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Competing Social Influence in Contested Diffusion: Luther, Erasmus and the Spread of the Protestant Reformation

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Competing Social Influence in Contested Diffusion: Luther, Erasmus and the Spread of the Protestant Reformationⁱ

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Abstract

The spread of radical institutional change does not often result from one-sided pro-innovation influence; countervailing influence networks in support of the status quo can *suppress* adoption. We develop a model of multiple and competing network diffusion. To apply the contested-diffusion model to real data, we look at the contest between Martin Luther and Desiderius Erasmus, the two most influential intellectuals of early 16th-century Central Europe. Whereas Luther championed a radical reform of the Western Church that broke with Rome, Erasmus opposed him, stressing the unity of the Church. In the early phase of the Reformation, these two figures utilized influence networks of followers, affecting which cities in the Holy Roman Empire adopted reform. Using newly digitalized data on both leaders' correspondence networks, their travels, the dispersion of their followers, and parallel processes of exchange among places through trade routes, we employ econometric tests and network simulations to test our theoretical model. We find that Luther's network is strongly associated with the spread of the Reformation and that Erasmus's network is associated with the stifling of the Reformation. This is consistent with a "fire-fighting" mechanism of contested diffusion, whereby the countervailing force suppresses innovations only after they have begun to spread.

Keywords: contested diffusion; multiplex networks; correspondence networks; Protestant Reformation

I. Introduction

The diffusion of ideas is typically modeled as a one-sided (*unidirectional*) pro-innovation influence against a passive status quo. Yet, while a proponent of change is invested in bringing about change, there may be strong and active opposition to convince others to defend the status quo. Our paper proposes a new model of contested diffusion, which is general in scope and applicable to a variety of contexts.² To illustrate our model, we look at one of the most dramatic periods of institutional change in the last millennium: the Protestant Reformation.

The Reformation began with Martin Luther's defiance of the Catholic Church in 1517. Luther rapidly expanded his influence from the provincial university town of Wittenberg to reach out to literate townsmen across Central Europe (Becker, Hsiao, Pfaff and Rubin 2020). But was Luther's effort to persuade cities to join the Reformation movement uncontested? Hardly. From the start, Luther had opponents. Theologians loyal to the Church tried to counter Luther, but their stale conservatism had little influence outside of bastions of orthodox strength (Bagchi 1991; Kim and Pfaff 2012). To counter the newly famous Luther—to admiring humanists the “German Hercules”—Catholic leaders like Pope Clement VII, Sir Thomas More, and Duke George of Saxony wanted an intellectual celebrity to go on the attack.

Desiderius Erasmus had been denouncing the renegade since Luther's condemnation at the Diet of Worms in 1521, but in 1524, he satisfied Catholic Europe's pleas for him to swing his enormous influence against Luther. He published a diatribe, *The Freedom of the Will*, criticizing Luther's theology, accusing him of undermining popular piety, and threatening Western Christendom. Luther replied in a diatribe of his own, *On the Bondage of the Will*, condemning Catholic doctrine and Erasmus in unsparing terms (Massing 2018, chs. 34, 38; Winter 1961).

In the 1520s, Luther and Erasmus became the “two suns” around which debates concerning Church authority and doctrine revolved (Burnett 2019: 17). Rummel (2004: 90) notes, “In fact, it is striking how many people depicted their confessional choice as one between Erasmus and Luther.” They waged a war of words and “the widening differences between the two men flared into bitter competition” (Massing 2018: xiii). Humanists in the towns, advisors in rulers’ palaces, and students and scholars in the universities joined a debate split between Erasmian and Protestant camps (Tracy 1996; Rummel 2000, 2004; Burnett 2019). It was clear that every literate person would have to make a stark choice: remain with the Church, as Erasmus urged, or break with it, as Luther demanded.

Our paper focuses on the early phase of the Reformation in the Holy Roman Empire (hereafter, HRE): the period from 1523 (when the first formal adoption of the Reformation occurred) to 1530 when the Protestant princes and cities, meeting in Augsburg, formed a political coalition. We focus on this phase because it was then that the Reformation took the form of an urban social movement (Ozment 1975; Scribner 1986; Kim and Pfaff 2012). During this phase, the HRE’s territorial princes played a secondary role (Dixon 2000; te Brake 1998), allowing us to test diffusion mechanisms among cities without the decisive influence of larger political forces. This is because in the decentralized and politically fragmented HRE, larger towns and cities were self-governing corporate entities (*Stadtrecht*) governed by town councils (*Räte*). As the Reformation spread, civic elites were under pressure to adopt Protestantism or remain with the Church. By 1530, about one third of cities in the HRE adopted reform.³ Why did some cities swiftly adopt it while others resisted early Protestant inroads?

We focus on the conflict between Luther and Erasmus and the public contention it created because it sheds light on the general process of *contested diffusion*. By that we mean the process

by which the diffusion of an innovation is actively propelled by influential agents while simultaneously being actively opposed by others. We develop a model of contested diffusion and test it based on a reconstruction of Luther's and Erasmus's networks. We selected them because they were the key intellectual figures in early Reformation and the most famous Europeans of their day. Fortunately for the social scientist they left abundant information about who they knew, who they wrote, and where they traveled. We gathered extraordinarily rich data regarding their networks through their correspondence, the places they visited, and the students they influenced. Importantly, we know where these contacts were located, allowing us to recreate the spatial reach of their competing influence networks.

We build on the approach taken by Becker et al. (2020). They find that the presence of Luther's personal influence network was positively associated with a town adopting the Reformation and simulate counter-factual scenarios with and without his influence. We go a significant step further to consider a neglected factor, namely, how ideological opponents can *counteract* the adoption of innovations. Capturing contestation is an important consideration for any episode of institutional innovation that diffuses across pre-existing networks. Nevertheless, contested diffusion is overlooked in many studies of innovation and most papers in the social-scientific study of the Reformation ignore such forces, noting that the institutionalized resistance did not begin until the Council of Trent (1545-63).⁴ But this did not mean that there were no forces impeding the earlier spread of the Reformation (Kim and Pfaff 2012). Erasmus and his influence network were one such force that has never been systematically evaluated. In the Reformation, averting the breakthrough of the incipient Protestant insurgency at a few key nodes in the urban network could have been enough to impede its spread.

