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Emergent Scale-free Social Networks in History: Burning and the Rise of English Protestantism

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Abstract

There is a large and rapidly increasing literature which analyses social networks for which substantial amounts of quantitative data are available. Further, there is a growing and related literature on what is referred to by economists as 'information cascades' on such networks.

In this paper, we describe the process of emergence and evolution of a historical social network across which the opinions and behaviour of individuals were influenced. We also illustrate how empirical networks can be reconstructed relying principally on information contained in qualitative, historical sources.

The specific example we use is religious belief in England in the 1550s. We describe how the burnings of Protestant leaders by the Catholic Queen Mary (1553-1558) created a set of martyrs which was decisive in increasing support not just for Protestantism compared to Catholicism, but which led to the rapid disappearance of rival Protestant factions.

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1.   Introduction

There is a large and rapidly increasing literature which analyses social networks for which substantial amounts of quantitative data are available. Well known examples from the (relatively) early days of this literature are the World Wide Web[1] and the distribution of sexual partners.[2] A more recent example is the pattern of obesity amongst a densely connected network of 12,067 people assessed repeatedly from 1971 to 2003 as part of the Framingham, Massachusetts heart study[3].

Further, there is a growing and related literature on what is referred to by economists as 'information cascades' on such networks. Individuals form their opinions on particular topics in a variety of ways, but an important one is by noting the opinions of others who the individual considers to be significant in the particular context. Empirical examples include the volatility of financial markets[4], the success or failure

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[1] A-L. Barabási, R. Albert, H. Jeong, 'Scale-Free Characteristics of Random Networks: The Topology of World Wide Web', *Physica A*, 281 (2000), 69-77.

[2] F. Liljeros, C. R. Edling, L.A.N. Amaral, H.E. Stanley, Y.Aberg, 'The web of human sexual contacts', *Nature*, 411 (2001), 907-08.

[3] NA Christakis, JH Fowler, 'The spread of obesity in a large social network over 32 years', *New England Journal of Medicine,* (2007), 357;4, 370-379

[4] A. Kirman, 'The Behaviour of the Foreign Exchange Market', *Bank of England Quarterly Bulletin*, 35 (1995), 268-93.

of film releases in the United States[5], understanding why dramatic changes in crime can take place[6], the distribution of honesty ratings amongst sellers on websites such as e-Bay[7] and whether or not people in the UK have bank accounts[8]. The analytical foundations of all these studies are very similar, and a modern historical example traces how liberal social attitudes have come to predominate in the Anglo-Saxon countries over the past few decades even though initially they were held by only a distinct minority of the population.[9]

The aim of this paper is two-fold. First, to illustrate how empirical networks can be reconstructed relying principally on information contained in qualitative, historical sources. Second, to give an example of the process of evolution of a historical social network across which the opinions and behaviour of individuals are influenced.

In this paper we consider how social networks help understand how competing ideologies either spread or are eliminated amongst the relevant population in historical situations. The specific historical example we use to illustrate this technique is the evolution of religious beliefs in England in the 1550s and early 1560s.

In the early 1550s, the vast majority of the English population still adhered to Catholicism. A decade later, substantial and influential support for an extreme version of Protestantism had been established. And a decade later still, by 1570, Catholicism had largely disappeared from England, except in its lowly populated, remote regions. This represents, historically, a rapid and profound switch in doctrinal beliefs. This article suggests a model to show how the burning of Protestants may have led to a crucial increase in respect amongst the general population for Protestantism through the conduct of those burnt.

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[5] A. De Vany and R. Wallis, 'Bose-Einstein Dynamics and Adaptive Contracting in the Motion Picture Industry', *Economic Journal*, 106, (1996), 1493- 1514.
[6] E.L.Glaeser, B.Sacerdote, and J.A.Scheinkman, 'Crime and social interactions', *Quarterly Journal of Economics*, 111 (1996), 507-48.
[7] P Laureti, F Salnina, Y-K Yu and Y-C Zhang, 'Buyer feedback as a filtering mechanism for reputable sellers' , *Physica A*, 316, (2002), 413-429.
[8] P Meadows, P Ormerod and W Cook, 'Social Networks: Their Role in Access to Financial Services in Britain', *National Institute Economic Review*, 189 (2004), 99-109.

King Henry VIII broke with the Papacy in 1534. The leadership of the Church in England then became progressively more Protestant in its outlook, culminating in the introduction of the 1552 prayer book under his son Edward VI (1547-1553). Yet at the time of Edward's death, not only had this radical religion not yet settled into custom, but it had raised considerable hostility among the wider population.

There was a very large body of support for Catholic customs in 1553, when Queen Mary took the throne and restored Catholicism as the state religion. Further, there were rival factions vying for the allegiance of Protestants. The doctrinally austere Reformed Protestants, who believed that each individual had been predestined from the creation of the world to Heaven or Hell, had been in the ascendancy in Edward's later years. But outside the ecclesiastical establishment's upper reaches, there were alternative varieties of Protestantism on offer. The most important of these was the Freewiller movement, which held that human freewill and individual choices governed the eventual destination of the soul .

Yet within a few months of the accession of Elizabeth I five years later, her 1559 settlement had introduced, apparently to widespread satisfaction, doctrine and liturgy which one modern account describes as 'a snapshot of King Edward VI's Church as it had been…in autumn 1552.'[10]

A considerable proportion of the population may still have adhered to the old religion, but there was now substantial acceptance of what historians have termed 'Reformed Protestantism' and rival reforming Protestant factions, principally the Freewillers, had disappeared.

