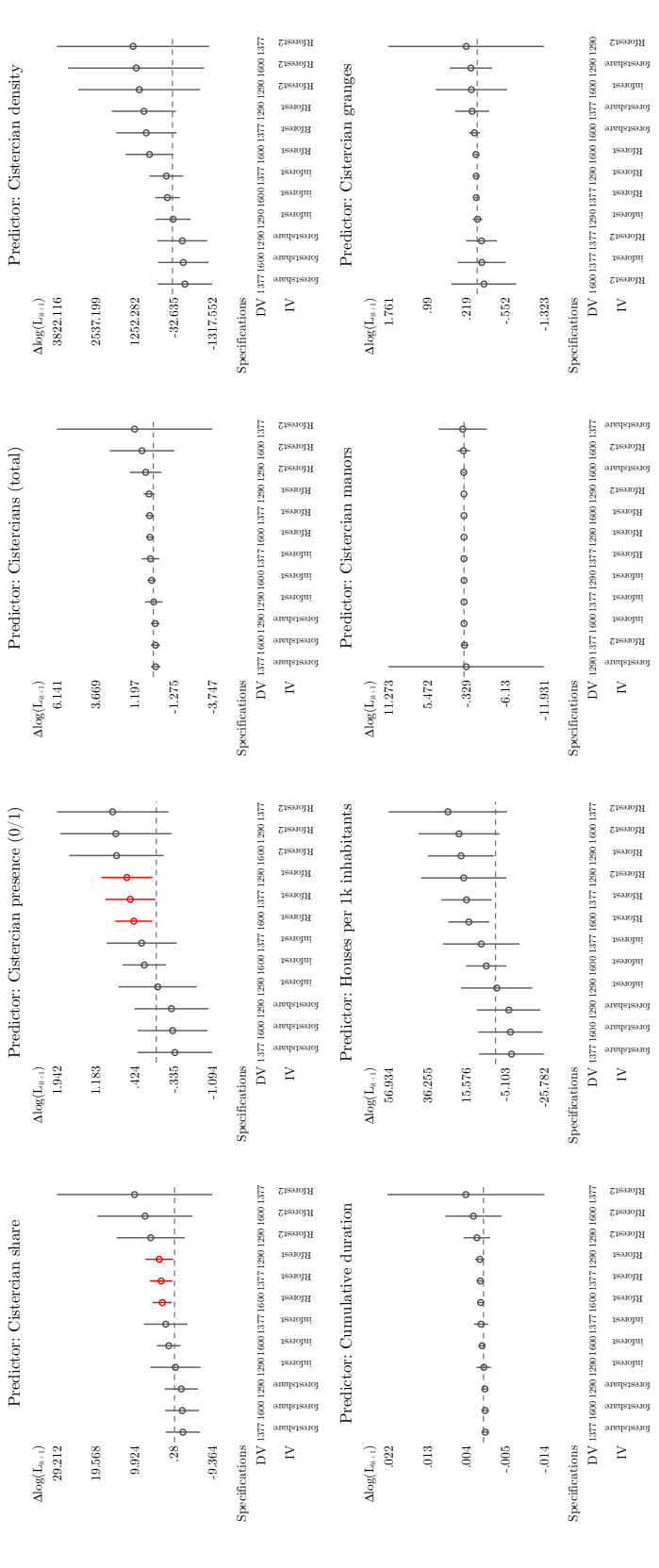


Figure 4.5: Systematic robustness check of S2LS estimates ($N = 40$). The figure shows coefficients (second stage) from 96 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence (the endogenous regressor). The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on heteroskedasticity-robust standard errors. The two lines DV and IV below indicate the specification used to obtain the respective coefficient estimate above. DV gives the starting year of the period with the end point being 1801 in all specifications. The specifications in the original ABDS paper are in red. Exogenous controls included in all models: population density at the start of the period, total number of monasteries, land quality, and the suitability for pasture. Models control for forest share when it is not the excluded instrument.

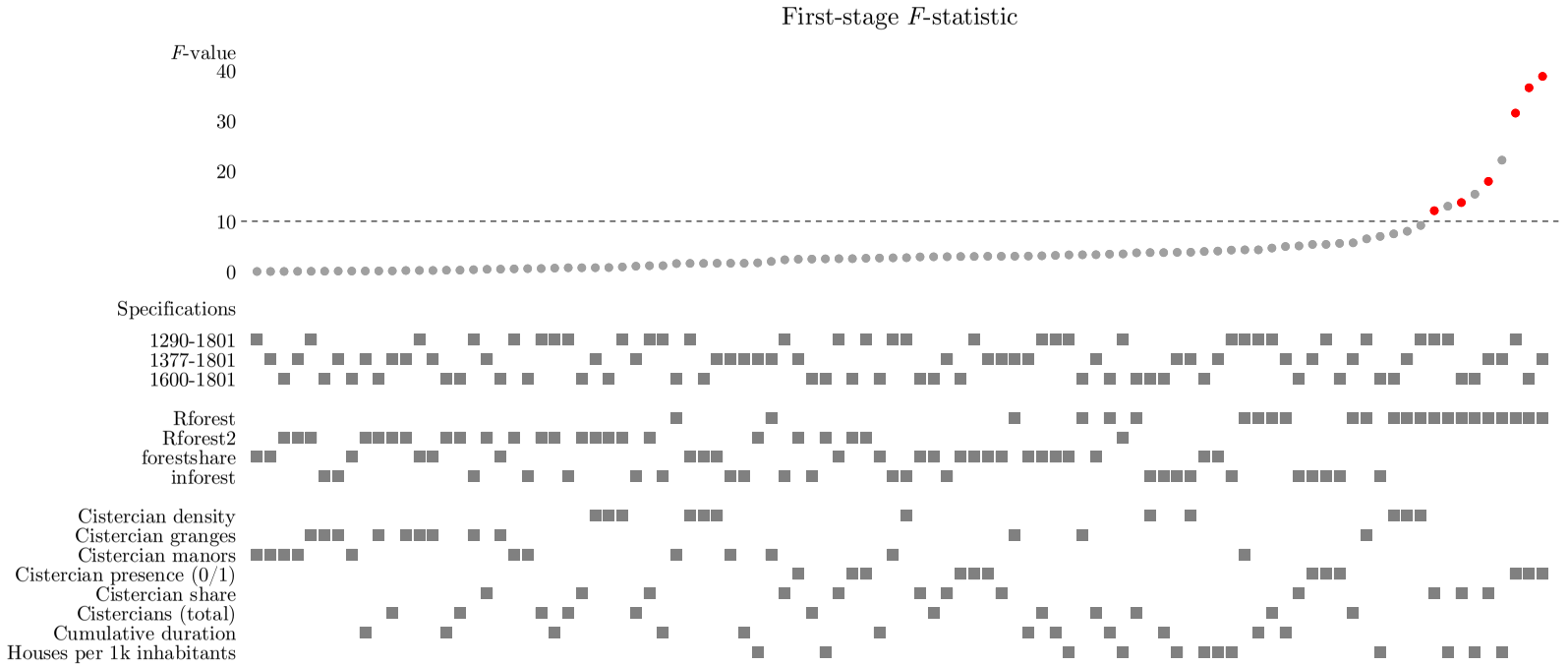


Figure 4.6: First stage F-statistic of 96 2SLS regressions. The F-values are ranked from smallest to largest. The dashed horizontal line at $F = 10$ corresponds to the rule of thumb suggested by Staiger and Stock (1997). F-values of ABDS models are highlighted in red. The squares below indicate the specification characteristics.

the four indicators proposed by ABDS and the second row are my additional four indicators. The 90% confidence intervals correspond to the significance level chosen by ABDS. The six models highlighted in red (Figure 4.5) are the original specifications.

I start with the four indicators in the first row. Only models using, first, Rforest as an instrument and, second, either Cistercian share or a dummy of Cistercian presence produce significant results. Those are exactly the six specifications presented by ABDS. However, some specifications approach significance, e. g. specifications using Cistercian density as indicator and Rforest as IV.

Overall, the most important decision seems to be the choice of the instrument. A clear pattern emerges regarding the IV choice: Using forest share as an IV consistently produces negative, but statistically insignificant, estimates of Cistercian influence on population growth. Using inforest – the actual number of Cistercian houses in forests – leads to very small or null effects. Choosing Rforest and Rforest2 consistently results in estimates with the expected (positive) sign. Rforest2 produces the largest effect sizes – larger than the original Rforest IV – but the estimates are, at the same time, very uncertain as indicated by the wide confidence intervals.

Regarding the second set of indicators in Figure 4.5, it is clear that specification using CCCP (cumulative duration), the number of manors or the number of granges produce small and very uncertain effects regardless of IV choice. Specifications with the number of Cistercian houses per population as endogenous regressor and Rforest2 as IV have positive effects. Again, only models using Rforest as an instrument have positive and significant effects.

In summary, the most crucial decision in order to arrive at positive and significant effects is the choice, of the Rforest instrument whose problems were discussed in Section 4.2.2. Figure 4.6 shows the descriptive specification curve of the first-stage F-statistic for testing the hypothesis that the instrument's coefficient is zero. Only Rforest correlates strongly with some of the endogenous regressors. All other IVs must be considered weak. Most importantly, Rforest2 – albeit leading to some strong positive effects in the second stage – is indeed a weak instrument. Therefore, the strong correlations between Rforest and Cistercian share, the Cistercian presence dummy, and Cistercian houses per population hinge upon the counties with marginal forest shares.

OLS results: inforest

There is yet another possibility to approach a credible estimation of the causal effect. As I have already hinted at in Section 4.2.2, depending on the assumptions, it may be unnecessary to use 2SLS. If the number of Cistercian forest settlements is exogenous, it seems reasonable to simply estimate OLS models with inforest as regressor. This can be rationalized in two

Table 4.5: Reasonable specification choices of the *inforest* OLS model.

Decision	Alternative Specifications
(1) Controls	Include Cistercian houses outside forests (yes/no)
(2) Operationalization	Number of houses or dummy variables
(3) Dependent variable	1290–1801, 1377–1801, 1600–1801

ways: either as the reduced form of the IV models using inforest or as inforest already representing the best approximation of the desired first-stage outcome, i. e. the exogenous variation in the number of Cistercian houses. Therefore, I estimate the OLS model

$$\Delta \log(L_{t+1}) = \beta_1 + \beta_2 \text{inforest}_i + \beta_3 \log(L_{it}/X_i) + \beta_4 M_i + \boldsymbol{Z_i'\beta} + \varepsilon_i \tag{4.3}$$

including the same controls as in the previous specifications. This model involves (at least) three challengeable decisions (Table 4.5). It could be argued that the models should include the number of Cistercian houses outside forests as well, for their presence may have affected the propensity of Cistercian foundations in forests (see Figure 4.18 in Appendix 4.C for a DAG presentation of the causal structure). Moreover, since there are only three counties with two settlements and thirteen with one, it could be reasonable to use a dichotomized variable instead. Most trivially, the model can be estimated for all three observation periods.

Figure 4.7 presents the relevant coefficients of the 12 ($2 \times 2 \times 3$) resulting models. None of these approached significance at the 10% level. Comparing the coefficients of models M4–M6 as well as M10–M12 suggests that Cistercian presence outside forests is more reliably associated with later population growth than Cistercian presence inside forests. The former association cannot be interpreted as strong evidence in favor of a causal effect because the possibility of unobserved confounding was the motivation for using IV estimation in the first place.[23]

General OLS results

The bottom line of the previous section is that it proved difficult to convincingly estimate a causal effect of Cistercian presence on population growth. The small sample size severely limits the usefulness of more sophisticated methods and arguments. In light of this, it is worthwhile to briefly revisit the general OLS estimates of ABDS:

1. If the relationship between Cistercian presence and population growth is robust to arbitrary specification choices, the hypothesis is at least not falsified by the best available historical data.

[23] It could be argued that the weaker effect of inforest in models M10–M12 can in part be attributed to the smaller number of such houses (19 or 38 % of all Cistercian foundations).