We proceed to overlay Luther and Erasmus' personal networks on a city-wide network based on European trade route maps. This multimodal strategy (Knoke, Diani, Holloway, and Christopoulos 2021) allows us to determine whether they exercised influence above and beyond network diffusion among cities. We readily acknowledge that towns could have influenced each other's decisions to adopt or reject based on spatial proximity in the network without leaders having independent influence. It is also possible that Luther or Erasmus's influence on a town may have diffused to nearby towns without those towns actually having a contact with the leaders via trade network diffusion. We are able to recreate the networks over which Erasmus or Luther had *direct* influence (via a personal connection) and *indirect* influence (via spatial network diffusion). We can also analyze whether Luther and Erasmus reduced each other's influence. Further, we can exploit temporal variation to discern whether the order of contestation mattered.

Analytically, we begin by presenting a set of panel regressions which allow us to control for various characteristics of a city that may have contributed to its decision to adopt the Reformation. Our regression results reveal two robust results: 1) Luther's network was positively associated with the spread of the Reformation, but only when a town was not subsequently contested by Erasmus, and 2) the Reformation spread spatially independent of Luther and Erasmus's influence (i.e., neighboring towns adopting the Reformation influenced the adoption decision).

However, there are pitfalls to relying solely on regression analyses. Beyond the fact that the network of both men was not exogenous to the questions under study, simple regression analyses do not permit us to tease out the *counterfactuals* that give greater credence to a causal interpretation of influence networks. To explore counterfactual scenarios, we propose a contested diffusion model in which a global innovator makes personal connections with local elites, attempting to persuade them to adopt where local resistance is an expected part of the adoption process. However,

in our contested diffusion scenario, the global innovator is opposed by a global defender of the status quo who also uses personal connections with local elites, persuading them to reject the innovation. If contested diffusion actually mattered for the spread (or failure) of the Reformation, it should matter in some key nodes more than others. To address this issue, we conduct a simulation analysis based on our model that explores three ways in which pro-innovation and anti-innovation influences might compete, which we denote *market competition*, *ideological inoculation*, and *firefighting*. Combined, the results of the regression and simulation analyses suggest that unidirectional diffusion models may overstate the degree to which a network is responsible for diffusion when that diffusion is *contested*. To complement regression analysis and computer simulations, we further provide an analysis of case studies of cities where firefighting was at work.

II. A Theory of Contested Diffusion

The case of the early Reformation seems incompatible with simple social diffusion models. For one thing, it spread through multiple vectors, most famously printing (Rubin 2014, 2017). However printed materials alone cannot explain patterns of Protestant adoption. The Reformation did not occur because of simple viral transmission of ideas or because of individual conversion. Reform required major institutional alterations, namely, changing the constitution of the city (Dittmar and Meisenzahl 2020). This meant that there were substantial obstacles to reform, including local resistance, established interests, and status quo bias. Although abolishing the Roman Church and replacing it with new churches may have suggested a variety of benefits to civic elites (Ekelund, Hebert and Tollison 2006; Pfaff and Corcoran 2012; Cantoni, Dittmar, Yuchtman 2018), the payoffs to adoption remained uncertain in the early Reformation. In addition, adoption was complicated by very real dangers, not least, civil war or imperial and papal

retribution against wayward cities (te Brake 1998; Nexon 2009). In short, institutional adoption involved costs and uncertainty, faced orthodox resistance, and confronted steep hurdles to implementation. Learning processes are inadequate to generate widespread adoption when information is poor, investment in the existing institutions is substantial, and when status quo bias increases thresholds for embracing the new (Young 2009). Widespread adoption under these conditions depends upon persuasion and social reinforcement.

Our theory expands upon the complex diffusion model elaborated by Damon Centola (Centola and Macy 2007; Centola 2018) and employed in subsequent empirical studies (Manzo et al. 2018; Wurpts et al. 2018; Becker et al. 2020; Hsiao 2021). The complex diffusion framework challenges simple viral diffusion models in which exposure to contagion suffices for adoption, making the topology of the network the most important factor in accounting for the breadth of diffusion. Complex adoption processes are costly and involve uncertainty. We extend the argument to claim that, when an innovation challenges established institutions, widespread adoption requires persuasion. Of course, actors seek to learn about the costs and benefits of innovation as part of decisions to adopt it, with the anticipated size of payoffs being a factor in adoption (Young 2011; Kreindler and Young 2014). However, the importance of learning can be overstated. Centola (2018) argues that uncertainty is an important part of complex adoption. Overcoming it may require endorsement by opinion leaders whose social capital offers positive reinforcement and reduces uncertainty (Barabási 2009; Burt 2005; Manzo et al. 2018; Siegel 2009). Complex adoption depends upon “legitimacy, credibility, or complementarity” (Centola 2018: 35). Decisions by others to adopt fosters adoption, and interdependence is one of the hallmarks of sociological diffusion models (Moody 2009; Valente 1995, 2005, 2017). This means, as Centola and others have shown, that the structural features of networks matter. Wide bridges (e.g., multiple ties

between actors) and local clusters of adopters seem to promote the diffusion of innovations (Centola 2018; Centola and Macy 2007; Kreindler and Young 2014; Strang and Soule 1998;; Valente 1996; Young 2011).