In this paper, we focus on just one reason for this rapid change, but one which was regarded as important by both contemporaries and many subsequent historians. In

[9] P Ormerod,' Hayek, "The Intellectuals and Socialism", and Weighted Scale Free Networks', *Economic Affairs*, 26 (2006), 41-47.
[10] D. MacCulloch, 'Putting the English Reformation on the map', *Transactions of the Royal Historical Society*, 6th series, 15 (2005), 87-88.

popular myth 'bloody Mary' opened the door to Protestantism by making martyrs of the men and women who were prepared to die for their beliefs.

The sentencing of religious dissidents to the stake was not unknown in England, but burnings were infrequent, even during the repression of the Lollard movement, the most important medieval challenge to religious orthodoxy in England, during the 15th and early 16th centuries.   In the hundred years between 1423 and 1522 only some 30 people had been burnt from 544 trials.[11]

In contrast, Mary's short reign was possibly the most ideologically repressive in the whole of English history, with around 300 burnings of Protestants in the space of only five years.

This paper looks at two important issues. First, we examine how contemporaries thought of martyrdom as a way of influencing popular opinion. This evidence makes it clear that a social network evolved across which religious opinions were strongly influenced. Second, we use this information to approximate the topology of the network which is consistent with the evidence on how religious opinions altered during the 1550s. Any quantitative assessment of popular opinion in the sixteenth century is inevitably conjectural, nevertheless the conclusions are suggestive.

Section 2 of the paper expands the relevant historical context. Section 3 discusses how this qualitative, documentary evidence can be used to approximate how social networks evolve.   Section 4 describes the model, and section 5 sets out the results. Finally, section 6 offers a short conclusion.

2.   The historical context

There was nothing inherently foolish about the choice of burning to extirpate heresy by the Marian government. It was first used against heresy on a large scale in Europe in the thirteenth century and was drawn from Roman penalties for treason, in

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[11] M. Lambert, *Medieval Heresy,* (3rd edn., Oxford, 2002), 400.

particular forgery of coins. Such counterfeit religion threatened people's souls and it was the responsibility of the secular power to extirpate it.[12]

Earlier campaigns on the Continent had followed the pattern of a violent opening with a considerable number of burnings followed by a more nuanced policy of penances and the occasional use of the stake to remind folk of the dangers of dissent.

Mary's advisers appear to have had a similar tactic in mind when they mounted their assault on heresy in the early months of 1555. As Stephen Gardiner, Catholic Bishop of Winchester put it in his condemnation of John Rogers, the preacher, biblical translator and first Protestant to be burnt; 'execution and punishment….may be to the salvation of thy soule, to the extirpation, terror and conversion of the heretickes to the unity of the catholik faith.'[13] He also brought eighty imprisoned preachers to his London home at St. Mary Overy's in January 1555 and urged them to recant on pain of death.[14]

So the Catholic authorities had the intention of creating a climate of fear which they believed would suppress what they regarded as the Protestant heresy. They rapidly imprisoned many of the leaders of Reformed Protestantism

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[12] M.Bévenot, 'The Inquisition and its Antecedents', *The Heythrop Journal*, 7, 3 (1966); 7, 4 (1966), 381-93; 8,1 (1966), 52-69; 8,2 (1966); 152-68: H. Maisonneuve, *Etudes sur les origines de l'inquisition* (Paris, 1960), 151-98, 243-368. For burning in Roman law see *Theodosiani Libri xvi cum constitutionibus Sirmondianis*, eds. P. Krueger and T. Mommsen, (Berlin, 1954), 9:21:5. Aquinas on heresy as forgery of currency, *Summa Theologiae*, 2.2. Q11. ª3, Benziger Bros. edn., 1947 in Christian Classics Ethereal Library, Grand Rapids, Michigan on website:
http://www.ccel.org/ccel/aquinas/summa.SS_Q11_A3.html (accessed 6 August 2007).
[13] John Foxe, *The First Volume of the Ecclesiasticall History, contayning the Actes & Monumentes of thinges passed in every kinges time , in this Realme, especially in the Churche of England principally to be noted, with a full discourse of such persecutions , horrible troubles; the suffring of martirs, the severe punishment of peresecutors, the great providence of God in preserving many, and other thinges incident, touching aswell the sayde Church of England, as also Scotland, and all forrein nations, from the primitive time till the raigne of king Henry the Eyght*, (London, 1576), [hereafter referred to as Foxe, *Actes*, (1576)], 1418. This is now most easily reached through the online variorum edition of the UK Humanities Research Institute, University of Sheffield (2006) at
http://www.hrionline.ac.uk/johnfoxe/index.html (accessed 6 August, 2007).
[14] D.Loades, *The Reign of Mary Tudor: politics, government and religion in England, 1553-58*, 2nd edn. (Harlow, 1991), 272-3.

In contrast, the Protestant clerical elite were convinced from the outset that their death could cause the policy to rebound on the persecutors. They were well aware of the necessity of creating a good impression at the stake.

To this end then they encouraged one another, On 8 February 1555, on the morning of his execution Laurence Saunders, a noted Protestant preacher in London and the Midlands, wrote to his wife and supporters:

> God's people shall prevayle: yea our blood shal be their perdition
> Who do most triumphantly spill it.[15]

A few weeks earlier he had written to Cranmer, Latimer and Ridley who were in prison also on the verge of execution. These three were probably the most prominent of all the Reformed Protestant leaders. Cranmer was the Archbishop of Canterbury, the religious head of the English Church, Latimer was Bishop of Worcester and a famous preacher, and Ridley, Bishop of Rochester, was the author of the 1552 *Book of Common Prayer* which defined the liturgy of the Reformed Protestant faction. To these men, Saunders wrote

> And herein wee shall have to reioyce in the behalfe of the
> church of Christ whose faith may be the faster fixed
> upon Gods verity, being confirmed with three such worthy
> witnesses. Oh thanks be to god for this hys unspeakable gift.[16]

In other words, in order to make the process a triumph for the faith, the persecuted Protestants believed that they had to put on a good show. Latimer and Ridley famously rose to the occasion, with perhaps the most memorable of all the quotes of the English martyrs when about to be burnt:

> Be of good comfort, master Ridley, and play the man.
> We shall this day light such a candle, by God's grace

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[15] Foxe, *Actes*, 1428.
[16] Foxe, *Actes*, 1423.

in England, as I trust shall never be put out.[17]

The image is all the more striking because the world of the 16th century was largely unlit, incredibly dark compared with the early 21st century, and a single candle could have a visibility of a mile or more. Certainly, no words were necessary, especially as the Marian authorities were loath to allow any preaching besides abject recantations. The drama of the occasion sufficed; Saunders died embracing the stake, Rogers was seen to be washing his hands in the flames and Archbishop Cranmer signalled his adherence to the Protestant faith by thrusting into the fire the right hand which had previously signed his humiliating recantation.[18]

The language of contemporary Protestant support is rich in the vocabulary of dissemination: John Careless wrote from prison in the spring of 1556;

> as we now go forth weeping, bearing forth good seed, so shall
> we come again with joy, and bring our sheaves full of corn.
> Yea the death of the martyrs….shall be the life of the gospel,
> spite of the papists' hearts.[19]

A few months before, an anonymous woman supporter of his wrote to Bishop Bonner of London taunting him with a vivid and accurate metaphor regarding the burning of John Philpot in December 1555, 'You have broken a pot indeed, but the precious word [nard] contained therein within is so notably shed abroad….. that they [the congregation of Christ] cannot abide any more the stinking savour of your filthy ware.'[20] The biblical origin of this rhetoric should not disguise its attempt to describe the phenomenon the Protestants thought they were seeing around them.

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[17] Foxe, *Actes,* 1662.

[18] Saunders, Foxe, *Actes,* 1421.

[19] Foxe, *Actes*, 1826 (corrected pagination; originally 1838).

[20] Foxe, *Actes*, (1583 ed.), 1843. In the Latin first edition of his Acts and Monuments published in 1559 Foxe recalls pleading for the life of Joan Bocher of Kent burnt by Edwardian Protestants in 1550. He used an illness metaphor familiar in anti-heretical rhetoric, 'she might infect a few by living, she would confirm many more if she were punished with death.' Foxe suppressed this anecdote for all later versions of his work. J.F. Mozley, *John Foxe and his book*, (London,1940), 35-6

Of course, the fact that the martyrs themselves believed they would influence people by their behaviour does not mean that they were necessarily right. However, contemporary accounts suggest strongly that their views on this matter were correct.

Rogers' execution was observed by 'a wonderfull number of people'.[21] Even the notoriously grumpy John Hooper took the opportunity of the journey back to his former bishopric of Gloucester to charm a woman of Cirencester, bless a blind child, and greet local dignitaries. Foxe, the main contemporary chronicler of these events, put the crowd assembled to watch him burn at 7,000, 'for it was market-day and many also came to see his behaviour towards death.' His cheerful fortitude won them over. By the time the fire was ready to be lit 'there was nothing to be seen but weeping and sorrowful people'.[22] Numbers may well be exaggerated in Foxe's accounts, but there is some corroboration from the Catholic writer, Miles Huggarde who described Foxe's 'godly multitude and congregation' at the Smithfield burnings as 'more people….flocking together on heaps than you shall see at a good sermon or exhortation by some learned man in a whole week.'[23]

Potential victims encouraged supporters to be present. Saunders was burnt in Coventry where he had been active and on the morning he was executed wrote to friends:

> Make haste my deare brethren, to come unto me that we may be mery.[24]

It was a sign of the success of this tactic that the government's policy changed and in July 1555 John Bradford was conveyed to Newgate between 11 and 12 at night, in time, it was rumoured, for a burning in the small hours before as few witnesses as possible. By four o'clock in the morning, a large crowd had gathered at Smithfield, although in the event it was nine before Bradford was led to his fate.[25]

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[21] Foxe, *Actes*, 1420.
[22] Saunders, Foxe, *Actes,* 1421; Hooper 1435 -6.
[23] Collinson, 'Truth and Legend', 47-8.
[24] Foxe, *Actes*, 1428.

The images of the martyrs are so iconic in English history that it is easy to forget that there were other strategies applied within Protestantism under the Marian repression. The Freewillers were a group first identified in the new year of 1551 when Edward VI's Privy Council had thirteen arrested in the aftermath of an assembly at Bocking in Essex at Christmas.[26]

There is uncertainty about the extent of support for the Freewillers. One historian of the period argues they were a real threat to Reformed Protestantism in the early 1550s[27]. Another, less convinced of the group's significance, warns against giving 'exaggerated attention' to the group.[28] On balance, the consensus seems to be that the Reformed Protestants were substantially more numerous than the Freewillers, but that the latter nevertheless represented a distinct alternative.

Certainly from the point of view of their Reformed Protestant opponents in King's Bench prison in 1554 and 1555, the Freewillers represented a real threat. In January 1555, John Bradford commented that 'more hurt will come by them, than ever came by the papists, inasmuch as their life commendeth them to the world more than papists.'[29]

Among the Reformed Protestants there was nervousness about the popular appeal of the rival doctrine of freewill compared to their own doctrine of predestination, with its terrifying implication that the actions of individuals could do nothing to save them if they had been predestined for damnation   The Zurich reformer, Heinrich Bullinger

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[25] Foxe, *Actes*, 1522.

[26] J. W. Martin, ' "The First that Made Separation from the Reformed Church of England" ', *Archive for Reformation History*, 77 (1986), 281-313, reprinted with revisions in his *Religious Radicals in Tudor England*, (London, 1989), 41-70 which is used here. T.Freeman, 'Dissenters from a dissenting Church: the challenge of the Freewillers, 1550-1558', in *The Beginnings of English Protestantism*, eds. P.Marshall and A.Ryrie, (Cambridge, 2002); cf. D.A. Penny, *Freewill or Predestination: the battle over saving grace in mid-Tudor England*, (London, 1990).