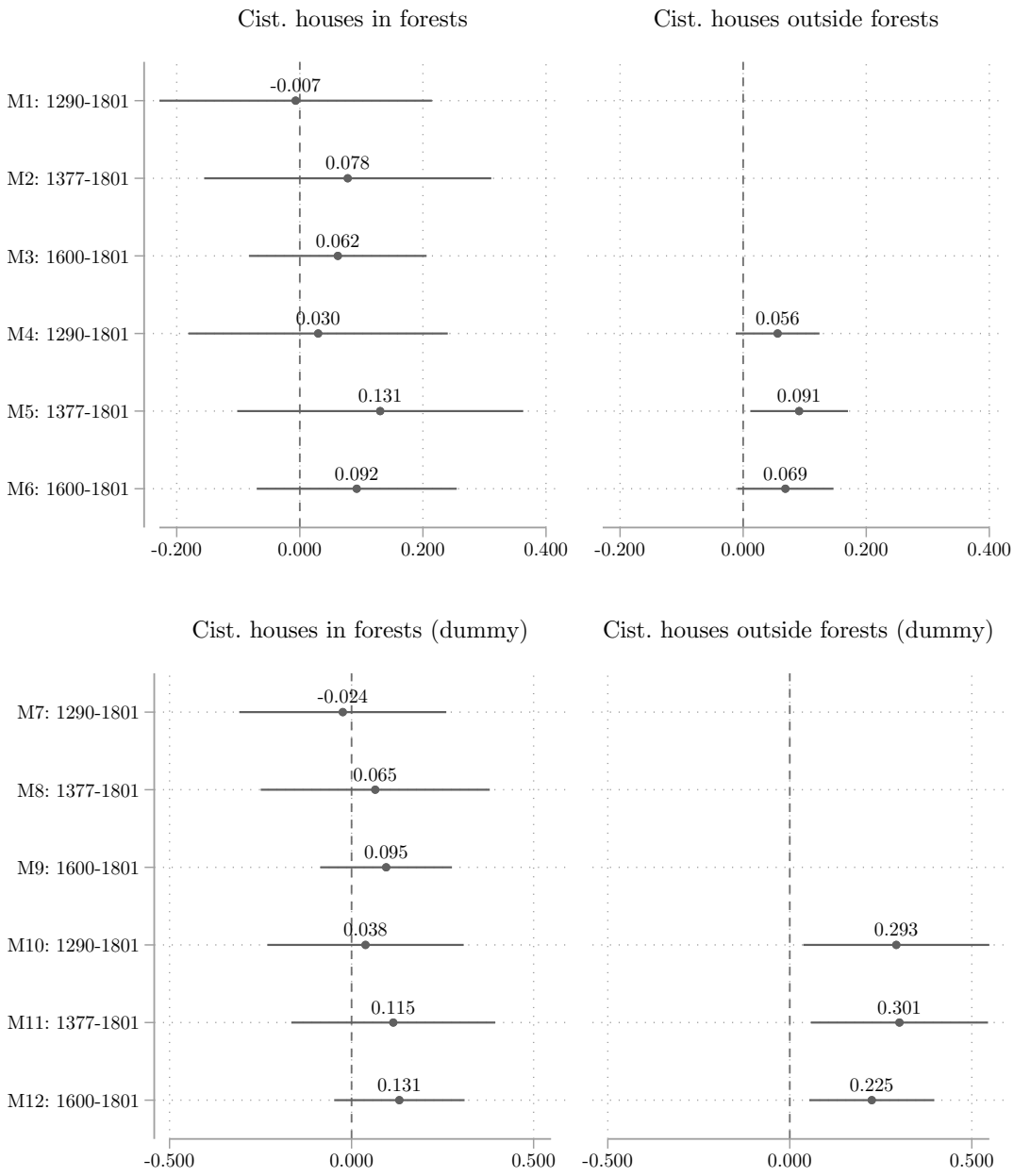


Figure 4.7: Results of OLS regressions ($N = 40$). The figure shows coefficients of 12 specifications. The upper subfigure shows results for models that use the number of monasteries. The lower subfigure shows results for models that use dummy variables. Bars indicate the 90% confidence interval based on heteroskedasticity-robust standard errors. Exogenous controls included in all models: population density at the start of the period, the total number of monasteries, land quality, the suitability for pasture, and forest share.

Table 4.6: Reasonable specifications of the OLS model.

Decision	Alternative Specifications
(1) Controls	Land quality, Rivers (length/area), County area (log), Coal, Coastal (= 1), Roman Road density (length/area,) Suitability for pasture (% of area), Literacy rate 1851
(2) Cistercian influence indicator	Cist. share, Cist. presence (0/1), Cistercians (total), CCCP, Houses per population, Cist. density, Cist. manors, Cist. Granges
(3) Dependent variable	1290–1801, 1377–1801, 1600–1801
(4) Region fixed effects	Yes/no (8 regions)

2. The theory brought forward by ABDS will gain additional plausibility if the relationship is unique to the Cistercian order, i. e. all other orders do not show a robust correlation with population growth.

3. Lastly, ABDS provide evidence for a correlation of contemporary value orientations and former Cistercian settlements in Europe. Again, if this correlation is robust to specification choices as well as unique to the Cistercian order, this, in combination with the historical evidence from England, should at least be considered an interesting puzzle.

The OLS specifications are based on Table 2 and Table 3 (Andersen et al., 2017: 1773, 1776). ABDS used four indicators of Cistercian presence, ten control variables in various combinations, and region fixed effects.[24]

All models of the specification curve analysis include two basic controls: First, the population density at the start of the growth period. Second, either the total number of religious houses or the total number of manors (if the indicator is Cistercian manors or granges). Table 4.6 gives an overview of the remaining decisions. In principle there are $2^8 \times 8 \times 3 \times 2 = 12,288$ combinations. However, the small sample size limits the usefulness of certain model choices. More specifically, I exclude all combinations that results in fewer than 27 residual degrees of freedom.[25] That means, I do not estimate models with fixed effects that include more than two additional covariates besides the two basic control variables. Moreover, because data on the literacy rate in 1851 is not available for 3 counties, the analysis does not include models with the full set of controls. The effective number of estimated models is 6,648. The descriptive specification curves in Figure 4.8 and 4.9 give a very rough

[24] Admittedly, these choices do not constitute the complete "multiverse" of plausible specifications. ABDS report additional variants in the online appendix of their article, e. g. concerning the functional form of initial population density.

[25] This threshold is somewhat arbitrary. ABDS only report models with at least 28 degrees of freedom.

overview of the results. I start by focussing on Figure 4.8 which displays results on ABDS's four indicators.

The figures allow some very general conclusions. First, the sign of the effect is consistently positive. Second, the average size of the point estimates is comparable to the reported effect sizes in Tables 2 and 3 (Andersen et al., 2017: 1773, 1776). The average effect size of the coefficients of the dummy variable for Cistercian presence is 0.229, close to the 0.262 reported by ABDS in their baseline specification. The average effect size of Cistercian share is 1.440, almost similar to the effect size reported by ABDS for the model with full controls in Table 3 (1.562). The number of Cistercian monasteries in a county ("Cistercians (total)") – my preferred indicator – has an average effect size of 0.066, slightly lower than the estimates reported by ABDS (0.084 and 0.088). Third, there is variation in the effect size as well as the certainty of the estimate. If statistical significance is used as the decisive criterion for judging the relevance of effects, model choice matters. Fourth, we can identify some patterns determining effect sizes and standard errors. The choice of the dependent variable seems to have the most consistent influence. For example, almost all of the larger and significant estimates for Cistercian share and Cistercians (total) can be found in models using the 1377–1801 growth period as dependent variable. However, these patterns are not consistent across indicators. For example, with respect to the dummy indicator, large effects are found mainly in models using the 1290-1801 period.

The results depicted in Figure 4.9 are broadly consistent with the general conclusion noted in the last paragraph. The results for Cistercian manors and granges are of special interest because they are intended to test a different causal mechanism (see Section 4.1.4). By and large, the relationship between these indicators of Cistercian economic (rather than spiritual) activity and later population growth does not seem to be more robust and less variable than the indicators proposed by ABDS. The point estimates of both indicators even turn negative for certain specifications. At the same time, the 133 positive coefficients with the smallest p-values are all from models estimating the effect of Cistercian granges. What these models have in common is the 1600–1801 growth period as dependent variable and that county area is not in the set of controls.[26] Grange coefficients tend to be small or negative for regressions 1) modeling the 1290–1801 growth period 2) controlling for everything except suitability for pasture. Although not more robust than the original indicators, the high rate of significant results for the coefficient of Cistercian granges still suggests the rational management of agricultural resources as a possible alternative channel of Cistercian influence.

Before drawing a final conclusion about the English medieval case, I want to consider one last analysis. The question is: Is this positive, albeit highly variable, relationship unique to the Cistercian order? ABDS present some robustness checks in their appendix. They

[26]There are still significant, but slightly smaller estimates for the grange coefficient in models controlling for area.

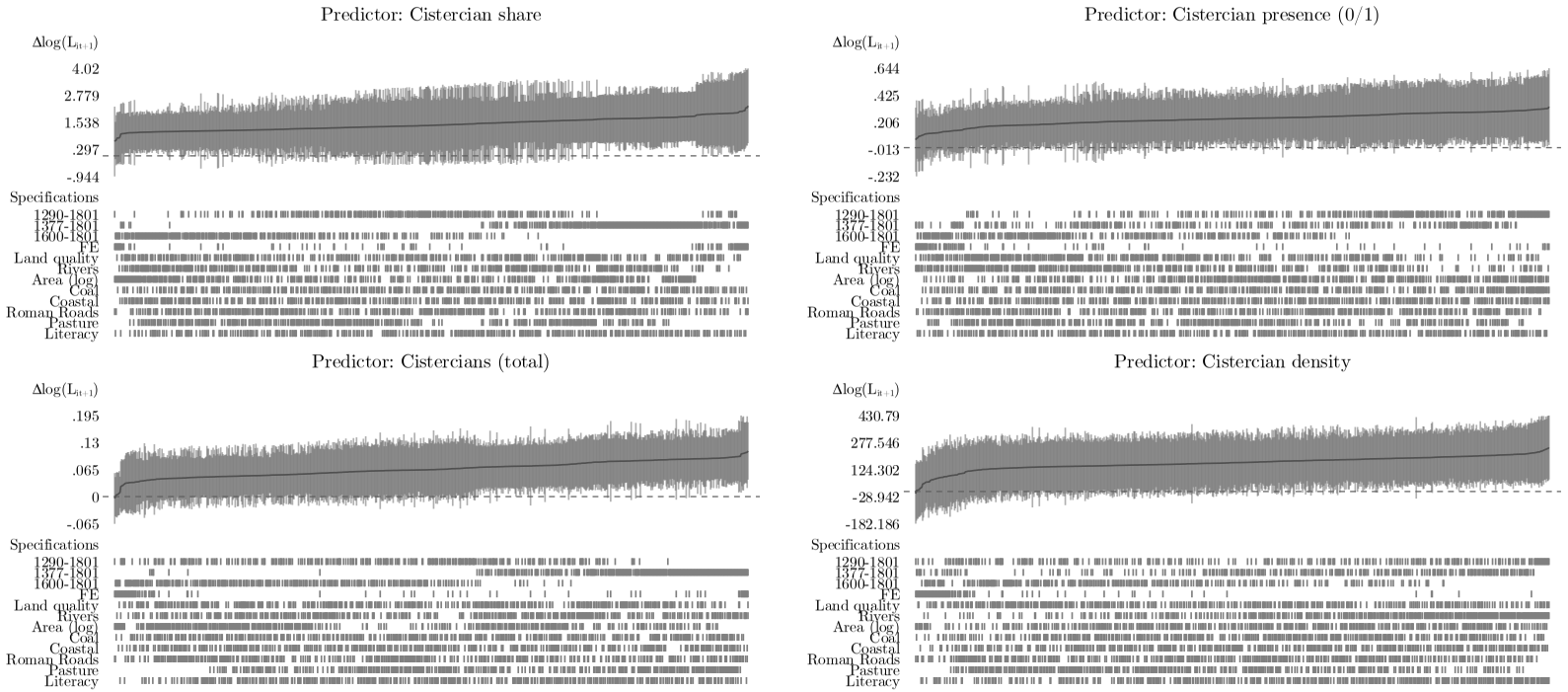


Figure 4.8: Systematic robustness check of OLS estimates ($N = 40$). The figure shows coefficients from 3324 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on heteroskedasticity-robust standard errors. The bars below indicate the specification choices for each model (see Table 4.6). The first three rows indicate the dependent variable. The fourth row indicates whether regional FE are included or not. Rows five to twelve indicate whether a respective covariate was included as a control.