Centola and Macy's (2007) original paper included an element of resistance in complex contagion but did not address competing influence. They assumed a conservatism that would be reinforced by a local proportional threshold of others remaining with the status quo. Hence, the greater the number of conservative ties in one's neighborhood, the lower the odds of adoption. Beyond structural reinforcement, however, relational factors might be decisive, in particular the work of opinion leaders who exploit their influence network to persuade others to adopt (Rogers 2003; Valente and Davis 1999; Valente and Pumpuang 2007; Watts and Dodds 2007). However, opinion leaders need not favor innovation. Complex diffusion can take on the form of a contest between the defenders of established ideas and institutions and those who seek to unseat them. In that instance, diffusion occurs partly because of the relative influence on potential adopters of the insurgents, on the one hand, and, on other, the defenders of the status quo. This means that, net of the characteristics of the adopters and the structural context in which they act, the chances of adoption are affected by the weight of social influence of the contending opinion leaders. Insurgents and defenders strive to make themselves persuasive, influencing potential adopters not only through the indiscriminate, broadcasted influence of books, pamphlets, or mass media, but through *targeted personal outreach* to local decision-makers that is enabled by the breadth of their social networks.

“Legitimacy” and “credibility” are acknowledged parts of the complex adoption scenario. This implies that opinion leaders can exploit their influence as a relational feature of networks. By influence, we mean a relational property of individuals that is constituted by their reputation,

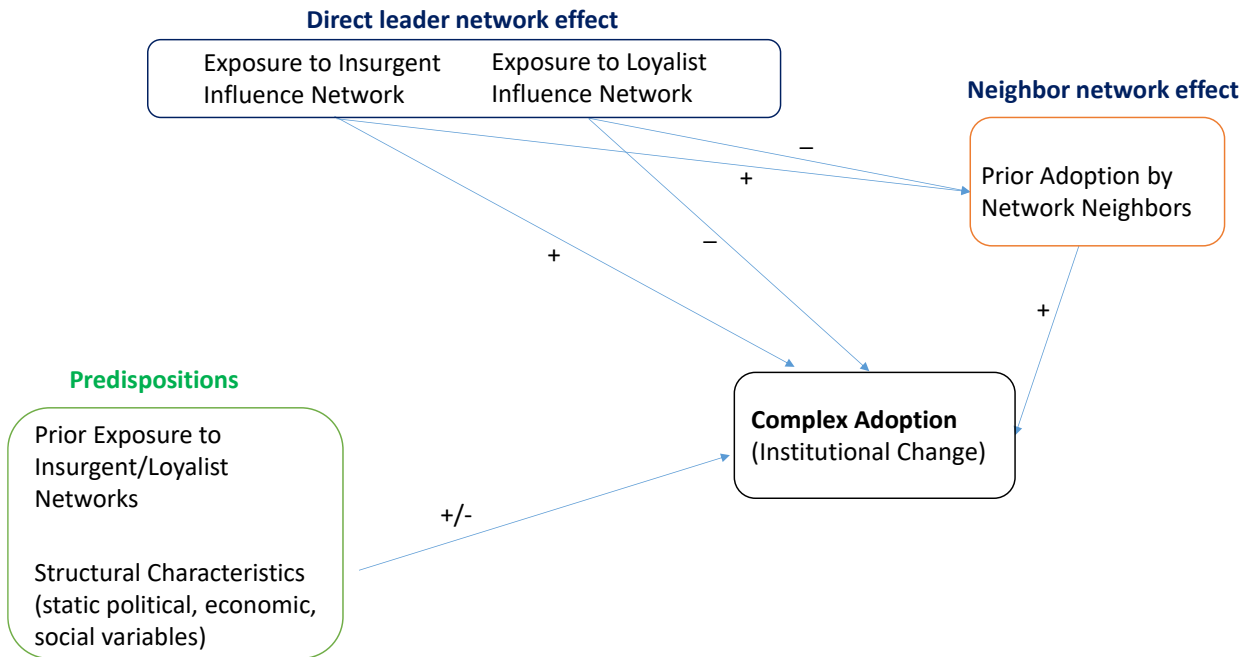
rhetorical skill, and previous accomplishments (Knoke, et al. 2021: 7). We routinely see this kind of influence in political campaigns, where personal appearances by candidates or their boosters can be an important factor in persuading voters (e.g. Buggle and Vlachos 2023; Heersink and Peterson 2017). However, the literature has generally focused only on the pro-adoption influence of opinion leaders (e.g. Assouad 2021; Cagé et al. 2022; Selb and Munzert 2018; Wang 2021).⁵ Theoretically and empirically, not all opinion leaders should be assumed to favor innovation. Some might be invested in the defense of incumbent institutions or established practices, persuading others to reject the innovation. For instance, famous people might make campaign appearances to persuade citizens to vote against a referendum.

The two-step, contested opinion leader model of social diffusion we propose suggests that success of a complex innovation at the local level requires that it be first taken up by resourceful, respected, and informed actors, who, in turn, increase the odds that others in their social circles will adopt as well. However, the failure of a complex innovation can be understood the same way once we include the efforts of global defenders of the incumbent institution to persuade locally influential people to oppose adoption. In sum, we propose a model that presumes a flow from the global to the local site of adoption: pro- and contra-innovation global opinion leaders → local elites → complex adoption/or status quo. Our theory of contested diffusion is summarized below in Figure 1.

The literature has started to pay attention to processes of contested diffusion, especially by developing game-theoretical or simulation models (Fazeli, Ajourlou, and Jadbabaie 2017; Hsiao 2022; Huang, Chen, and Ma 2021). Nonetheless, because of the hypothetical nature of such models, contested diffusion is *assumed* rather than proven. In evaluating our model, we use empirical data and employ regression analyses but also use empirically-based simulations to probe the

mechanisms operating in the Reformation. Because of our empirical data, we evaluate, rather than assume, multiple potential mechanisms by which pro-innovation and anti-innovation influences might compete, which we denote *market competition*, *ideological inoculation*, and *firefighting*.

Figure 1: A Model of Contested Diffusion in Complex Adoption



Market competition occurs when two or more ideas or innovations contend. One of them may enjoy an incumbency advantage but the market is open and contestable (see, e.g., Adler and Kwon 2013; Fiss and Zajac 2004; Schneiberg 2013). In such situations, information about alternatives and the anticipated payoff to adoption decide the extent of diffusion (Young 2011; Kreindler and Young 2014).