[27] For example, T.Freeman, 'Dissenters from a dissenting Church: the challenge of the Freewillers, 1550-1558', in *The Beginnings of English Protestantism*, eds. P.Marshall and A.Ryrie, (Cambridge, 2002).

[28] F. Heal, *Reformation in Britain and Ireland*, (Oxford, 2003), 251.

[29] J. Bradford, *Writings*, ed. A. Townsend, 2 vols. (Cambridge, 1853), II, 170-1.

conceded that 'if it were proposed so nakedly to the people, it would be proposed to more of them with offence than with edification.'[30]

The Freewillers essentially followed the strategy of survival to preach another day. Although some were imprisoned with other Protestants by Mary's government in King's Bench prison, in general they avoided being burnt. John Trew, their leader in jail managed to escape. Hart, another prominent Freewiller, was active in London until 1557 before dying a natural death. Many others slipped away into obscurity and there is a suspicion that they may have been able to cut deals with Mary's government which was eager to foster division among their opponents.[31] This is not to say that Freewillers were unwilling to suffer for their cause, at least four are known to have been burnt and Trew had his ears cut off.[32] However, the extent of persecution amongst Freewillers was very much less than amongst their predestinarian contemporaries.

So the reformed Protestants were not the automatic inheritors of anti-Marian or anti-Catholic feeling by virtue of there being no alternative. However, those who identified sufficiently strongly with the Edwardian doctrine of Reformed Protestantism to suffer at the stake did manage to reach the largest audiences. As a modern historian has noted :'If the ordinary Englishman wanted to know how the heretics behaved in public he could, if he lived in the South or East of England [where most of the population was], attend a trial or burning without much difficulty.'[33]

3 Emergence and evolution of the network of influence

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[30] C. Haigh, 'The Taming of Reformation: Preachers, pastors and parishioners in Elizabethan and Early Stuart England', *History*, 85, (2000), 581-2: P.White, *Predestination, Policy and Polemic*, (Cambridge, 1992), 78: D.Wallace, *Puritans and Predestination*, (Chapel Hill, NC, 1982), 14.

[31] Freeman, 'Dissenters', 154.

[32] Martin, *Religious Radicals*, 67, 69-70. For Trew, see the 1563 edn. of Foxe, *Actes,* 1681. Dasent, *Acts of the P.C.*, V, 316. The degree of suffering by the freewillers may be underestimated because Foxe himself wanted to present an unbroken picture of unity among the dissidents and his writing 'lies over the landscape of Edwardine and Marian Protestantism like a blanket of snow', as Freeman has memorably put it ('Dissenters', 155). See also P. Collinson, 'Truth and Legend: the veracity of John Foxe's Book of Martyrs' in *Clio's Mirror: Historiography in Britain and the Netherlands,* eds. A.C. Duke and C. A. Tamse, (Zutphen, 1985), 31-54.

For historians, the idea that a small number of influential people with a particular belief leads to a greater chance of that belief spreading may not seem very surprising. However, we might reasonably ask why the Reformed Protestant leaders under the Protestant Edward VI did not have a decisive effect on religious opinion during his reign. Then, as under Mary, the leaders of the Protestant church were prominent and well-known, yet the vast majority of the population remained attached to Catholicism. Indeed, the Church leaders under Edward VI were essentially the same group who were imprisoned and burned under Mary.

Sixteenth century England was already, by world standards, both economically prosperous and densely populated. The bulk of the population (some 3 million in total) lived within 150 miles of London. News and information traveled surprisingly quickly, to many modern eyes, throughout Western Europe as a whole, and nowhere more so than in the advanced and geographically concentrated state of England. [34]

In other words, a network of *awareness* of religious leaders existed, both national and regional, under Edward VI. It is here that the specific historical context becomes of crucial importance. We can think of the relevant social network before the Marian persecutions as being a *latent* scale free network. The structure existed in principle but it required specific historical events to activate it and turn it into one in which opinions were actually influenced.

It is precisely the specific historical background described above which led to this network becoming decisive in the spread of Protestantism. Most martyrs knew that they were already well known, whether at a national or regional level; they knew that news of their burnings and how they behaved would become widespread, indeed, as we have seen, they positively encouraged people to witness their executions; and they deliberately behaved with great fortitude in the face of a terrible death exactly to encourage the spread of their doctrine.

[33] D. Loades, *The Oxford Martyrs*, (London, 1970), 190.
[34] P. Williams, *The Later Tudors:England 1547-1603*, (Oxford, 1995), p.14.
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Of course, the process of religious conversion is more complicated than this. So, for example, even in the context of the percolation of belief across a social network, people may make up their own minds and not really be influenced by others, or they might be counter-suggestible to the ideas of influential people. And we have no way of judging the sincerity or otherwise of conversions.

The problem of conversion has in fact received much attention from historians of religion in recent years. Of particular interest are cases of religious choice such as that between paganism and Christianity in the early middle ages, heresy and orthodoxy in the later medieval period and the competing forms of Christianity on offer in the sixteenth century. Some older work saw such questions through a 'confessional lens', emphasising the internal spiritual experience, deriving from a conversion tradition starting with Paul on the way to Damascus. It is still possible also to describe conversion as something done to a population, such as Vladimir of Kyiv's forced baptism of his nobility or the imposition of the Prayer Book in the reign of Edward VI.

But in order for the conversion to last, a process of acceptance among the wider population which combines both internal and external factors has to take place. This can be multi-faceted, with the desire for salvation mingling with vested interests such as benefiting from confiscated monastic wealth. An important aspect of conversion, however, is how purveyors of the new faith are perceived, in their manner of life and death. As the Cathar (the first major heresy of the medieval period) question has it. 'Did they make a good end?'[35]

In the context of the current topic,. there is a strong consensus, both amongst contemporaries and subsequent historians, that the martyrs were a decisive influence in the spread of Reformed Protestantism.