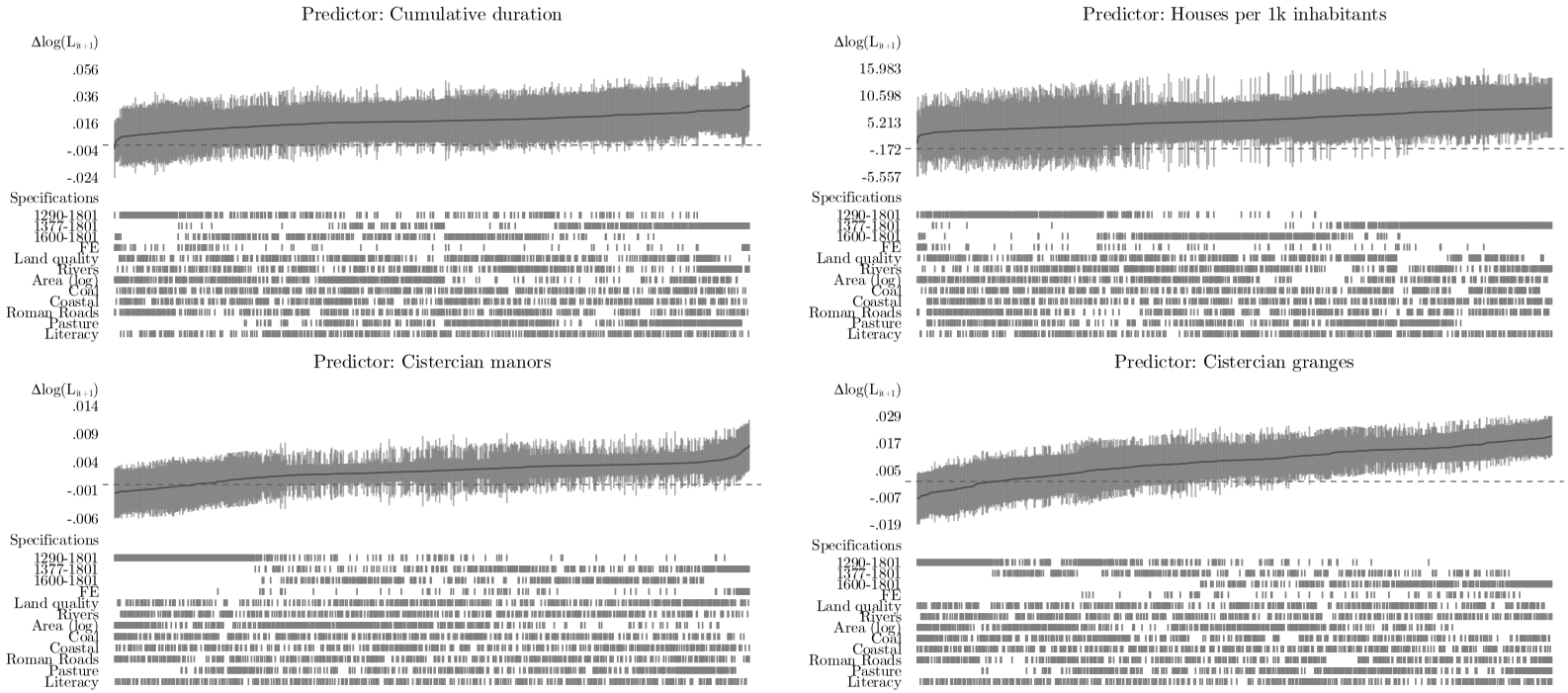


Figure 4.9: Systematic robustness check of OLS estimates ($N = 40$). The figure shows coefficients from 3324 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on heteroskedasticity-robust standard errors. The bars below indicate the specification choices for each model (see Table 4.6). The first three rows indicate the dependent variable. The fourth row indicates whether regional FE are included or not. Rows five to twelve indicate whether a respective covariate was included as a control.

replace the Cistercian share with the Benedictine share of all monastic houses in Table C3. And in Table C4 they "include the Cistercians alongside the Augustinians, the Cluniacs, the Premonstratensians as well as the Benedictines; only the Cistercians appear to be correlated with population growth over the period" (Andersen et al., 2017: 1775). However, there is multiverse of possible models for each of these orders that can be systemically studied.

Therefore, I replicate my specification curve analysis except that I replaced the indicators for Cistercian influence with the corresponding indicators for the Augustinian canons. The results can be seen in Figures 4.10 and 4.11. Without spending too many words on the details, the overall picture is not too different from the previous finding, i. e. there is a consistently positive effect across all indicators. Some effects are on average smaller, others are larger. The mean coefficient of the Augustinian dummy is 0.569, double the size of the Cistercian dummy, and statistically significant on the 10 %-level in 86 % of the specifications. As Table 4.7 illustrates, it would be easy to compile a set of confirmatory models including manifold – though selective – robustness checks. Moreover, it is easy to rationalize the choices. For instance, it makes perfect sense to use the 1290–1801 growth period as a baseline because almost all English Augustinian houses were founded before 1290 (203 of the 209 houses in the dataset).

I am not insinuating that ABDS intentionally "p-hacked" their results or were intentionally reporting only confirmatory results. I am merely stressing the difficulty of assessing a general hypothesis with scarce historical data that are very open to different interpretations.

Now it is true that ABDS derived their hypothesis about the Cistercian influence from a (speculative) theoretical argument. Accordingly, one might be willing to assign a higher prior probability to the association of Cistercian presence and population growth to be causal. In contrast, there is no theoretical justification to believe that the Augustinians were conductive to local economic development. Nonetheless, the findings relating to the Augustinian "placebo treatment" could mean that testing the ABDS hypothesis in this way is prone to false positive results.

4.4.2 Evidence from contemporary Europe

Lastly, and very briefly, I will partially re-analyze the European-wide data provided by the authors of the original article. ABDS proceed in two steps: First, they estimate the relationship between indicators of past Cistercian presence and contemporary values using the 2008–10 wave of the European Values Study (EVS). Further analyses test whether past Cistercian presence is correlated with current economic growth and higher employment levels.

The EVS models regress *individual* values on *regional* indicators of past Cistercian presence. More specifically, the indicators are computed for the NUTS2 subregions where

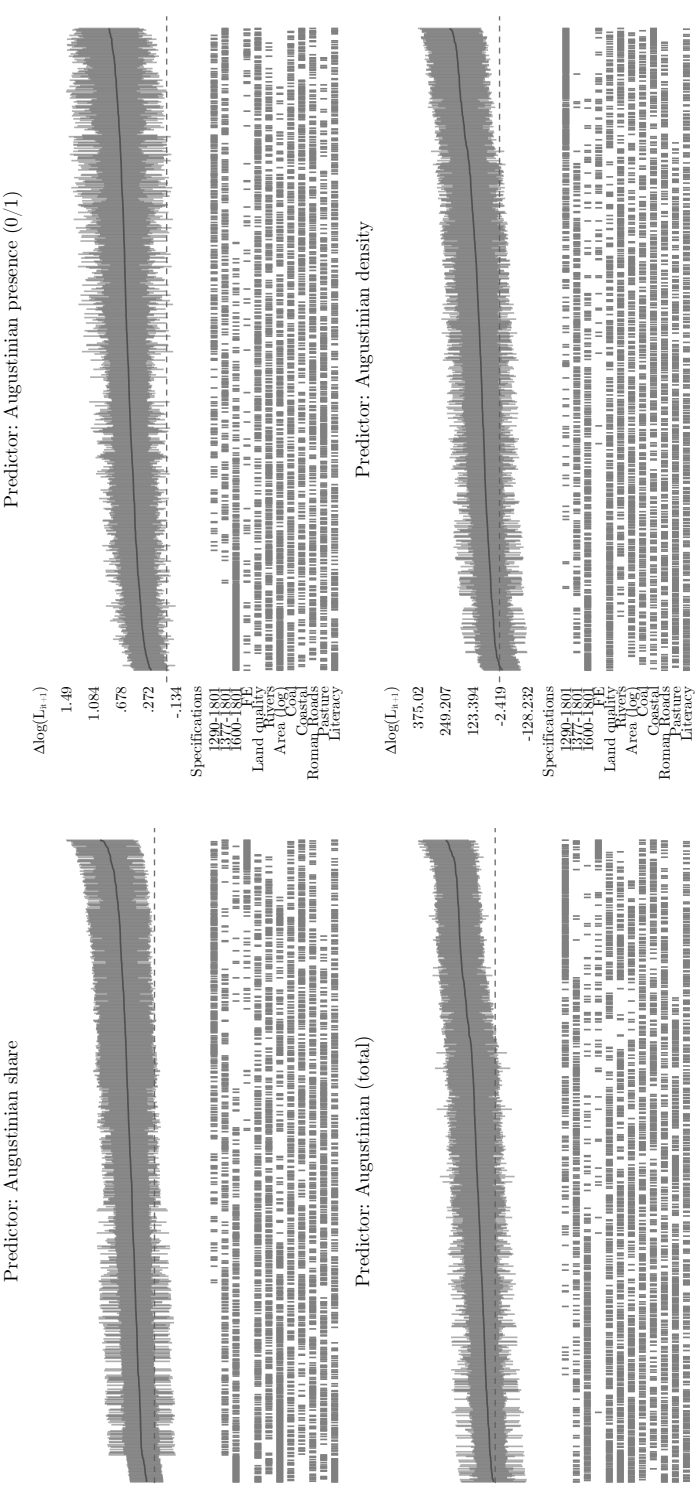


Figure 4.10: Systematic robustness check of OLS estimates ($N = 40$). The figure shows coefficients from 3324 model specifications. Each sub-figure shows results for a different indicator of Augustinian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on heteroskedasticity-robust standard errors. The bars below indicate the specification choices for each model (see Table 4.6). The first three rows indicate the dependent variable. The fourth row indicates whether regional FE are included or not. Rows five to twelve indicate whether a respective covariate was included as a control.

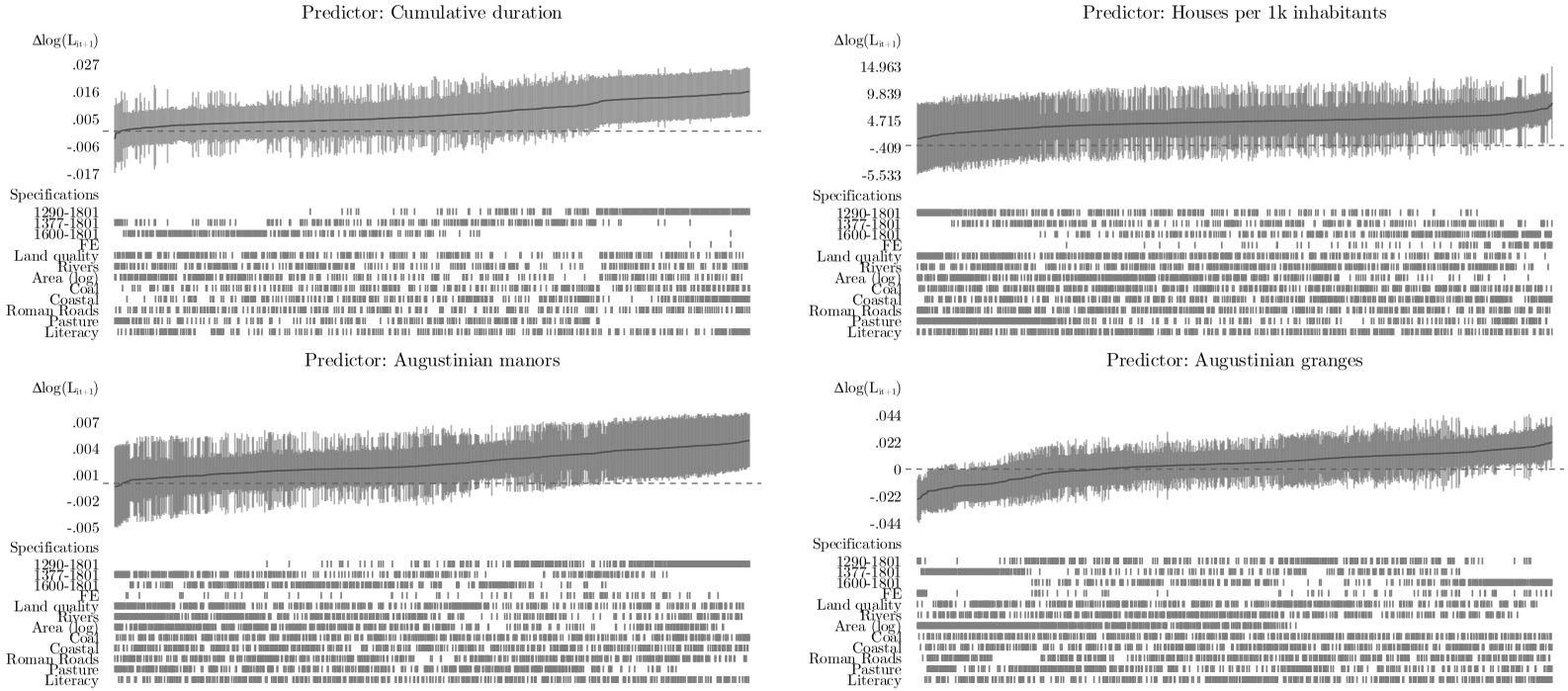


Figure 4.11: Systematic robustness check of OLS estimates ($N = 40$). The figure shows coefficients from 3324 model specifications. Each sub-figure shows results for a different indicator of Augustinian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on heteroskedasticity-robust standard errors. The bars below indicate the specification choices for each model (see Table 4.6). The first three rows indicate the dependent variable. The fourth row indicates whether regional FE are included or not. Rows five to twelve indicate whether a respective covariate was included as a control.

Table 4.7: Selected OLS models of Augustinian influence. Column names indicate the starting year of the time period under consideration (1290–1801 or 1377–1801). The table lists unstandardized regression coefficients with heteroskedasticity-robust standard errors in parentheses.