The second possibility is that defenders of incumbent institutions use their influence to negate the appeal of innovators in advance of contagion, perhaps by *ideological inoculation* against innovation. They acknowledge grievances and insist not on uncritical orthodoxy or repression but

rather on loyalty to the established institution (see, e.g., Holtkamp 2022). Loyalty is a sentiment that deters exit (Dowding et al. 2000; Hirschman 1970).

Finally, contested diffusion could be thought of as *firefighting*. An incumbent facing insurgent challengers may respond by seeking to stamp out the sparks of that insurgency by deploying prominent defenders to intervene. This kind of contest would be largely reactive, with the incumbent institution monitoring the activities of their opponents and responding to local threats.

III. The Contest in Context: The German Hercules versus the Great Northern Humanist

Whatever early sympathies Erasmus had for Luther's calls for reform, he thought that the renegade was stirring up trouble: "I was sorry that Luther's books were published; and when some or other of his writings first came into view, I made every effort to prevent their publication", he wrote to Cardinal Albert of Brandenburg in 1519 (Grendler 1983: 94). His hostility mounted after the imperial condemnation of Luther at the Diet of Worms in 1521 (Rummel 2004). As the "natural" leader of the literate burghers, Erasmus considered himself the "ideal person" to rally the cities against Luther (Tracy 1996: 81). He was confident of his success, boasting that his opposition "produced a change of heart in many people who had been wholly committed to the Lutheran view" (Massing 2018: 609).

Communication and persuasion were unmistakable parts of the Reformation (Pettegree 2005). The importance of the printing press is well established and both men were prolific authors with a wide market reach (Edwards 1994; Eisenstein 1980; Rubin 2014, 2017; Pettegree 2015). However, the printed word was not the only vector by which contending influences shaped the Reformation. There was a contemporaneous "communications revolution" alongside printing (Behringer 1990, 2006; Greengrass 2016; John 2015). Letters, goods, and people were moving more swiftly and

more easily. In the HRE, Habsburg emperors contracted postal services to an innovative and effective private firm (the *Thurn und Taxis* family) and opened the system to the public, inaugurating a “golden age” of postal expansion.

The imperial contract regulated the prices and speed of delivery between cities. For example, the 1516 contract specified that a letter posted in Brussels should reach Innsbruck in five days and that one posted in Antwerp should reach Augsburg in six days (Behringer 2006: 344, 347). Improved roads and postal inns allowed private travel to flourish (Behringer 2006). This communications leap explains why Luther and Erasmus as global opinion leaders could reach local elites and influence local disputes. From the perspective of contested diffusion through social influence, new infrastructure enabled 1:1 communication across space, even across great distances.

Why were these two contenders so influential? Our theory treats influence as a relational property of an individual that is constituted by their social standing, reputation, rhetorical skill, and accomplishments. Today, Martin Luther (1483-1546) is famous because of his role in initiating and leading the German Reformation (Brecht 1985; Oberman 2006; Hendrix 2015; Roper 2017). Luther began as an unknown professor at Wittenberg where he made his public stand against the doctrine of indulgences in 1517. In the next few years, he became renowned through pamphlets, sermons, and public hearings at official disputations. He withstood condemnation at the imperial diets at Augsburg and Worms. By 1521, Luther had been excommunicated and outlawed but an evangelical movement he inspired began to spread outward from Wittenberg, a process accelerated by the reach of his influence networks (Becker et al. 2020).

Erasmus (1466-1536) was the greatest man of letters in Europe. Historians regard him as the continent’s first “public intellectual” (Burke 1999) and Western Christendom’s “first citizen of the world” (Grendler 1983: 88). He published textbooks in Greek and Latin, manuals on piety and

ethics, political treatises, and religious polemics (Massing 2018). To give but one example of his reach, by 1520 his satire, *The Praise of Folly* (1509), had been reprinted some forty times in runs of at least one thousand copies (Grendler 1983: 96).

The “prince of the humanists” owed his fame to the expanding ranks of literate burghers, especially those aspiring to Classical learning (Schoeck 1990; Tracy 1996). Having done more than anyone else to carry the the Renaissance north of the Alps, Erasmus positioned himself as the leader of cosmopolitan society and a unified Catholic civilization (Grendler 1983; Tracy 1968, 1996; Greengrass 2016). His New Testament in the original Greek, with Latin translation and commentary, was taken up by every serious Biblical scholar, including Luther. At the same time, loyalty to the Church and its traditions were absolutely sacrosanct for Erasmus (Schoeck 1990).

Luther and Erasmus tried to sway the same sort of people. Luther’s ideas gained purchase partly because of his standing as a priest, monk and professor at Wittenberg, “[o]ne of the earliest and most important universities founded in the humanistic spirit” (Hammerstein 2003: 17). Luther and his colleagues portrayed Wittenberg as a hub of Humanism—an association Erasmus denied (Rummel 2000: 22). Erasmus also sought to shape the universities, prevailing against conservative resistance to reform the curricula at Louvain and Basel.

Beyond their personal animosity, Luther and Erasmus offered profoundly different visions of what urban religious and cultural life should be like and whether fidelity to the Church was healthy or destructive. Literate opinion mattered in the self-governing towns. Accordingly, both men sought to use their social ties to persuade cities to accept or reject the Reformation. Some humanists, influenced by Erasmus, would stay with the Church, while others went over to the Protestant movement (Rummel 2004).

IV. Mapping Luther and Erasmus's Influence Networks

Luther and Erasmus developed multiplex influence networks (Knoke et al. 2021; Wasserman and Faust 1994) in parallel fashion, operating through their correspondence networks, visits to friends and important people, and through their influence on scholars (Roper 2017: xxiii; Schoeck 1990: 206-7). To be clear, we do not contend that their social networks were initially designed to facilitate or arrest the spread of the Reformation. Both men's social networks originated prior to 1517 and for reasons that had nothing to do with the Reformation. However, once the Reformation struggle began, Luther and Erasmus sought to exert and expand their influence and benefitted from already established attraction to their ideas and personas. By the 1520s, both men's influence networks connected them as global opinion leaders with the locally influential people who would decide the fate of reform in the towns.