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[35] For Russia see J. Shepard and S. Franklin, *The Emergence of Rus, 750-1200* (Harlow, 1996), 160-9; medieval Cathars, A. P. Roach, *The Devil's World, 1100-1300* (Harlow, 2005); early modern England, E.H. Shagan, *Popular Politics and the English Reformation* (Cambridge, 2003), 1-25. See also *Cambridge History of Christianity* vol.6 *Reform and Expansion, 1500-1660*, ed. R. Po-chia Hsia (Cambridge, 2007) and vol.3 *Early medieval Christianity* (Cambridge, 2008, forthcoming) ed. J.M.H. Smith.

4   Description and calibration of the formal model

In the nature of social science, we are required to make simplifications and approximations. In the next section of the paper, we assume that individual doctrinal belief is determined solely by the network of influences on a weighted scale free network. We set up an agent based model, which proceeds on a step-by-step basis. Within each step, each individual decides whether to remain with his/her existing doctrine or to switch to an alternative. The individuals are connected on a scale free network. A person considers the allegiance of the small number of individuals to whom he or she pays attention in deciding this matter, and switched doctrinal allegiance depending upon the relative weight of influence of theses individuals. We discuss this in more detail below.

Before doing this, however, we need to form a view on the initial conditions of the model, namely the distribution of doctrinal allegiance in the early 1550s between Catholicism, Reformed Protestantism and Freewill Protestantism

The extremes of assessment by historians of religious feeling probably still lie with two of the classic works on the period. For A. G. Dickens in *The English Reformation* Protestants were 'an ever-growing minority among the people of south-eastern England'. However, J. J. Scarisbrick was content to remark that 'the Protestantisation of England, insofar as it was ever accomplished, was really a consequence, not a cause of the Reformation'. For him there were very few Protestants in England and the changes in worship were accomplished by religious zealots hijacking the English state.[36]

More recent writers have been less inclined to present such a polarised picture of religious opinion. Heal reminds us of 'that useful, but inherently ambiguous, term "neuter"', namely the uncommitted, the indifferent, the confused and the outwardly conformist who kept their private views to themselves. Heal considers that at the

beginning of Mary's reign the majority of the population were at least religiously conservative, if not Catholic, and that the number of Protestant supporters 'even calculating to the largest iceberg would only produce a small minority in a population of 2.5 to 3.0 million.'[37] During Mary's reign all these ambiguous categories except the last, could probably be labelled 'Catholic'. Given the discussion at the beginning of this piece and the evidence of genuine enthusiasm for the restoration of Catholicism, this does not seem an unreasonable assumption.[38]

Perhaps the most systematic attempt at an overview of the various studies of popular opinion has been Robert Whiting's *Local Responses to the English Reformation*.[39] What emerges most clearly are the pitfalls of conducting any such exercise. For example, actual presentments of 'heretics' have been discounted as telling more about the attitude of local authorities than the populations. In the diocese of York, which covered most of the North of England, just 47 were accused of heresy in the period 1554-58, yet we know there were pockets of Protestant sympathy in towns such as Hull or Leeds even if the North was generally more conservative and Catholic. Strikingly there was just one burning. By comparison Ipswich, less than 100 miles to the East of London, had 94 presentations for heresy in 1556 alone.

A more subtle method has been using preambles to wills and these are the figures reproduced below. Sixteenth century wills traditionally began with a brief summary of the spiritual reasoning behind the document, such as bequeathing the testator's soul to God, Christ, the Holy Spirit, various saints or Our Lady. A mention of the mediation of the saints or the Virgin Mary on the testator's behalf hints at Catholic sympathies, a more sparse dedication confining itself to the Trinity may indicate Protestant beliefs. Because the author was making provision for eternity and the document would only become public after the testator's death, greater credence has been attached to these documents than other statements of faith.

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[36] Dickens, 2nd edn. (London, 1989), 385; Scarisbrick, *The Reformation of the English People*, (Oxford, 1984), 56. See also C. Marsh, *Popular Religion in Sixteenth-Century England* (Basingstoke 1998), 13-15.
[37] Heal, *Reformation*, 173, 221, 239-40.
[38] E. Duffy, *The Stripping of the Altars* (2nd edn. New Haven, 200), 525-8.
[39] Whiting, (Basingstoke, 1998).

As with a great deal of data in the social sciences, the measurements are far from perfect. For example, those who made wills were overwhelmingly male and middle class and indeed middle aged or older. Preambles were often composed by notaries and testators chose from a range of standard texts which may or may not have represented their private sympathies. Finally, as the middle decades of the sixteenth century wore on, testators became increasingly concerned that the government was going to confiscate all private wealth on religious grounds (a not unreasonable fear after the depredations of the monasteries and private chantries), and so adopted studiously neutral religious formulae which could be misinterpreted as 'Protestant' by later historians.[40] With all these caveats here is a table drawn from Whiting's work.[41]

Protestant preambles as % of wills

	Durham Diocese	York diocese	Hull .	Canterbury diocese	London diocese
1547 -53	7-8	7-8		7-8	32
1553 -58	6	6	4	7-8	20
1558- 68			49		
1558 -70	31	31			

Source: R Whiting *Local Responses to the English Reformation* (London, 1998)

Durham and York are extensive bishoprics in the North. Hull is a major port on the East coast, and Canterbury is the main centre of the English Church 60 miles to the south east of London.