	(1) 1290	(2) 1290	(3) 1290	(4) 1290	(5) 1377	(6) 1290	(7) 1290
Augustinian houses	0.057**				0.043+	0.060**	0.078**
	(0.020)				(0.022)	(0.018)	(0.024)
Augustinian share		1.088+					
		(0.579)					
August. presence (0/1)			0.773*				
			(0.342)				
Augustinian density				160.878*			
				(67.122)			
Pop. density 1290 (log)	−1.037**	−1.056**	−1.002**	−1.157**		−1.140**	−1.010**
	(0.175)	(0.171)	(0.168)	(0.176)		(0.190)	(0.196)
Relhouses	−0.016**	−0.002	−0.005	−0.005	−0.015*	−0.013*	−0.028**
	(0.006)	(0.005)	(0.004)	(0.004)	(0.006)	(0.006)	(0.010)
Land quality	−0.326	−0.282	−0.530	−0.334	−0.606*	−0.381	−0.392
	(0.316)	(0.317)	(0.356)	(0.324)	(0.243)	(0.301)	(0.296)
Pop. density 1377 (log)					−0.779**		
					(0.208)		
Coastal (=1)						−0.114	−0.075
						(0.144)	(0.145)
Roadshare (length / county area)						3.753+	3.624+
						(1.990)	(1.964)
Rivers (length/area)						−0.579	−0.633
						(2.201)	(2.061)
Cistercians							0.107*
							(0.049)
Constant	4.223**	3.996**	3.493**	4.431**	3.457**	4.424**	3.981**
	(0.591)	(0.596)	(0.590)	(0.570)	(0.710)	(0.600)	(0.617)
N (counties)	40	40	40	40	40	40	40
R^2	0.709	0.717	0.738	0.712	0.603	0.729	0.758

+ $p \leq 0.1$, * $p \leq 0.05$, ** $p \leq 0.01$. Robust standard errors in parentheses.

Data source: Andersen et al. (2017) and English Monastic Archives.

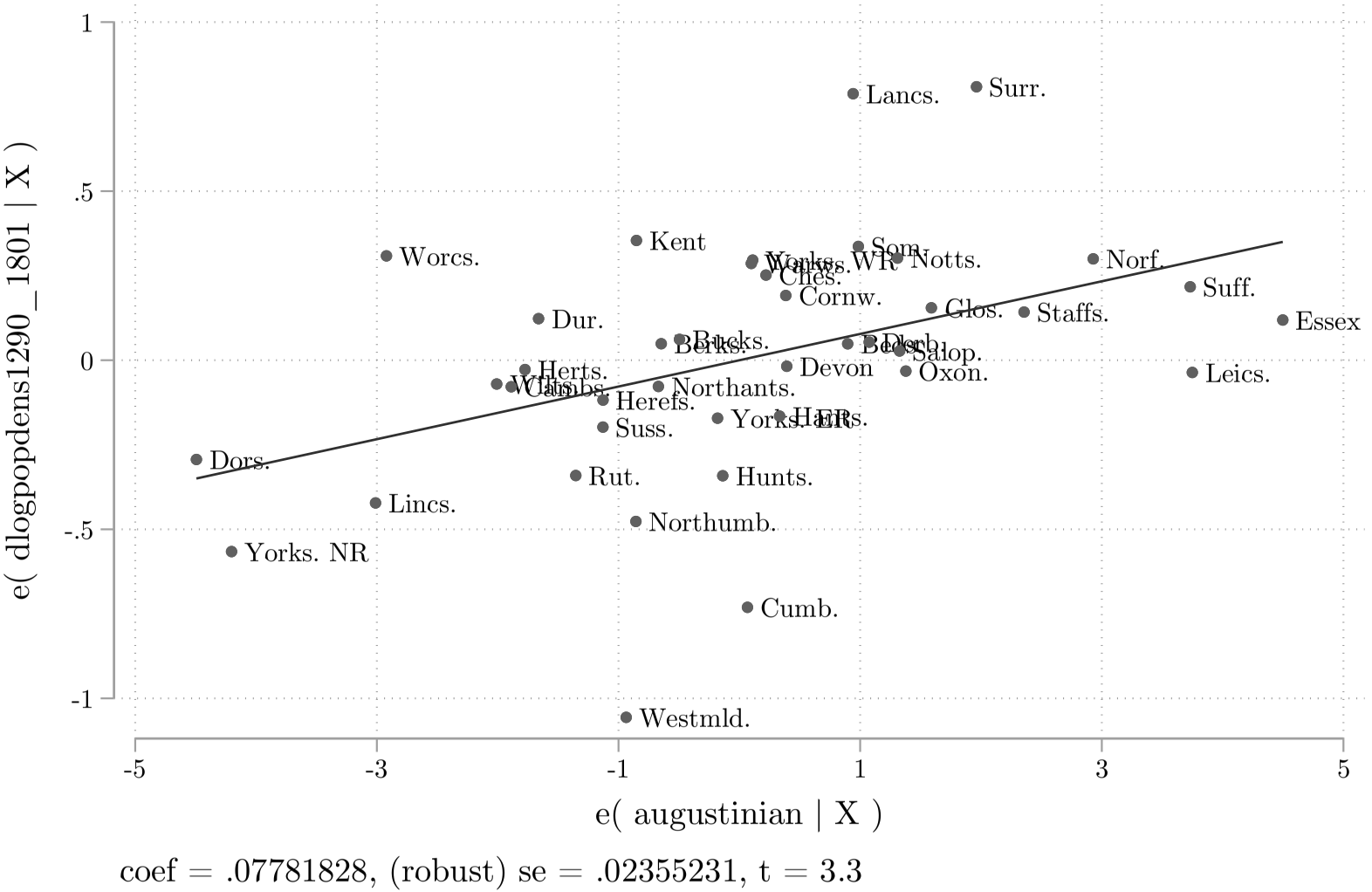


Figure 4.12: The partial correlation between Augustinians and population growth, 1290–1801. The plot illustrates the regression results reported in Table 4.7, column (7).

Table 4.8: Original and alternative reasonable specifications of "Values in Europe" model.

Decision	Original specifications	Alternative Specifications
(1) Influence Indicator	Density, presence (0/1), # houses, # houses (log)	(same but all combinations)
(2) Order	Cistercians	Carthusians, Cluniac, Premonstratensians
(3) Baseline controls	Yes/no	(same but all combinations)
(4) Religion dummys	Yes/no	(same but all combinations)
(5) Area	Area, area (log)	(same but all combinations)
(6) Sample	Full, Catholics and Orthodox	Catholics only
(7) Model	OLS	Probit

respondents resided at age 14. The dependent variables are answers to two yes/no-questions: whether individuals value hard work (henceforth *hardwork*) and whether they value thrift. It turns out that, controlling for individual characteristics of the respondents, only the relationship with hard work is robust. I focus on the latter in order to keep this section short.

ABDS estimate linear probability models (LPM) with the binary response as dependent variable. In total, there are four indicators of past Cistercian presence at the regional level. The three controls included at the regional level are NUTS2 units' area (in some models the natural logarithm of their area) and the absolute latitude as well as longitude of the NUTS2 units' centroids. They include individual level controls (*baseline controls*) for age, age squared and dummy variables for the attributes male, married, and educational attainment. Additionally, they include dummies for religious adherence in some regression models. Lastly, they include country fixed-effects.[27]

I modify, add and exclude certain choices for the specification curve analysis, namely: I add data on three other orders as explained in Section 4.3.2. Moreover, since the dependent variable is binary, the specification curve analysis estimates every specification as an LPM as well as a probit model. I report average marginal effects for the latter kind of models. There is also a small inaccuracy in the original model description. ABDS write they "sometimes restrict the sample to Catholics only" (Andersen et al., 2017: 1783, notes to Table 5), even though their syntax file reveals that they use a sample compromised of Catholics as well as Orthodox respondents.[28] Therefore, I re-estimate the models with the combined

[27] ABDS use standard errors clustered at the country level. Since the model assumes that the treatment is assigned at the NUTS2 level, it could be argued that standard errors should be clustered at the regional level as well (Abadie et al., 2017). I refrain from doing so in order to stay close to their original approach. However, I note that clustering at the lower level increases standard errors across the board (results not shown).

[28] They never discuss this particular choice. What is more, the exclusion of Protestants is based on the idea that their agreement with the values of hard work and thrift might be the results of the diffusion of the "Protestant Ethic" *sensu* Weber (Andersen et al., 2017: 1782). However, Weber stressed the general

sample as well as the exclusively Catholic sample. However, I do not estimate models with a sample restricted to England and neither do I exclude respondents for Midland "when this is an outlier" (p. 1785).[29] Table 4.8 summarizes the specification decisions. In total, there are $(4 \times 4 \times 2 \times 2 \times 2 \times 3 \times 2) - 256 = 768 - 256 = 512$ reasonable specifications per dependent variable according to the choices listed in Table 4.8. 256 model variants are redundant because it is unnecessary to include dummies for religious adherence if the sample is exclusively Catholic.

The results are shown in Figure 4.13. The coefficient of Cistercian influence is positive across all four operationalizations. With the exception of the binary presence indicator, Cistercian presence consistently exhibits the strongest relationship with the value of hard work compared to the other three orders. In the cases of density and number of houses, most coefficient estimates for Cistercian presence are many times larger than for other orders as well as statistically significant at the 10% level. Moreover, effect sizes of those two indicators are stable across models, e. g. the average coefficient estimate for Cistercian houses is 0.0038 within a range of 0.0029 (min.) to 0.0048 (max.). Hence, one additional Cistercian house in the NUTS2 region of childhood residence increases the probability of valuing hard work by approximately ca. 0.3 to 0.5 percentage points.[30] The coefficient estimates for Carthusians tend to be negative and are strongest for the binary indicator as well as the natural logarithm of houses.

I deem this robust pattern across different specification as the strongest evidence so far in favor of the "Cistercian ethics" hypothesis, especially because the Cistercians are the only order that consistently shows such a clear, positive relationship. However, the reader has to keep in mind that the evidence for the other dimension of work ethics, thrift, is much weaker (see Figure 4.14). The coefficient estimates for the Cistercian influence indicators are not statistically significant, not always positive, and not consistently larger than the estimates for other orders.

Economic Outcomes

The last step in ABDS's line of argument is the connection to contemporary economic outcomes: employment and GDP growth in European regions. They hypothesize that

diffusion of the Capitalist Spirit beyond the initial adherents of Calvinism. At the same time ABDS chose England for their historical case study. England is a predominantly Protestant country and ABDS nonetheless claim that regional differences in economic development can be explained by past Cistercian presence. It seems arbitrary to argue that the lasting influence of Cistercian values is not detectable in the contemporary European Protestant population even if the Protestant respondents were socialized in a region whose general culture still reflects past Cistercian influence.

[29] Since the findings for historical England are weak in my opinion, this sub-sample analysis is of lesser interest.

[30] The average marginal effects produced by the probit models are instantaneous rates of change and only approximate the unit change.

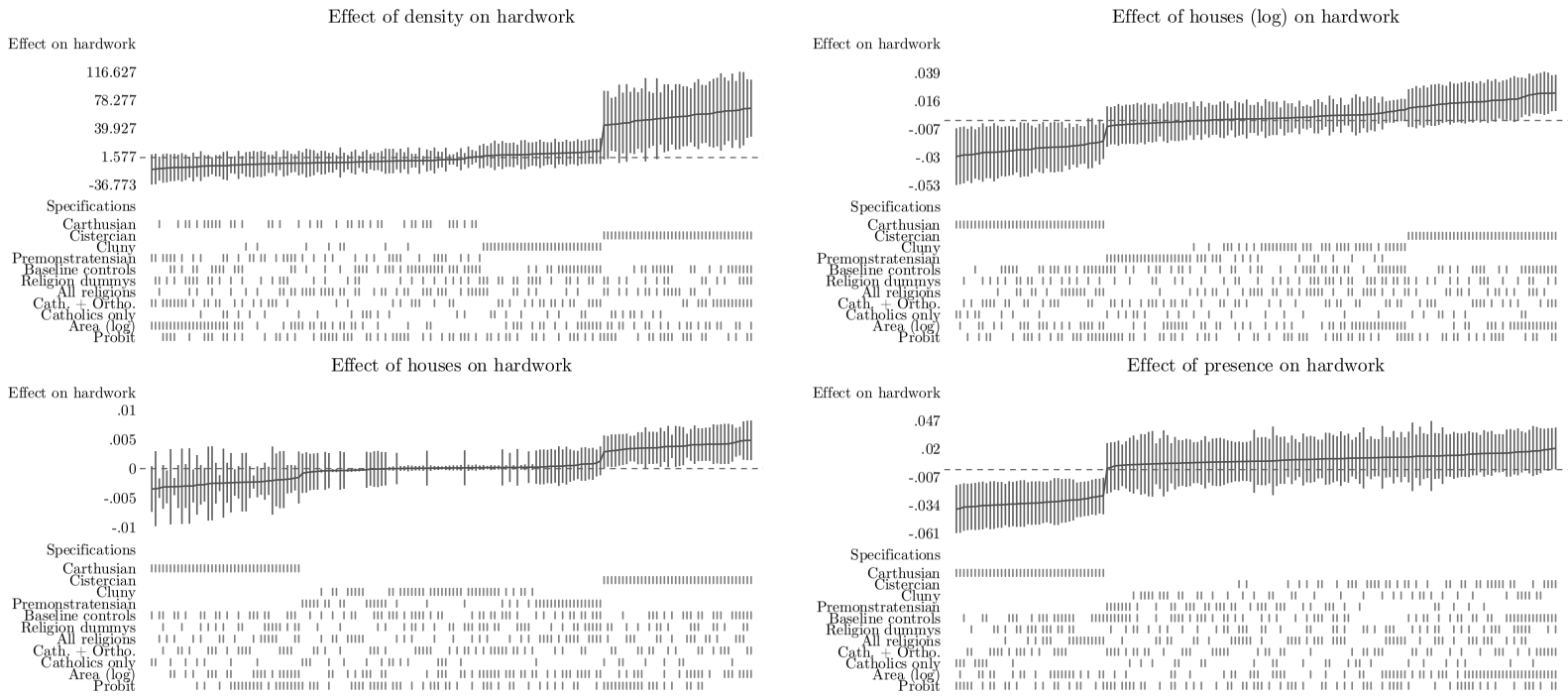


Figure 4.13: Systematic robustness check of OLS and probit estimates. The figure shows coefficients from 640 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on clustered standard errors. Estimates for probit models are based on average marginal effects. The sample size varies from 18,083 (subsample with only Catholics, full model with FE, regional, and baseline controls) to 32358 (full sample, basic model with FE and control variable for NUTS2 area). The bars below indicate the specification choices for each model (see Table 4.8). The first four rows indicate the order whose historic influence is being tested. The fifth row indicates whether individual level baseline controls are included. The sixth row refers to the inclusion of dummies for respondents' religious adherence. The seventh to ninths rows indicate the religious composition of the (sub-)samples. The tenth row indicates if the NUTS2 area is included in natural (km^2) or logarithmic units. The eleventh row indicates whether probit models rather than LPM are estimated.