(1) Correspondence

Erasmus and Luther were master practitioners of the art of humanist letter-writing and used it to win friends and influence people (Greengrass 2016; McLean 2007). Humanists imagined the letter as something more than a mere exchange of information. Erasmus insisted that letters should be persuasive and a means to conduct conversations between absent friends, including among correspondents who never met in person (McLean 2007)

Erasmus was the greatest correspondent of his age, authoring thousands of letters to wide network of associates, many of whom he never met in person (Grendler 1983: 95; Schoeck 1990: 252; Tracy 1996: 111). He especially cultivated ties to humanists and powerful people like kings, popes, officials, prelates, and civic leaders (Schoeck 1990: 104). Erasmus' early experience as a Latin secretary to a bishop strengthened his affinity with the educated secretaries and lawyers who

flourished with secular and ecclesiastical administrative centralization (Grzymala-Busse 2020). He assiduously cultivated such people as sources of information and patronage (Schoeck 1990: 140-1). A master letter writer, he was famous for his rhetorical techniques of flattery and persuasion (Tracy 1996: 111-115).

Martin Luther too was a prolific correspondent (Roper 2010: 283). Luther used letters to stay in contact with students and colleagues, to rally supporters, to respond to queries and critics, to answer requests for assistance or advice, and to persuade influential people to adopt the Reformation (Brecht 1985: 77-80; Roper 2010; 2017; Greengrass 2016). Like Erasmus, he was a “brilliant, engaging correspondent” (Roper 2017: xxxiii).

(2) Travel

Travels were the second activity that created Luther’ and Erasmus’ influence networks. Luther’s journeys provided him with opportunities to make personal connections and cultivate allies in the heart of the German-speaking lands. In about half of the places Luther visited, he preached, gave a public address, or met senior political or ecclesiastical officials (Buchwald 1929). The detailed accounts of his journeys in Köhler (1880) and Lingke (1769) suggest that Luther used visits as opportunities to widen his social network and cultivate allies.

Erasmus was born in the Low Countries but his true homeland was the Latinate world of Europe. Study, the business of book publishing, and the pursuit of employment and patronage led him to travel often and widely—in the Low Countries, France, Italy, along the Rhine, and to England (six times!). Wherever he went, Erasmus sought to cultivate friends among literate people and power-holders (Schoeck 1990: 253-4). For instance, during his journey up the Rhine in 1514, Erasmus visited humanists wherever he went: “Germany has received me with so much honor that

I am almost embarrassed”, he wrote (Tracy 1968:282). In repeated journeys from the Low Countries to Switzerland, humanists in the larger towns eagerly received and hosted Erasmus. In them he befriended scholars, prelates, printers, and leading burghers (Bejczy 1997; Massing 2018: 241-2).

(3) Students

After 1517, Luther began to mobilize Wittenberg students to become proponents of the Protestant cause in their native lands. Luther had a missionary enterprise and students were his emissaries (Schwiebert 1996; Grendler 2004; Hendrix 2015). Luther cultivated students with the intention of sending them back to their home towns to preach the new theology and press for local reform (Kim and Pfaff 2012).

Erasmus also had a large influence on university life, though he was never an ordinary professor and never mobilized students in the same way as did Luther. Nevertheless, he had an enormous presence in the university towns of Louvain and Basel where curricula were reorganized according to his plan for trilingual (Hebrew, Greek, Latin) colleges (Burke 1999). Generally, Erasmus was very active in cultivating Humanism in the universities (Massey 2018: 294).