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[40] Heal, *Reformation*, 219-21, A. Ryrie, 'Counting sheep, counting shepherds: the problem of allegiance in the English Reformation' in Marshall and Ryrie eds. *Beginnings* , 86-7.
[41] The most careful consideration of the methodology of the use of will preambles is in Caroline Litzenberger's *The English Reformation and the Laity: Gloucestershire, 1540-80*, (Cambridge, 1997), 168-78. Litzenberger's detailed regional study has not been included here, but her figures for 'Protestant' preambles broadly follow the pattern below established from Whiting, allowing for

We chose as the initial configuration of doctrinal adherence for modelling purposes the percentages which correspond to those in provincial cities in the years around 1550. In other words, we specify that just 8 per cent of the population were Protestant and the other 92 per cent Catholic. Within Protestantism we assign 7 of the percentage points to the majority Reformed doctrine and 1 percentage point to divergent groups, represented by the Freewillers

These percentages are chosen deliberately to be close to one of the extremes of historical opinion. Assigning the vast majority to a clear allegiance, namely the 'Catholic' category will help to illustrate very clearly the impact of influential individuals in switching opinion. In other words, to anticipate, the results show that a relatively small number of influential individuals within a total population can bring about substantial changes of opinion even when the vast majority hold a different view at the outset.

From these initial conditions, as noted above, the model is populated by 500 agents and proceeds on a step by step basis. An individual can hold at any point in time one of the three doctrines. Individuals take into account the views of the small number of people in the scale-free network whose opinions influence them. In the results below, an individual considers the opinion of four other people in deciding whether or not to make the switch. Within reason, the results are not sensitive to the precise choice of 'four'. Again, however, in the absence of precise information, it seems reasonable to assume that in a matter as intimate as the choice of religious doctrine, in general people will only seriously take account of the opinions of a small number of others.

The individuals are allocated to their respective doctrines, and the relative weight of their importance is added up. This weight is given by the number of individuals each of these individuals influences. Of course, this will not be known precisely in practice by the person considering his or her allegiance. But he or she will be aware of the relative weights, so that a bishop or a martyr will in general be known to be more significant than, say, one's brother.

Litzenberger's insistence on testator caution and therefore 'neutrality' after 1558, viz. 1541-6, 0.4%; 1547-53, 3%; 1553-58, 1.6%; 1559-69, 2.2%.

An individual decides to switch if more than a certain percentage of the total weight of the individuals to whom he or she pays attention subscribes to the rival ideology. In other words, this is a measure of the pressure from the relevant peer group. The more the people to whom an individual pays attention are in the rival group, the more likely it is that he or she will switch. The critical percentage is set by the user of the model.

Given that switching is by no means a trivial matter, it makes sense to assume that a clear majority of the weighted relevant opinion for an individual should be of the opposite view before he or she decides to switch. In the illustrative results below, we set the critical percentage at more than two-thirds (0.67). In other words, if up to and including two thirds of the influence to which the individual pays attention is in the rival camp, he or she remains faithful to his or her original set of views. Only if this is greater than two-thirds will the switch be made. This is a deliberately conservative assumption; religion is not a supermarket and it is difficult to change people's religious outlook. If we had empirical evidence on the size of the critical percentage, we could use it in the model, but in the absence of this knowledge, the two-thirds assumption seems reasonable.

Knowledge of who precisely holds to what doctrine can never be recovered, except for a few prominent individuals, no matter how careful and diligent the historical research, so in each solution we allocate individuals at random in the percentages 92 Catholic, 7 Reformed Protestant and 1 Freewill Protestant. Further, we do not know the exact structure of the social network across which people formed opinions, but are approximating it with a structure which appears reasonable. The outcome of each individual solution will depend upon exactly who holds what opinion to begin with, and in exactly who is connected to whom. However, by obtaining a large number of separate solutions (500 in the results below) two advantages are achieved; in statistical terms the idiosyncrasies of individual solutions are averaged out and in real life the solutions of the network tell us not what will or has happened, but the likelihood of one particular solution prevailing.

5   Results

First of all, we present results in which everyone in the model is allocated initially a doctrine at random according to the specified percentages. An implication of this is that, because 92 per cent of the total number of individuals is assumed to be Catholic, the most influential individuals are much more likely to be allocated as Catholics rather than Protestants.

On average, across 500 separate solutions of the model, the percentage of Catholics rises from 92 per cent at the start to 97.8 per cent. In no fewer than 360 out of the 500 solutions, the spread of Catholicism is complete and 100 per cent adhere to that doctrine. The percentage of Reformed Protestants falls from 7 per cent to, on average, 1.8 per cent , and the Freewill from 1 per cent to only 0.2 per cent. Indeed, in 409 out of the 500 solutions Freewill is eliminated completely.