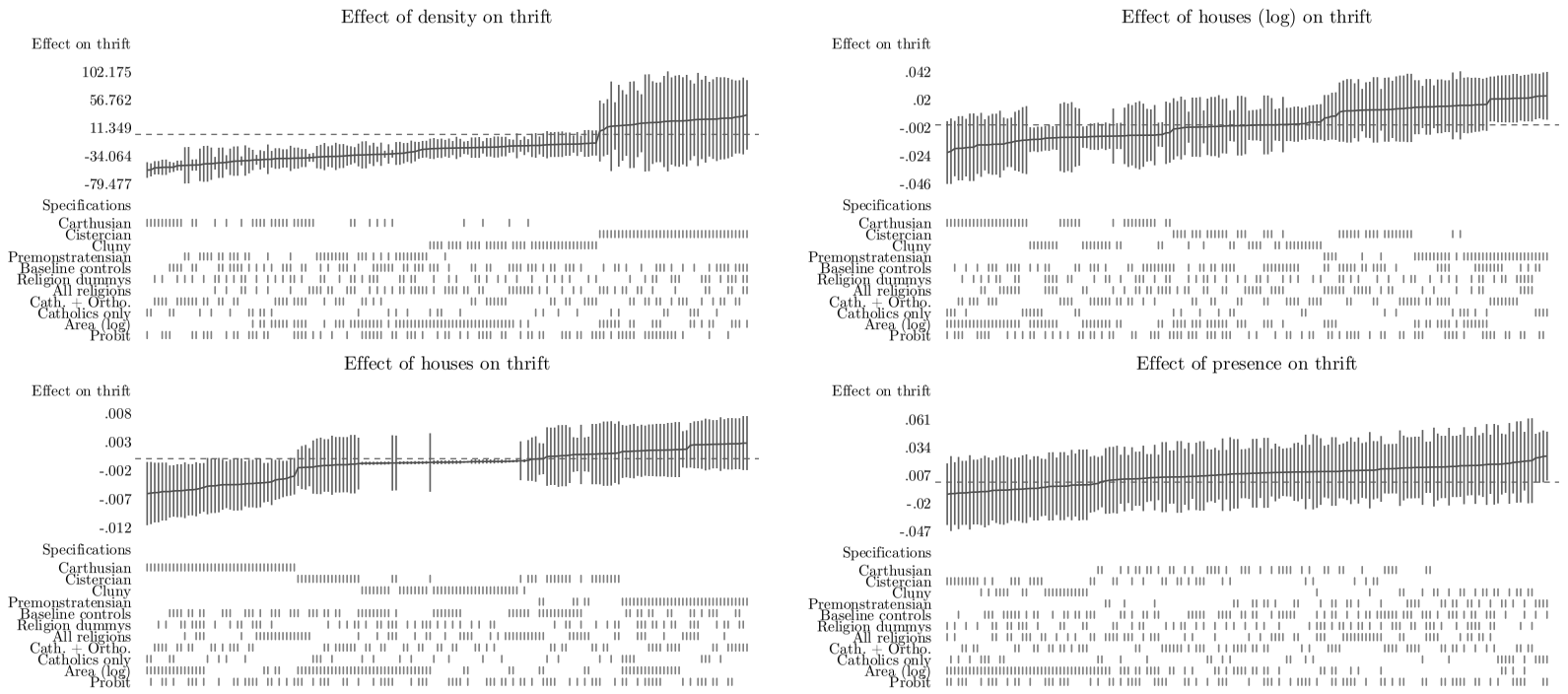


Figure 4.14: Systematic robustness check of OLS and probit estimates. The figure shows coefficients from 640 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on clustered standard errors. Estimates for probit models are based on average marginal effects. The sample size varies from 18,083 (subsample with only Catholics, full model with FE, regional, and baseline controls) to 32358 (full sample, basic model with FE and control variable for NUTS2 area). The bars below indicate the specification choices for each model (see Table 4.8). The first four rows indicate the order whose historic influence is being tested. The fifth row indicates whether individual level baseline controls are included. The sixth row refers to the inclusion of dummies for respondents' religious adherence. The seventh to ninths rows indicate the religious composition of the (sub-)samples. The tenth row indicates if the NUTS2 area is included in natural (km^2) or logarithmic units. The eleventh row indicates whether probit models rather than LPM are estimated.

Table 4.9: Original and alternative reasonable specifications of economic outcome models.

Decision	Original specifications	Alternative Specifications
(1) Influence Indicator	Density, presence (0/1), # houses, # houses (log)	(same but all combinations)
(2) Order	Cistercians	Carthusians, Cluniac, Premonstratensians
(3) Baseline controls	Yes/no	(same but all combinations)
(4) Area	Area, area (log)	(same but all combinations)
(5) Level 1 unit	NUTS1	Country
(6) Estimator	Fixed effects	Random effects

Cistercian historical influence should increase the absolute employment of regions but not their GDP (Andersen et al., 2017: 1790).[31] I focus on the positive relationship between past Cistercian presence and the regional employment.

The units of analysis are 234 NUTS2 regions. ABDS estimate OLS regressions with the natural logarithm of employment in 2007 as dependent variable. As before, the main predictors are indicators of Cistercian presence at the regional level. Controls include the population size (log), area or area (log), fixed-effects for NUTS1-level regions, and a set of baseline controls. The latter are the average age of the local population as well as longitude and latitude of the region. Besides the standard set of theoretically interesting predictors (fours indicators of past presence of four orders) I systematically vary the operationalization of a region's area (ABDS sometimes use the natural logarithm of the area), the level 1 unit (NUTS1 or country), and the estimator (fixed effects vs. random intercept).[32] The standard errors in all models are clustered at the country level.

In total I compute $4 \times 4 \times 2 \times 2 \times 2 \times 2 = 256$ models. However, I exclude random intercepts models when a Hausman-like test indicates that the level 2 effects are not distributed independently of level 1 covariates. More specifically, because the Hausman test assumes homoskedasticity while the models assume clustering at the country or NUTS1 level, I use the generalized robust test as implemented with the Stata command `xtoverid` (Schaffer and Stillman, 2006). I exclude random intercepts models if the null hypothesis is rejected at the 10% significance level. That leaves me with 231 models for employment as dependent variable (and 195 for GDP growth).

As can be seen in Figure 4.15, results are mixed but largely confirm a stable positive

[31] "Incipient labour productivity differences, and thus wage differences, are what theoretically drives mobility, leading to a reallocation of employment. In this process, labour productivity is reduced in the high productivity regions due to diminishing returns" (Andersen et al., 2017: 1790). However, there is a positive and significant relationship with GDP growth in some plausible model specifications (see Appendix 4.E).

[32] Especially when using NUTS1 regions as level 1 units, there are many level 1 groups (89) with few observations (between 1 and 7). In this situation, fixed-effects may overfit the data within each region (Gelman and Hill, 2006: 253).

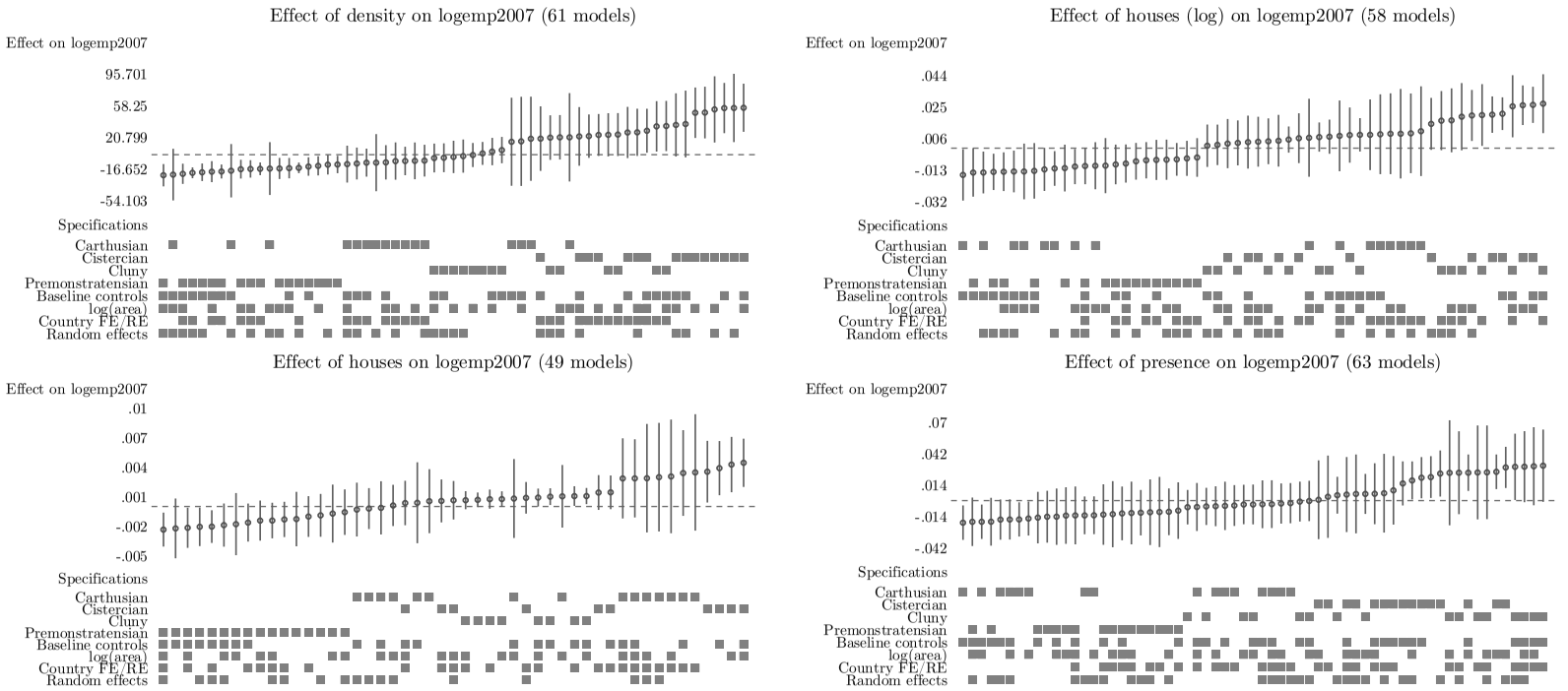


Figure 4.15: Systematic robustness check of OLS and random intercepts estimates ($N = 234$). The figure shows coefficients from 231 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence. The point estimates are ranked from weakest to strongest effect with bars indicating the 90% confidence interval based on clustered standard errors. The squares below indicate the specification choices for each model (see Table 4.9). The first four rows indicate the order whose historic influence is being tested. The fifth row indicates whether regional level baseline controls are included. The sixth row indicates if the NUTS2 area is included in natural (km^2) or logarithmic units. The seventh row shows whether countries or NUTS1 regions are the level 2 units. The eighth refers to the choice of (country/NUTS1) fixed or random effects (random intercepts).

association between historic Cistercian influence and employment. The sign of the Cistercian effect is always positive. However, the effect size varies considerably within the different operationalizations, depending on the exact specification. For example, including country FE instead of NUTS1 tends to produce smaller coefficients for Cistercian indicators. The most important comparison is the contrast to other orders. Past Cistercian presence is consistently among the strongest effect sizes across all indicators. Historic Cluniac influence is likewise associated with employment and has coefficients of comparable size for three of the four indicators (number of houses being the exception). Hence, the positive association between employment and past Cistercian influence is not as outstanding as in the case of the individual level analysis of attitudes towards hard work. Indicators of Premonstratensian presence tend to have negative coefficient signs.

4.5 Conclusion

The general result of my re-assessment is that we should be far less certain about the "pre-reformation roots" of a strict work ethic than ABDS want us to believe. The evidence is mixed and correlational in nature. The specification curve analysis of the IV results for England revealed the original results to depend on a disputable operationalization of the instrument. In summary, all attempts to estimate a causal effect using a credible research design have failed to produce strong confirmatory evidence.