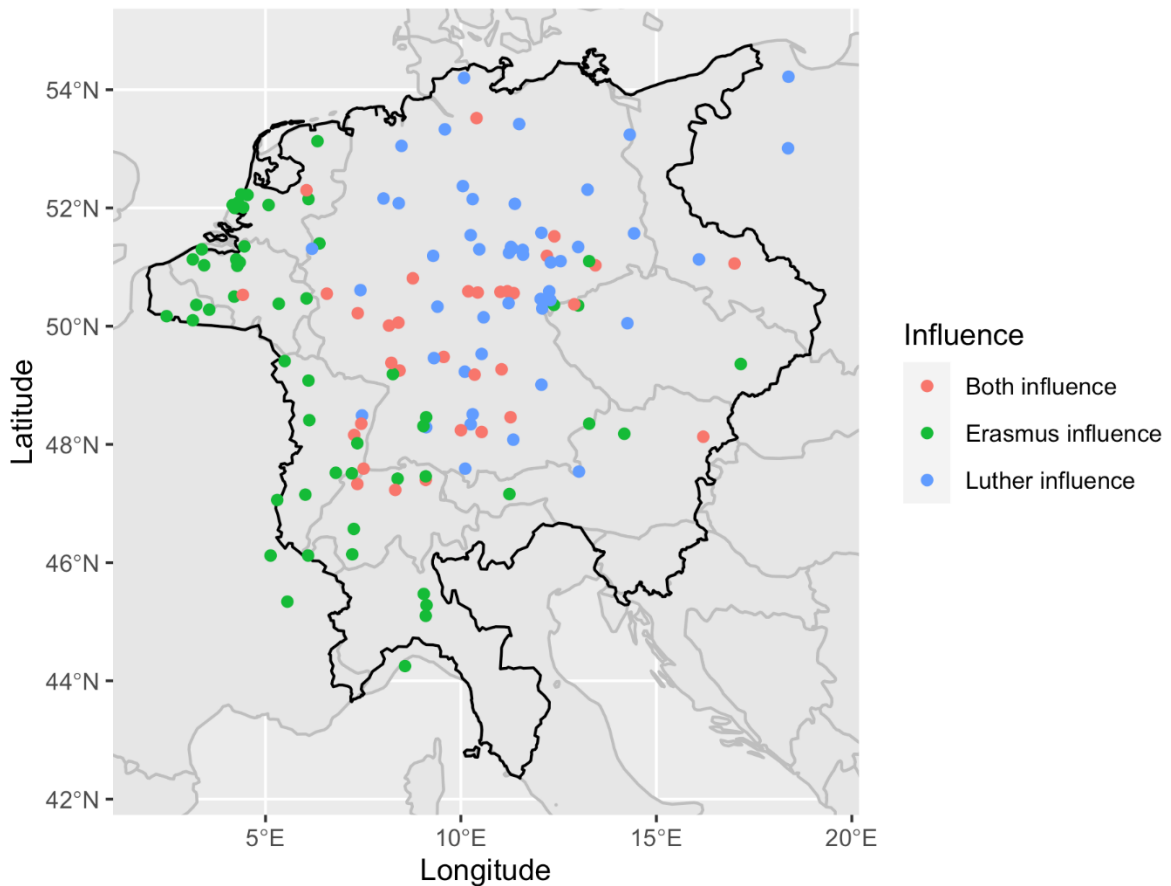
V. Data

We employ several data sources to test the role that Luther’s and Erasmus’s networks played. Our universe of observations in the regression analyses is cities in the de jure HRE that either have evidence of population in 1500 in the dataset collected by Bairoch et al. (1988) or had town status and a population size of two thousand or more in 1500. The de jure HRE includes cities in present-day Germany, Switzerland, Austria, Czech Republic, Belgium, Netherlands, Luxembourg, France,

Italy, and Poland.⁶ This yields 585 cities. Data on Reformation adoption, printing press adoption, and a host of control variables are from Kim and Pfaff (2012) and Rubin (2014). We reconstructed the trade network between these cities as revealed by their location on the contemporaneous regional and long-distance (*Handels-und Fernhandelsstrassen*) trade routes in standard historical atlases (Berthold 1976; Magocsi 2018).⁷

Luther's correspondence is coded from the recently digitized Weimar edition of Luther's collected works (*Luthers Werke*, 2018). Erasmus's correspondence is coded from Allen (1934). In both sources, each entry contains the addressee and the date of the letter. We include both ingoing and outgoing letters. From these we coded several variables: the year the letter was sent or received, and the location of the correspondent. Figure 2 reveals where each man had correspondents.

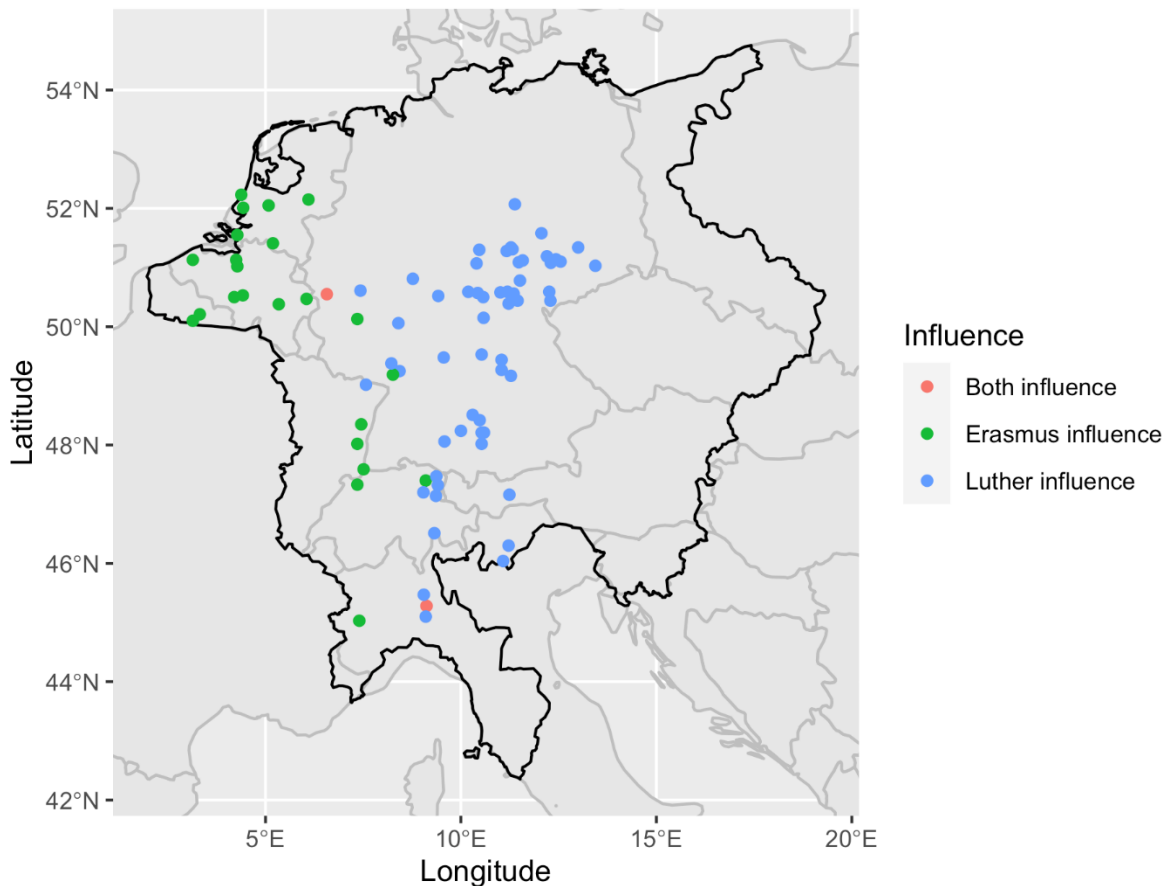
Figure 2: Erasmus and Luther's Letters, by city



Note: the dark black line is the border of the Holy Roman Empire in 1500.

We also coded the location of all towns in our dataset that Erasmus and Luther visited through the end of 1530. These data are recorded in the *Luther-Kalendarium*, an exhaustive register of all of Luther's known activities (Buchwald 1929), supplemented with documentation provided by Schneider (2011). For Erasmus, we assemble his travels from four biographies: Huizinga (1924), Schoeck (1990), Tracy (1996), and Massing (2018). While historians focus on different aspects of his life, fortunately the sources agree on his itinerary, which is well known thanks to his prolific writings and correspondence. For both Luther and Erasmus, we code both a binary variable (whether they visited a town in a given year) and a count variable (the number of times they visited a town in a given year). Figure 3 reveals the cities that Luther and Erasmus visited prior to 1530.