Figure 1 below summarises the results. In interpreting this chart, remember that it is summarising 500 separate solutions of the model. The tall bar at the right indicates that in many of these solutions, 360 to be exact, all the population end up as Catholic. Catholicism remains the completely dominant religion in all solutions, and in only 49 out of the 500 does the percentage of Catholics end up at a percentage lower than the initial one of 92.
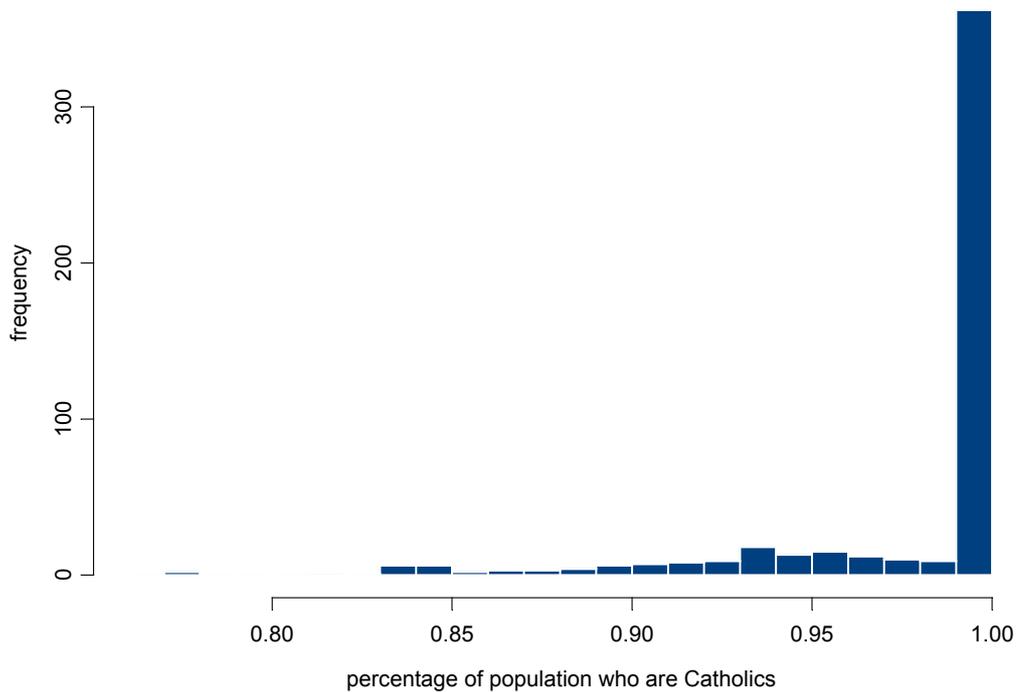
Figure 1 *Percentage of population who end up as Catholics. Initially, 92 per cent are Catholic, 7 per cent Reformed Protestant and 1 per cent Freewiller. Initially everyone, including the most influential individuals, is allocated at random to these categories in the respective percentages*

We now allocate initially the most influential 0.2 per cent of the population to be Reformed Protestants. Otherwise, everyone else is allocated at random, and the overall percentages of the three doctrines are as before.

The effect of this seemingly small change is rather strong. Catholicism gains 100 per cent adherence in just 45 out of the 500 solutions, compared to 360 above, and on average 88.1 per cent end up as Catholics. The eventual outcome in 358 out of the 500 solutions is that the Catholic percentage is lower than the initial 92 per cent, though it ends up as a minority in only 2 solutions out of the 500. Protestantism survives, though the percentages are still small, with 11.5 per cent on average being Reformed Protestants and 0.4 per cent Freewill.
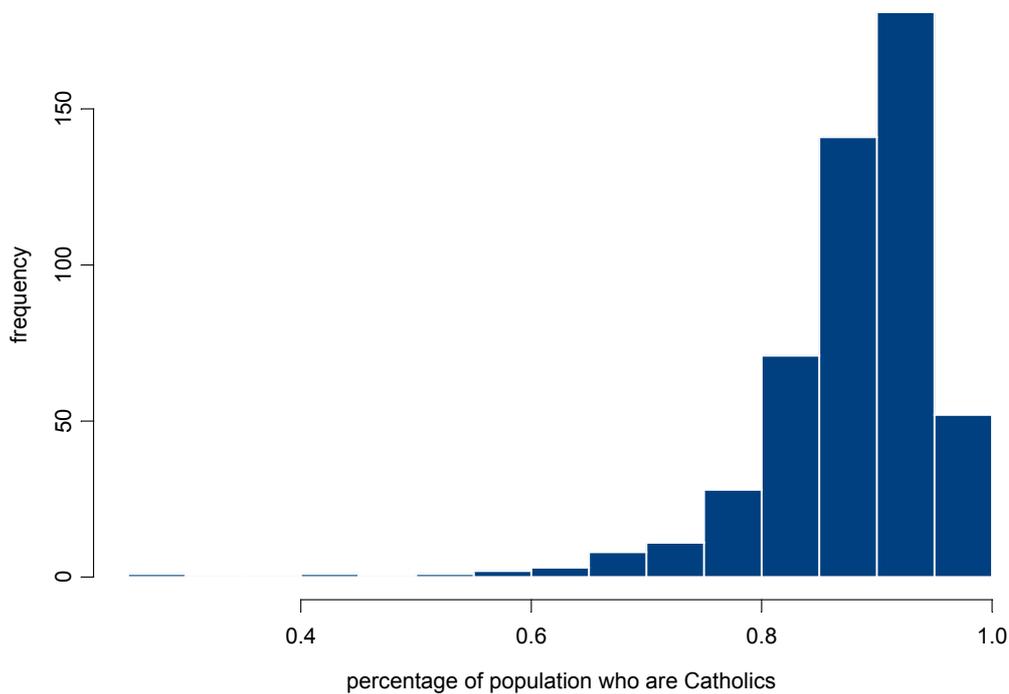
Figure 2 *Percentage of population who end up as Catholics. Initially, 92 per cent are Catholic, 7 per cent Reformed Protestant and 1 per cent Freewiller. Initially everyone, except the most influential 0.2 per cent of individuals, is allocated at random to these categories in the respective percentages. The most influential 0.2 per cent are allocated as Reformed Protestants.*