At the same time, there is a stable and strong association between Cistercian presence and population growth across most OLS models. But considering that I am able to find equally strong and stable associations for at least one other order – the Augustinian canons –, it seems advisable to be cautious in interpreting the results as evidence for the diffusion of Cistercian values. This is especially true given the highly speculative nature of their theory. The estimated associations could be the result of confounding by other unobserved factors.

The most plausible indicator pertaining to Cistercian economic activity (granges) shows a strong positive relationship with population growth in many plausible specifications. The finding is consistent with the hypothesis that the association between Cistercian presence and population growth is driven by the diffusion of technological and managerial practices rather than work ethics. Since granges were often administered by lay brothers and choir monks, this association could still be the result of attitudes toward work spreading to the surrounding population – it is not decisive evidence – but the Cistercians' more tangible actions to increase the effectiveness of their agrarian estates are well documented (Lekai, 1977: 293–297).

The correlation between past Cistercian presence and the contemporary value of hard work merits further research, though it seems imperative to establish the causal channel more directly, e. g. to connect the contemporary pattern to historical growth processes.

Weber motivated his Protestantism thesis *inter alia* by pointing out that predominantly Calvinist and Puritan regions in Europe like England, the Netherlands and Geneva were the "most advanced economically" (Weber, 2005: 5). Likewise, one of the reasons ABDS choose to study England's historical development is that it "later turned out to be the epicentre of the industrial revolution" (Andersen et al., 2017: 1757). However, the core area of the Cistercians before and after the Reformation was France with at least 241 foundations until 1500 according to my own data. The question naturally arises why France did not industrialize earlier.

Moreover, it should be noted that ABDS themselves fail to find evidence for a causal path from contemporary values to employment. Including the share of respondents in a region that value hard work and thrift respectively, both coefficients are small and insignificant. At the same time, the coefficient of Cistercian presence, irrespective of operationalization, is undiminished by their inclusion (Andersen et al., 2017: Appendix C, Table C12). Since the Cistercian influence on contemporary employment levels is not mediated by contemporary value orientations, it becomes more difficult to make sense of the totality of findings.

The study also has to be placed in the context of other research. It is my impression that the literature on the interrelation of religious values and economic growth should proceed more systematically. For example, research by Akçomak et al. (2016: 824) found no connection between Cistercian presence and economic growth in the early modern Netherlands (see Appendix 4.G for a brief re-examination with regard to the Cistercians). Instead they argue that the religious movement of the *Brethren of the Common Life* (BCL) stimulated human capital accumulation during the early Renaissance. Dutch cities with BCL presence had higher rates of literacy and higher levels of book production. They also find evidence of an impact on city growth. A cynic might wonder whether we can find at least one order or religious movement in every European country whose geographic distribution correlates with regional patterns of economic growth for some time period. Kelly (2019) raises the possibility that many results from the literature on regional economic persistence are the outcome of "fitting spatial noise." However, given the central role of Christian institutions in European history, it still seems possible that their cultural legacy left a measurable imprint on regional development. In my view, this research question has to be addressed in a systematic manner and, importantly, without overstating the theoretical guidance available to the analyst of historical data. The general lessons apply more widely to research in economic history and historical social research:

- We need data on as many orders in as many countries as possible. This reduces the dangers of small samples, in which a correlation can easily be the result of random variation.
- We have to combine different pieces of evidence. Andersen et al. (2017) as well as

Akçomak et al. (2016) should be applauded for their efforts to back the proposed mechanisms with additional evidence like survey results on values (Andersen et al.) or network data as well as data on literacy and book production (Akçomak et al.). However, this may not be enough and especially the role of qualitative historical evidence should be reconsidered.

- We have to take historical scholarship seriously. The theoretical and historical discussion revealed that certain aspects of the Cistercian doctrine have been selectively construed and presented in a misleading way. Social scientists[33] should read historical research extensively and be aware of the ambiguity of historic sources, the pitfalls of over-generalization, and changes in the consensus among historians. I am, of course, not objecting to the need for abstraction and simplification in quantitative historical research.

- We should stress the legitimate role of exploratory research. Describing an interesting phenomenon or hinting at possible explanations with purely "correlative" evidence is important work as long as the authors are transparent about the limitations of their theory and evidence. This kind of work is preferable to overly confident claims about causation that obfuscate the irrobustness of the underlying results. The toolkit of causal analysis is nonetheless indispensable because it allows to identify the limitations of exploratory work.

- Sometimes withstanding the pressure to produce causal estimates can be conductive to research quality. When in fact feasible, "causal" research designs can be invaluable tools. But the combination of correlational evidence based on high quality data, a strong theory, and qualitative historical case studies can be superior to a merely ritualistic applications of IV regressions. This is especially true when they discourage the search for additional data sources.

- Weak theories should be accompanied by systematic robustness checks. Results might be vulnerable to slightly different *ad hoc* decisions on a forking path (see e. g. Steegen et al., 2016).

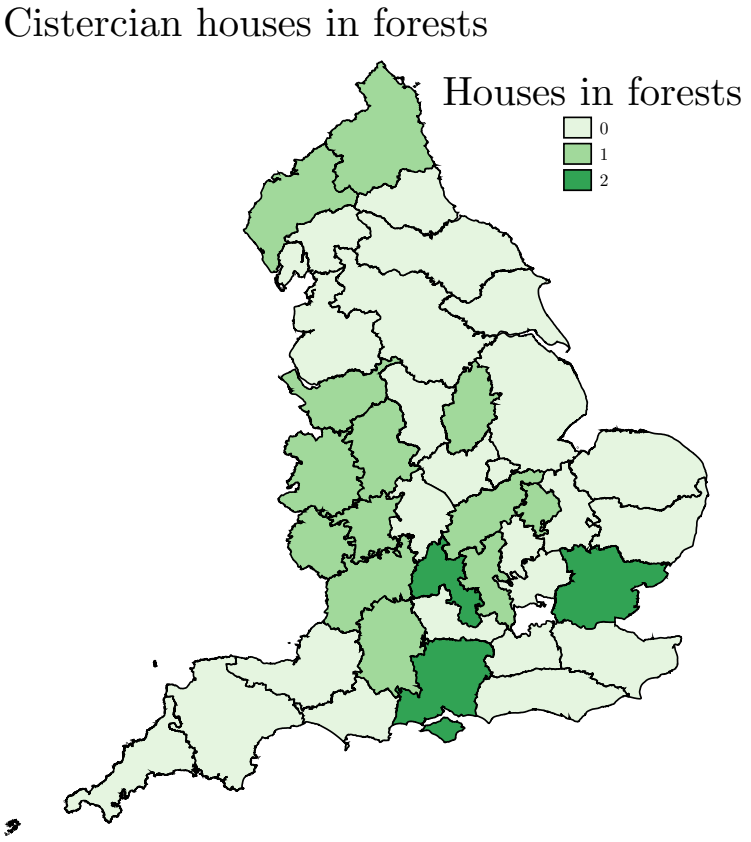
[33] That includes economists.

4.A List of forest settlements

Table 4.10: List of Cistercian monasteries that were located in royal forests according to Donkin (1960). I exclude Stanlow Abbey (Cheshire) as explained in footnote 15.

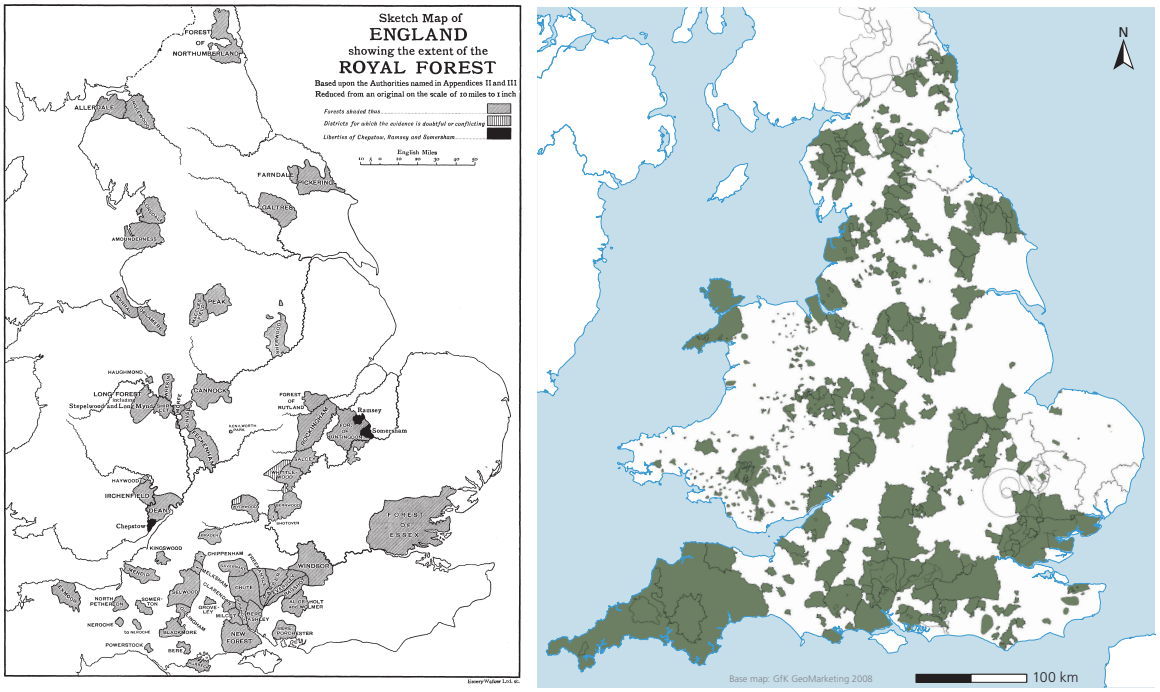
	Name in Andersen et al. data	Historic county
1.	Beaulieu	Hampshire
2.	Biddlesden	Buckinghamshire
3.	Bordesley	Worcestershire
4.	Buildwas	Shropshire
5.	Coggeshall	Essex
6.	Dore	Herefordshire
7.	Flaxley or Dean	Gloucestershire
8.	Holm Cultram	Cumberland
9.	Netley or Letley or Edwardstow	Hampshire
10.	Newminster	Northumberland
11.	Pipewell	Northamptonshire
12.	Radmore	Staffordshire
13.	Rewley	Oxfordshire
14.	Rufford	Nottinghamshire
15.	Sawtry	Huntingdonshire
16.	Stanley	Wiltshire
17.	Stratford Langthorne or West Ham	Essex
18.	Thame	Oxfordshire
19.	Vale Royal	Cheshire

Figure 4.16: Spatial distribution of Cistercian houses located in forests according to Donkin (1960).



4.B Medieval forests and chases

Figure 4.17: Extent of royal forests according to (one the left) Bazeley (1921) and the extent of medieval forests and chases according to (on the right) Langton and Jones (2010: Figure 1). I thank Graham Jones making a digital version of his map available to me.



4.C Alternative DAG

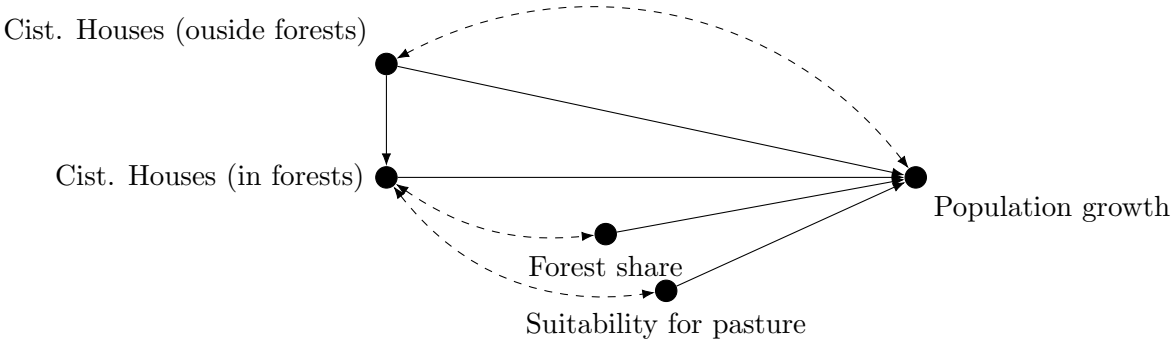


Figure 4.18: Directed acyclic graph summarizing the causal assumption of the OLS model in Section 4.4.1. The presence of Cistercian forest settlements is affected by the number of Cistercian houses outside forests. The coefficient of the latter cannot be causally interpreted due to unobserved confounding (the reason for using IV estimation in the first place).

4.D Data

Manors and Granges

Information about manors was taken from the English Monastic Archives (`https://www.ucl.ac.uk/history/research/english-monastic-archives`). The EMA contain information on monastic properties. The database distinguishes four types of properties: churches, chapels, manors, and urban property. In total, there are 1872 Cistercian properties, of which 1500 are manors. The EMA do not contain complete and systemic information on duration of tenure (e. g. start and end date). Therefore, the figure reflects the total number of manors that have been owned by the Cistercians (or other orders, respectively) at some point in time. The EMA has information about the county in which the manor was located. I use this information to create a count variable at the county level.