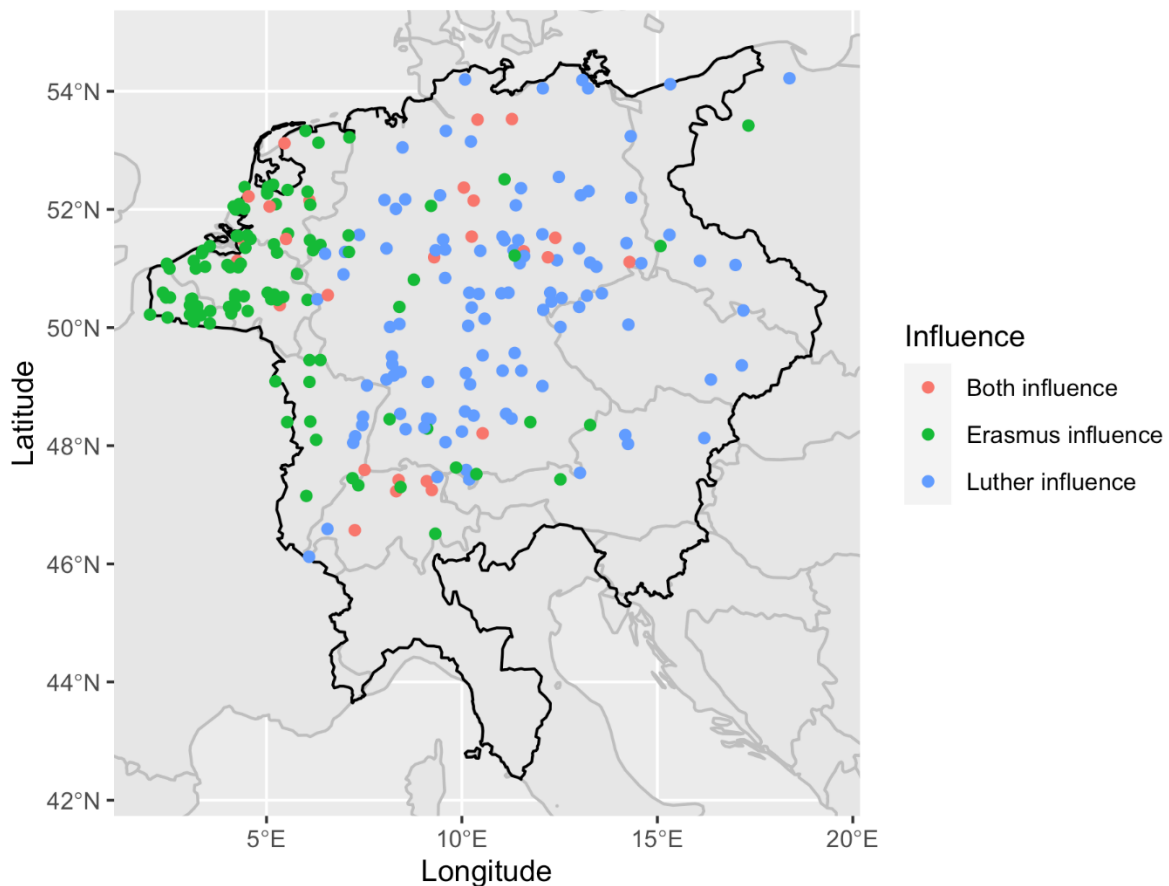
Figure 3: Erasmus and Luther's Visits, by city



Note: the dark black line is the border of the Holy Roman Empire in 1500.

Finally, we measure the number of students subject to the influence of both men. For Luther, these are students who enrolled at Wittenberg University from a given town during the period from 1512, when Luther assumed his professorship, through the end of 1530. The data were coded from the Wittenberg matriculation book edited by Förstemann (1841). For Erasmus, we document all students who enrolled in University of Louvain and University of Basel from a given town in the years in which Erasmus was there (1517-1521 for Louvain and 1522-1529 for Basel). These data are available in Wackernagel (1951) and Schillings (1962). Figure 4 maps the hometowns of students of Erasmus and Luther, and Table 1 shows summary statistics of the key variables.

Figure 4: Erasmus and Luther's Students, by city



Note: the dark black line is the border of the Holy Roman Empire in 1500.

Table 1: Summary Statistics, 1523-30, key variables

Variable	Mean	Std. Error	Min	Max	N
Protestant (0/1)	0.144	0.005	0	1	4680
<i>Erasmus and Luther Network Data</i>					
Luther letters	0.133	0.023	0	89	4680
Erasmus letters	0.102	0.013	0	28	4680
Luther visits	0.014	0.002	0	4	4680
Erasmus visits	0.002	0.001	0	1	4680
Luther students	0.070	0.006	0	10	4680
Erasmus students	0.007	0.002	0	3	4095
<i>Augmented Network Data (dummy variables)</i>					
Luther only presence	0.150	0.004	0	1	4680
Erasmus only presence	0.077	0.004	0	1	4680
Both Luther and Erasmus presence	0.064	0.004	0	1	4680
Erasmus before Luther	0.035	0.003	0	1	4680
Luther before Erasmus	0.029	0.002	0	1	4680
No Erasmus or Luther	0.709	0.007	0	1	4680
Proportion of Protestant neighbors	0.135	0.004	0	1	4680

Note: Observations are from a panel of 585 cities over eight years (1523-1530).

VI. Predictions

These data allow us to test several, non-mutually exclusive predictions regarding the spread of the Reformation. The first prediction is that the Reformation spread spatially independent of Luther or Erasmus. This is suggested by several recent works, including Becker and Woessmann (2009), Cantoni (2012), and Roller (2022). Our trade network data allow us to test this possibility. The economic distance between cities was closest for cities that were neighbors on the trade route. If the spatial hypothesis is correct, it entails that:

Hypothesis 1 (Spatial Diffusion): All else equal, the probability of adopting the Reformation was increasing in the proportion of neighboring towns that already adopted the Reformation.