The effect of assuming the most influential 0.4 per cent are initially Reformed Protestants is even stronger. Catholicism attracts 100 per cent support in just 8 solutions, and on average 71.6 per cent adhere to this doctrine. The eventual outcome in 492 out of the 500 solutions is that the Catholic percentage is lower than the initial 92 per cent, and it ends up as a minority in 37 solutions out of the 500. Now, the initial 7 per cent in the Reformed Protestant camp becomes 28.0 per cent, with again just 0.4 per cent subscribing to Freewill. In so far as we can calibrate the model to Whiting's data, this set of solutions broadly corresponds to the evolution of stated belief.
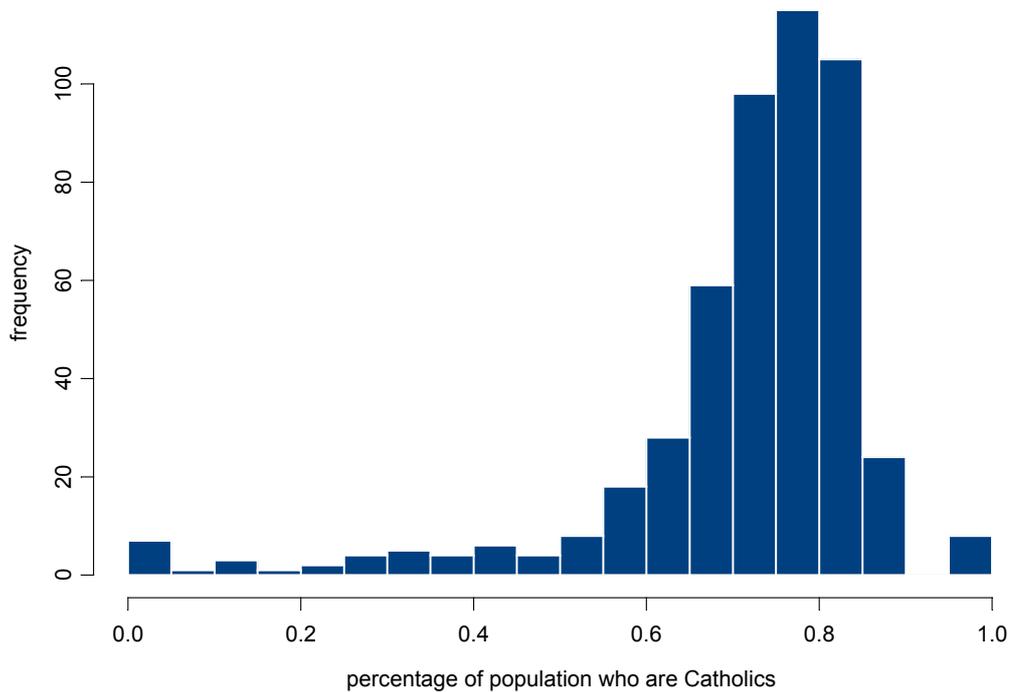
Figure 3   *Percentage of population who end up as Catholics. Initially, 92 per cent are Catholic, 7 per cent Reformed Protestant and 1 per cent Freewiller. Initially everyone, except the most influential 0.4 per cent of individuals, is allocated at random to these categories in the respective percentages. The most influential 0.4 per cent are allocated initially as Reformed Protestants.*

Finally, we allocate the most influential 0.2 per cent to be Reformed Protestants and the second most influential to be Freewill. The eventual percentage of Freewillers remains small, but the average of 5.2 per cent is decisively larger than in any of the above results. This compares to the average of 12 per cent for the Reformed Protestants. Indeed, in 19 out of the 500 solutions, the eventual percentage of Freewillers is greater than the percentage of Reformed Protestants. So if Mary had burned more Freewillers, it appears that the doctrinal splits within Protestantism would have been preserved.

These results can also be seen as hypothetical historical counter-factuals.

The first set of solutions, where the chief opinion formers are allocated at random, suggests that had Mary's government not burnt anybody, England might very well have remained a Catholic country. This is not completely surprising to historians, given the longstanding emphasis the historical literature has placed on the role of the martyrs. There were plenty of reasons why her English subjects disliked Mary, such as her marriage to the King of Spain, her close relationship with the Pope (there had been tension in the centuries prior to the 16th between Catholic England and the Pope), and her loss of Calais, England's last colonial territory in France. Her death, and Elizabeth's accession, were welcomed by many. But even so, without the martyrs, the reformers under Elizabeth might have found their task of restoring Protestantism much harder.

The two subsequent sets of results suggest that the persecuted Protestants were right and that the burnings offered an unprecedented opportunity to influence opinion. England still remains in most cases in the results a broadly Catholic country by the end of Mary's reign. But the scale of the changes caused by assigning a relatively small number of opinion formers to Protestantism suggests that enough people had switched allegiances to significantly weaken support for traditional religion by the early years of Elizabeth's reign. Moreover, the persecution concentrated attention on the Reformed Protestants and helped to effectively eliminate the attractions of competing Protestant groups.

The spread of Protestantism throughout England and the complete marginalisation of Catholicism took several decades to complete, but the seeds were sown in the 1550s. Those who were persecuted by the Marian government shrewdly chose martyrdom as an opinion-changing strategy as well as for its own spiritual benefits. Modern understanding of network theory shows that they were right to do so.

A final point from a historical perspective is that the results suggest that in this particular context, the behaviour of particular individuals was of decisive significance in influencing the eventual outcome. The rapid rise of Protestantism in England in the mid-16th century was not ultimately due to social and economic forces, but to the

deliberate actions of a relatively small number of religious leaders, both national and local, who chose to die for their beliefs.

6   Conclusion

There is a large and rapidly increasing literature which analyses social networks for which substantial amounts of quantitative data are available. Further, there is a growing and related literature on what is referred to by economists as 'information cascades' on such networks.

In this paper, we describe the process of emergence and evolution of a historical social network across which the opinions and behaviour of individuals were influenced. We also illustrate how empirical networks can be reconstructed relying principally on information contained in qualitative, historical sources.

The specific example we use is religious belief in England in the 1550s. We describe how the burnings of Protestant leaders by the Catholic Queen Mary (1553-1558) created a set of martyrs which was decisive in increasing support not just for Protestantism compared to Catholicism, but which led to the rapid disappearance of rival Protestant factions.

We have shown how qualitative information in historical documents can be used to describe how a network emerges and evolves across which ideological beliefs are determined. By supplementing it with a small piece of quantitative evidence, we are able to calibrate it to the data on the evolution of religious opinions in England in the 1550s, when the foundations for Protestantism were laid.