I identify Granges based on their name, selecting properties containing "Grange" or "grange." 27.87% (418) of the Cistercian manors are coded as granges. As expected, the share of Manors whose name contains "Grange" is significantly higher among the Cistercians than among all other orders. Only three properties not classified as manors contain the word "grange." These are churches that were located on corresponding manors. I create a count variable of manors named "grange" at the county level.

European Carthusians

The list of all charterhouses was taken from the database on the Analecta Cartusiana webpage (`http://analecta.chartreux.org/catalogue.php`). The Analecta Cartusiana is a series of books on the history and spirituality of the Carthusian monks. Entries on monasteries do not give coordinates. Hence, I geocoded all locations of monasteries founded before the 16th century myself based on the information provided (e. g. by looking up the location in Google Maps). When historical sites were not easily identifiable, I used additional material such as old maps. In a few cases in which I was unable to research the exact location, I recorded the coordinates of the respective municipality as given by Google Maps. Using a shapefile of the 2006 NUTS regions, I counted the number of charterhouses within the boundaries of each NUTS 2 region (2006 version) based on the geocoded entries.

European Cluniacs

In contrast to the Cistercians, the Congregation of Cluny was a lose federation of monasteries without a clear formal structure. Hence it is difficult to assess the membership of houses. The locations of all "Cluniac sites" were taken from the Clunypedia mapping project (`https://clunypedia.com/map`). I downloaded all database entries (state at 2021/05/26) and kept sites classified as priory, abbey, cell, ermitage, or college. The cleaned dataset has

entries on 1255 monastic communities in the sample region that were founded or reformed by Cluny up until 1500. Using a shapefile of the 2006 NUTS regions, I counted the number of monastic communities within the boundaries of each NUTS 2 region (2006 version) based on the coordinates provided by the Clunypedia project.

European Premonstratensian

The locations of the Premonstratensian houses were taken from the *Digital Atlas of Roman and Medieval Civilization* (DARMC, `https://darmc.harvard.edu/`). The respective DARMC map is based on Jedin et al. (1987: 54) as well as Bengtson and Milojčić (1995: 28). Using a shapefile of the 2006 NUTS regions, I counted the number of monasteries within the boundaries of each NUTS 2 region (2006 version) based on the coordinates provided by the DARMC.

4.E Cistercian presence and GDP growth

Table 4.11: Original and alternative reasonable specifications of regional GDP models.

Decision	Original specifications	Alternative Specifications
(1) Influence Indicator	Density, presence (0/1), # houses, # houses (log)	(same but all combinations)
(2) Order	Cistercians	Carthusians, Cluniac, Premonstratensians
(3) Baseline controls	Yes/no	(same but all combinations)
(4) Area	Area, area (log)	(same but all combinations)
(5) Level 1 unit	NUTS1	Country
(6) Estimator	Fixed effects	Random intercepts

The units of analysis are 234 NUTS2 regions. ABDS estimate OLS regressions with the (Log) gross regional product in 2007 as dependent variable. The main predictors are indicators of Cistercian presence at the regional level. Controls include the employment level in 2007 (log), area or area (log), fixed-effects for NUTS1-level regions, and a set of baseline controls. The latter are the average age of the local population as well as longitude and latitude of the region. Besides the standard set of theoretically interesting predictors (fours indicators of past presence of four orders) I systematically vary the operationalization of a region's area (ABDS sometimes use the natural logarithm of the area), the level 1 unit (NUTS1 or country), and the estimator (fixed effects vs. random intercept). The standard errors in all models are clustered at the country level.

In total I compute $4 \times 4 \times 2 \times 2 \times 2 \times 2 = 256$ models. However, I exclude random intercepts models when a Hausman-like test indicates that the level 2 effects are not

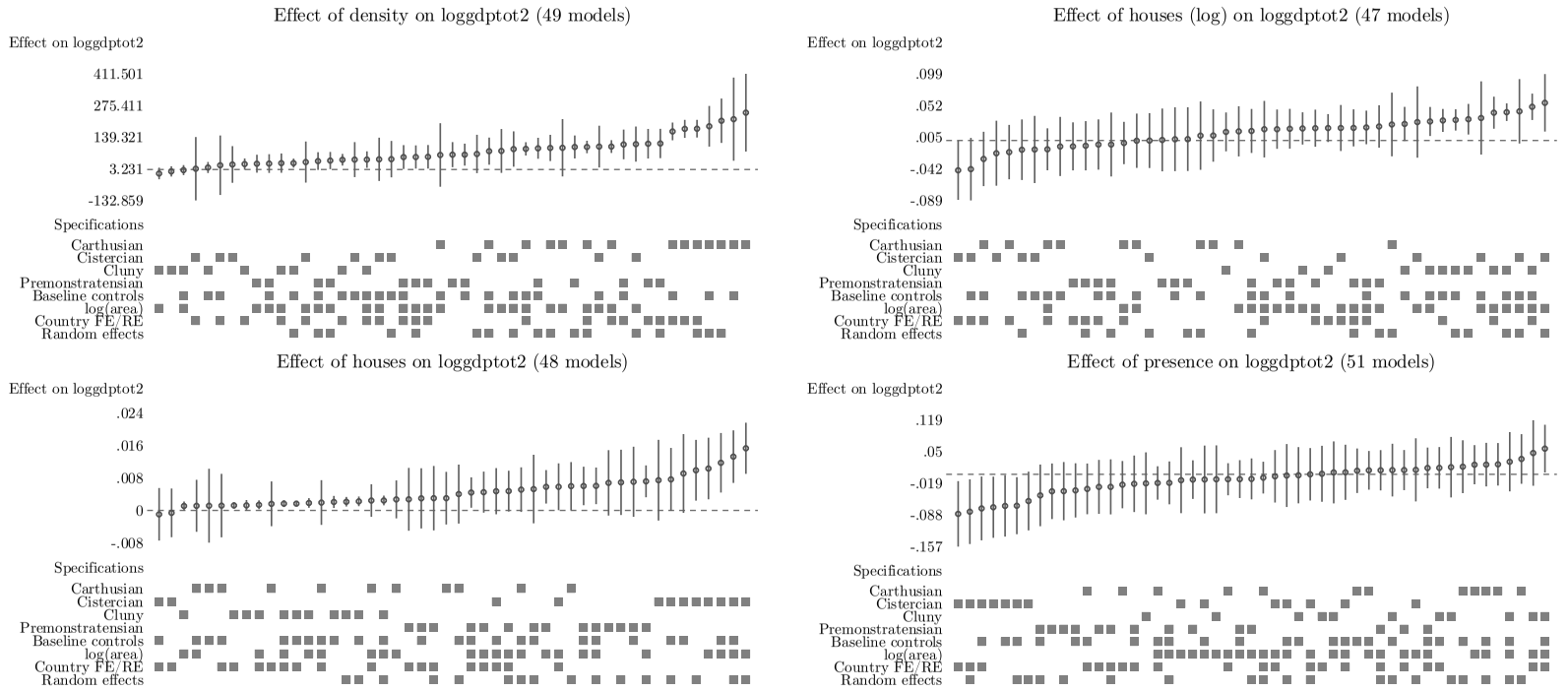


Figure 4.19: Systematic robustness check of OLS and random intercepts estimates ($N = 234$). The figure shows coefficients from 195 model specifications. Each sub-figure shows results for a different indicator of Cistercian influence. The point estimates are ranked from smallest to strongest effect with bars indicating the 90% confidence interval based on clustered standard errors. The squares below indicate the specification choices for each model (see Table 4.9). The first four rows indicate the order whose historic influence is being tested. The fifth row indicates whether regional level baseline controls are included. The sixth row indicates if the NUTS2 area is included in natural (km^2) or logarithmic units. The seventh row shows whether countries or NUTS1 regions are the level 2 units. The eighth refers to the choice of (country/NUTS1) fixed or random effects (random intercepts).

distributed independently of level 1 covariates. More specifically, because the Hausman test assumes homoskedasticity while the models assume clustering at the country or NUTS1 level, I use the generalized robust test as implemented with the Stata command `xtoverid` (Schaffer and Stillman, 2006). I exclude random intercepts models if the null hypothesis is rejected at the 10% significance level. That leaves me with 195 models for employment as dependent variable (and 195 for GDP growth).

4.F The true character of the Cistercian reform

Guerriero (2020) proposes and tests a more encompassing theory of endogenous institutions. Her mechanism incorporates the influence of Cistercians and the Franciscans, but she contrasts her own argument with Andersen et al. (2017). According to Guerriero (2020: 364), "[u]niquely within Western monasticism, both monastic [sic!] orders dictated charity-based norms of cooperation in exchange for guidance on how to share consumption risk" which is considered one step in a causal chain that generated regional political institutions conductive to economic development. While is it beyond the scope of this chapter to discuss the whole theory, her criticisms of Andersen et al. (2017) and her own theory of Cistercian influence are directly relevant. First, Guerriero (2020: 375) disagrees on the causes of the Cistercian reform:

> Focusing on the Cistercians, Andersen et al. (2017) propose a similar mechanism but describe them as aimed at spreading values of hard work and thrift [...] this vision is at odds with the more recent and substantial historic literature [...] Contrary to the speculation by Andersen et al. (2017), the fundamental issue distancing the order's founders from Molesme was not its 'failure to observe the Rule of St Benedict [but the fact that it] was rich [and] association of possession with virtues is not usually long-lasting' (Burton and Kerr 2011, p. 11).

This statement is a misreading of the historical evidence presented by Burton and Kerr (2011). In the cited paragraph, Burton and Kerr (2011) compare two early textual sources – the *Exordium Cistercii* and the *Exordium Parvum* – with regard to the stated reasons for the Cistercian reform initiated by its founder Robert of Molesme:

> The *Exordium Cistercii* also tells the tale of the departure of Robert and his companions, but in a much shorter text – a bare two chapters – which have none of the fierce criticism of Molesme found in the *Exordium Parvum*. The problem with the monastery, which caused Robert and his colleagues to leave, was not, as in the *Exordium Parvum*, failure to observe the Rule of St Benedict. (Burton and Kerr, 2011: 11)

Therefore, the cited passage does not summarize recent historical research but the content of one particular historical source. Moreover, the following discussion of accounts written by Benedictine monks (Burton and Kerr, 2011: 14–15) vindicates the view that the early Cistercians were stressing the importance of strict rule observance:

> [...] by the 1120s and 1130s the Cistercians were seen as the upholders of the Rule in its primitive form. That the witnesses are Benedictine monks makes their

> evidence the more compelling. This is how they understood Cistercian practices. The insistence on the strict observance of the Rule linked the early Cistercians with the most powerful written monument in the monastic tradition. (Burton and Kerr, 2011: 15)

Second, according to Guerriero's own idiosyncratic interpretation, the Cistercians strongly resembled a medieval NGO providing development assistance to the lay population. The Cistercians wanted

> to diffuse the novel and powerful idea [...] that [...] the interaction among worshippers should be rooted in 'mutual love and esteem, combined with a benevolent eye to human frailty [i.e.] charity rather than the exercise of power' (Tobin 1995, p. 40). Crucially, these charity-based norms of conduct should materialise not through alms but through cooperation (Burton and Kerr 2011, pp. 28–9), which the Cistercians themselves supported by organizing a series of risk-sharing activities with the help of local laypeople known as *conversi* and secular labourers (Burton and Kerr 2011, pp. 150–63; Donkin 1978, p. 39). (Guerriero, 2020: 368)

The Cistercians did of course emphasize basic Christian values like "mutual love and esteem." The characterization of their mission, however, is not supported by her sources. Burton and Kerr (2011: 28–29) summarize the content of the *Carter Caritatis*, one of the foundational statutes of the Cistercians. The *Carter* is mainly concerned with the unity of the Cistercians themselves. Furthermore, it would be misleading to single out sentences like "its statute pursues only charity and the advantage of souls in things human and divine" (Burton and Kerr, 2011: 29) to construct the narrative that Cistercians saw their mission in developmental economic cooperation with laypeople. Cistercian ideals were based on the same theological justification as the earlier monasticism (cf. Section 3.2).

The *conversi* were not just "local laypeople" but *lay brothers*. "The lay brothers took vows of obedience and were required to carry out some liturgical duties" and hence were members of the community even though "their day was focused on the workplace rather than the cloister and most of their devotions were celebrated there" (Burton and Kerr, 2011: 151). They worked on monastic estates and the fruits of their labor accrued to the monastic community. It was not an institution designed to cooperate with the local lay people.

Throughout the paper Guerriero suggests a number of other supposed forms of local cooperation and "risk sharing," none of which are convincing. To give one more example (Guerriero, 2020: 377):

> [...] it was the desire to rationalize neighbouring economies, inject liquidity in unstable markets, and make the lords' property available to the peasantry to guide the expansion of the order's holdings (Burton and Kerr 2011, pp. 160–8).

As Burton and Kerr (2011: 167–169) make clear, the Cistercians rationalized their own holding "[t]hrough consolidating lands into single units which were administered from agricultural centres, staffed by lay brothers and, importantly, exempt from tithes" (Burton and Kerr, 2011: 167–168). And neither the fact that benefactors sometimes sold land to the monasteries in order to "raise cash" (Burton and Kerr, 2011: 165) nor the case of the Galician monastery that bought "land from locals who had fallen on hard times" and "allowed the individual to remain on the land [...] on the understanding that the property would pass to the community upon his or her death" (Burton and Kerr, 2011: 166) can be construed as exclusively charitable acts fulfilling a moral mission. With regard to the latter case, it seems clear that "in this way the monastery gave the illusion of aid but was in fact the main beneficiary, reaping both short- and long-term advantages" (Burton and Kerr, 2011: 166). All things considered, the Cistercians role in local communities was rather conventional. They were integrated with the local economy and distributed a considerable amount of their revenues as alms (Lekai, 1977: 385–386). The Cistercians may have shaped local economic conditions, but any enduring influence did not result from a purposive plan to transform the environment of their settlements through cooperation initiatives.

4.G Evidence of Cistercian legacies in the Netherlands

So far, I have focussed the re-assessment of one particular study, although there are others that address similar questions about the long-term influence of religious movements on economic development. It is beyond the scope of this study to explore them in detail. I want to briefly consider evidence by Akçomak et al. (2016) for the role of Christian orders in the early economic development of the Netherlands. They argue that the religious movement of the *Brethren of the Common Life* (BCL) stimulated human capital accumulation during the early Renaissance. Dutch cities with BCL presence had higher rates of literacy and higher levels of book production. They also find evidence of an impact on city growth. Their OLS models show that population growth in the period 1400–1560 was about 35 % higher in cities with BCL communities. They use the distance to Deventer, the movement's city of origin, as an instrument and report an effect on population growth of more than 50 % in their 2SLS estimates.

Addressing Andersen's et al. research, they "find no effects of Cistercians or other religious orders on the economic development of the Netherlands" (Akçomak et al., 2016: 824). Even though they don't report analyses regressing population growth on Cistercian presence, the data provided in the supplementary materials allow some quick OLS calculations. Regressing city growth on a dummy variable of Cistercian presence, using the same control set as their main analyses, gives an effect size of about 24 % with $t = 1.98$. However, Akçomak et al. (2016) do not distinguish between male and female Cistercian monasteries. I

recode the dummy variable based on the location of male Cistercian communities to make the results more comparable to Andersen et al. Male Cistercians were located in six of the 67 sampled cities. The coefficient remains nearly unchanged (26 %) but the estimates are less precise ($t = 1.56$). This is (very) weak evidence for a relationship between Cistercian presence and Dutch economic development. The association is, however, stronger than associations between the other orders/religious movements[34] in the Akçomak et al. data and city growth. Overall, this is consistent with the broader picture: While we cannot reject the hypothesis that the presence of Cistercian monasteries stimulated local economic development in Europe, the evidence is far from being decisive. Whether one is persuaded by the evidence ultimately depends on the prior probability one assigns to the hypothesis.

[34] Franciscans, Tertiarians, Beghards and Beguines, and Modern Devotion.

5 Summary and outlook

The discussions at the end of the three studies have focused on the specifics of the respective theoretical arguments and methods. In the following, I will briefly attempt to outline, in broad strokes, the general lessons as well as possible avenues for future research.

The determinants of success

At the beginning of the book, I mentioned the overarching puzzle as being about the conditions of success of religious orders. The diffusion models in Chapter 2 contain a simple metric to quantify success: the maximum number of foundations or growth potential $N_{\max}$. The proposition by Rossman, that was being tested, stated that "[i]nnovations that deviate from extant categories will either diffuse via increasing hazards or not at all" (Rossman, 2014: 55), implying that orders of novel types should be, on average, less successful since some of them do not diffuse at all. This argument is in line with Stark's proposition that "[n]ew religious movements are likely to succeed to the extent that they retain cultural continuity with the conventional faith(s) of the societies in which they seek converts" (Stark, 1996: 136) but makes a novel connection to the diffusion of innovation literature, thereby grounding the religion-specific proposition in a more general theory. However, the maximum number of foundations among the 36 orders in the Dutch medieval data was almost unaffected by category density and, hence, legitimacy due to cultural continuity. Thus, although the model informs about the different channels of diffusion (internal vs. external), predictions about differential success have so far been falsified.

The results in Chapter 3 were not clear-cut either but the findings point to the relevance of certain monitoring institutions, most notably provincial visitations and General Chapter attendance. Especially in the case of the Cluniac order, the weakening of the systems of visitations also coincides with an overall increase in the rate of dissolutions. There was no robust evidence that the traditionally most acclaimed system of visitations, the filial bound between Cistercian mothers houses and their daughter houses, was in any way effective in stabilizing monastic communities. This might be explained by the imbalance in the distribution of daughter houses among Cistercian abbeys which rendered the system impractical. The filiation system was never as widely adopted as the institution of a General Chapter and the creation of administrative provinces. Thus, the emergence and diffusion of certain organizational features might be explained by their relative superiority. Theoretically,

the focus of the club-good model of religion was shifted from the immediate relationship between strictness and the production of collective goods in a group to the organizational principles that enable a solution to the second-order enforcement problem as well as the processes of organizational evolution.

Chapter 4 did not speak directly of success, even though the supposed wide-spread cultural penetration of Cistercian values can be thought of as an, albeit unintended, aspect of persistence and influence. However, scrutinizing Andersen's et al. (2017) claim about the diffusion of a Cistercian "work ethics" to the general population resulted in a skeptical conclusion. Population growth in England was robustly associated with both medieval Cistercian and medieval Augustinian presence. Contemporary European attitudes toward hard work are reliably associated with past Cistercian but not Premonstratensian, Cluniac, and Carthusian presence. Together this makes an interesting puzzle. However, as the previous chapter made clear, questions of causality and the actual theoretical mechanism require further research.

While the analyses shed light on manifold aspects of the spread and survival of orders, the ultimate determinants of success remained somewhat elusive. Organizational characteristics are the most substantiated determinants of success (survival). Whether legitimacy played a role in the diffusion process and whether certain values were particularly suitable for the adoption by the lay population and even provided the latter with survival advantages remains to be seen.

Pitfalls of historical social science

The previous, probably already oversimplified, summary highlights the complexity of the findings. This is to be expected given the challenges of historical social research. Nonetheless, some hypotheses were confirmed, others were ruled out, and all three studies resulted in the generation of new theory-guided predictions or suggested systematic approaches to further research. Moreover, Chapters 3 and Chapters 4 revealed the problems of past studies that, in my view, did not pay sufficient attention to historical detail. Finley (2021) tests similar hypotheses about the Cistercian visitation network with data that, at first glance, seem to be more adequate than the necessarily rudimentary information on the medieval network. I am not aware of a map of medieval transportation networks that would allow a more appropriate measure of travels costs than airline distance, comparable to the map of 18th century France used by Finley. The elegance of her approach is irrelevant, however, since the institutions of interest simply no longer existed in pre-revolutionary France.

Andersen et al. (2017) bring forward an intriguing hypothesis as well as correlative findings. However, given the lack of direct historical evidence for the wide-spread adoption of Cistercian values, contents of their doctrine that seem incompatible with the assertion,

and skepticism about the claim that a lesser preference for leisure would have been sufficient to promote the spread of a culturally distinct subpopulation in the Late Middle Ages, I am not convinced by their results. A systematic study of this hypothesis should not only strive to include a more complete sample of regions and orders but incorporate the insights of historical and interpretive scholarship like Kaelber (1998).

My own studies are certainly not flawless when it comes to the proper use of historical facts. I am confident that more knowledgeable readers will be able to point out errors and misconceptions. Nevertheless, I hope that I have conveyed a fair sense of the uncertainty of the findings without being overly skeptical to the point that I discourage the reader from engaging.

The usefulness of approaches and methods

Chapter 2 and Chapter 4 introduced methods that should prove useful to other researchers in the area of sociology of religion as well. Chapter 2 illustrates the applicability of diffusion models to the study of (historical) religious movements. They are an attractive tool because they allow the descriptive as well as explanatory reconstruction of theoretically interesting transmission mechanisms despite minimal data requirements. The chapter demonstrates the empirical content of the predictions, i. e. models entail diffusion curves with certain properties and hence can be falsified by empirical tests. Furthermore, extensions like multilevel diffusion curves (Rossman et al., 2008) provide a way to test explanations of differing growth patterns by incorporating features of religious movements as well as period effects.

Chapter 4 used a specification curve analysis to assess the robustness of the association between Cistercian presence and later economic development. The value of similar analyses have been advocated as part of the solution to the "crisis in science" (Young, 2018) of irreproducible research. Regardless of the status one assigns to the method in the concert of attempted solutions, it may prove particularly useful in the field of historical social research. In contrast to research on contemporary subjects, it is often not possible to collect additional data or pre-commit to a specific research design. The analyst must make do with the data that can be obtained based on surviving and edited sources. Therefore, it is necessary to resort to proxy measures and make other compromises during data analysis. Moreover, a lot of work in historical social science is more exploratory than generally admitted, that is, a major source of model uncertainty is the lack of clear theory-guidance. Many research questions pertain to *long-term macro-social phenomena*. Social scientists are usually not in a position to make precise predictions (or "retrodictions") with regard to such explananda. Another novel aspect of the specification curve analysis in Chapter 4 is the application to a causal research design or natural experiment. Angrist and Pischke (2010) argued that the increasing use of such research designs will make research more credible in part because

they reduce the number of assumptions. However, I my the view, the main advantage of new developments in the area of causal inference is that a better understanding of research designs as well as technical tools like directed acyclic graphs permit to state the underlying assumptions more transparently. Methods like instrumental variable estimation have their place but they introduce new researchers degrees of freedom.

Directions of further research: non-diffusion and competition

The discussions at the end of each chapter have already suggested various starting points for future research about historical orders. I will briefly focus on two ideas that have not yet received sufficient attention.

The failure of the first study to provide evidence in favor of a link between legitimacy and success might be explained by the inclusion criteria and the study's setup. Small orders were excluded because the features of their diffusion curves are impossible to model. The exclusion of small orders reduces the variation in the sample and possibly prevents an adequate test of Rossman's (2014) propositions which explicitly mentions the non-diffusion of non-legitimate innovations. Therefore, it might be necessary to conduct analyses on the full samples and model a two-stage process. In the first stage, the objective is to predict which orders grow beyond a certain threshold, the second stage concerns the size (number of foundations) as well as the shape of the diffusion curve.

The role of resource competition has been discussed as a relevant factor for the foundation of new as well as the survival of existing communities. However, monastic competition has not been systematically addressed in the current studies. The findings in Chapter 2 showed a weak negative relationship between legitimacy (category density) and the maximum number of foundations in the Dutch data. Moreover, the earliest forms of monasticism (Benedictines) and of canons regular (Augustinians) in England were the most successful orders in terms of total houses. Therefore, I hypothesized that there could be an advantage to "early entrants," i. e. the first orders within a category might be disadvantaged due to a lack of legitimacy but, at the same time, they enjoy the absence of competition for membership, donations, and other resources.

The analyses in Chapter 3 showed that Cistercian and Cluniac communities in proximity to each other were more likely to be dissolved compared to solitary communities. In keeping with the arguments from the same chapter, strong competition for potential members may induce orders adopt a "lamentably undiscriminating recruiting policy" in an attempt to replenish their membership (Wittberg, 1994: 179). Such a policy undermines the screening function of strict membership requirements (Iannaccone, 1992) and increases the share of free-riders, thus, lowering the production of collective goods and destabilizing the community. It seems promising to borrow concepts and methods from organizational ecology (Hannan and

Carroll, 1992; Carroll and Hannan, 2000) and attempt to measure the density of categories in order to study the nexus of competition and organizational success of religious movements.

At this point, the question my arise whether the religious economy literature (Stark and Finke, 2000; Stark and Iannaccone, 1994) is not a more natural complement to the club-good model which has been fruitfully applied to the study of religious orders. First of all, the religious economy view of competition is primarily directed at the relationship between the supply of religious goods and services on the one hand and measures of demand such as religious participation on the other. For example, Stark and Iannaccone (1994) argue that pluralistic competition increases quality by forcing religious "firms" (denominations or other groups) and their personnel (e. g. clergy) to be motivated and to develop distinct theological contents that appeal to potential "customers." Competition is expected, via higher quality, to increase religious behavior like church attendance. Leaving aside the known theoretical and empirical difficulties of the approach (Montgomery, 2003), it, thus, aims to answer a different set of questions.

These questions are interesting in their own right, but it would be difficult to test whether competition increased the quality of the religious goods supplied by historical religious communities, thereby enticing a larger percentage of the population to join religious orders. Neither the existing statistics on membership in medieval orders (e. g. Hostie, 1983) nor the estimates of population size are precise enough to test such predictions. A related, and potentially testable, proposition might be that competition among religious orders in the Late Middle Ages increased the quality and, therefore, the satisfaction with Church institutions. This could have lowered the appeal of the Reformation in the 16th century in regions with previously strong competition.

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