A second prediction is that diffusion was not contested. Becker et al. (2020) show that Luther's influence directly affected the spread of the Reformation. They do not consider the possibility of contestation. Of course, it is possible that Erasmus's influence was minimal, and contested diffusion is the wrong model for this phenomenon. Our data allow us to test this hypothesis. It implies that the presence of Luther's network should be positively related to the spread of the Reformation, regardless of whether Erasmus also had a presence in the city or the order in which they made connections in the city. It also implies that Erasmus should have had zero effect on a town's decision to adopt the Reformation where he had a connection but Luther did not. In other words:

Hypothesis 2 (Only Luther's Network Mattered): All else equal, the probability of adopting the Reformation was greater in towns where Luther had a connection and was independent of Erasmus's connections.

The final three hypotheses are different versions of *contested diffusion* that we discussed in Section 1: market competition, ideological inoculation, and firefighting. Under the *market competition* hypothesis, the order in which Luther and Erasmus made connections does not matter. Towns where Luther had a connection should have been more prone to Protestantism and those where Erasmus had a connection should have been less prone to Protestantism. This theory is ambiguous for towns where both had a connection, as it is not obvious *ex ante* which force should be stronger. That is:

Hypothesis 3 (Contested Diffusion, Market Competition): All else equal, the probability of adopting the Reformation was greater in towns where Luther had a connection and smaller in towns in which Erasmus had a connection.

Under the *ideological inoculation* hypothesis, the order in which Erasmus and Luther made a connection in the city matters. This hypothesis entails that towns in which Erasmus entered first should have been “inoculated” from Luther’s influence, meaning that such towns should not have been more likely to adopt the Reformation. It is possible that such towns are either less likely to adopt the Reformation or equally likely to adopt, depending on how effective the inoculation was. On the other hand, towns in which both had connections, but Luther made connections first should be more likely to adopt the Reformation, since such towns received a “dose” of Luther prior to inoculation. It also follows that un-inoculated towns in which only Luther had connections should have been more likely to adopt. That is:

Hypothesis 4 (Contested Diffusion, Ideological Inoculation): All else equal, the probability of adopting the Reformation was either lower or neutral in towns in which Erasmus made a connection prior to Luther and higher in towns in which only Luther made a connection.

Finally, the *firefighting* theory of contested diffusion entails that the order in which Luther and Erasmus made connections mattered, but for different reasons than under ideological inoculation. Under this hypothesis, if the firefighting worked, towns in which Luther made a connection prior to Erasmus should have been neither more nor less likely to adopt the Reformation. On the other hand, towns in which both had connections, but Erasmus made a connection first should have been

more likely to adopt the Reformation, since Luther’s “fire” was not subsequently put out. It also follows that towns in which only Luther had a connection should have been more likely to adopt.

In other words:

Hypothesis 5 (Contested Diffusion, Firefighting): All else equal, the probability of adopting the Reformation was neutral or lower in towns in which Erasmus made a connection after Luther and greater in towns in which only Luther made a connection.

VII. Regression Specification and Predictions

Our data allow us to test the five predictions laid out in the previous section. We begin with a regression analysis, which can jointly test each of the hypotheses. Since there are potential biases (laid out below) in the regression specifications, we follow this analysis with a network simulation exercise to consider counterfactuals that are impossible to address in a regression framework.

We have coded the various measures from the influence networks up to the end of 1530. Since the main variables listed in Table 1 vary over time, we organize the data as a panel. We focus on the early Reformation, and therefore estimate panel models predicting the adoption of Protestantism between 1523 (the first year of adoption anywhere) and 1530 (after which Reformation adoption became more closely associated with princely politics). The dependent variable is coded 1 for cities that are Protestant in year $t \in \{1523, 1524, \dots, 1530\}$ and 0 otherwise. The focal covariates are the Luther and Erasmus network variables. In order to test the hypotheses, we create several Luther and Erasmus network dummy variables: Luther only presence, Erasmus only presence, neither Luther nor Erasmus presence, Erasmus before Luther, and Luther before Erasmus. These variables take a value of one if the order of connections is as specified.

The primary reason we employ a regression analysis is that many socioeconomic features may spuriously affect either (or both) Erasmus’s or Luther’s network *as well as* the spread of the Reformation. Fortunately, many of these features are observable or there are observable proxies for them. For instance, the education and literacy rate of a town are likely related to the networks of both men, and it may have also had an independent effect on the propensity to adopt the Reformation. We can address these issues by controlling for the presence of a printing press, a university, and the number of editions of Luther and Erasmus’ publications printed in a town. Likewise, the dominance of the Church in a town likely affected the likelihood of both it being part of the networks of both men and it adopting the Reformation. Hence, it is useful to control for whether it was the seat of a bishopric, a proxy for Church influence.

The panel nature of our data also allows us to overcome many of these issues. We report numerous specifications which include city and year fixed effects. This allows us to focus on *within-city* variation. This helps address issues of unobserved, city-specific covariates, most of which are time invariant.

To test Hypothesis 1 (the Reformation spread via spatial networks), we also include some attributes of a city’s neighbors in the trade network. We coded cities as having a direct tie to another city if they occupied adjoining positions on overland trade routes or if they could be reached directly through river traffic or sea routes. This allows us to code the proportion of a city’s neighbors that are Protestant.

We can therefore specify the following regressions model (for each city i in year t):

$$\text{Protestant}_{i,t} = \alpha_0 + \alpha_1 \text{Erasmus before Luther}_{i,t-1} + \alpha_2 \text{Luther before Erasmus}_{i,t-1} + \alpha_3 \text{Erasmus only}_{i,t-1} + \alpha_4 \text{Luther only}_{i,t-1} + \alpha_5 \text{Proportion Neighbors Protestant}_{i,t-1} + \alpha X_i + \lambda_i + \lambda_t + \varepsilon_{i,t}, \quad (1)$$

where $\text{Protestant}_{i,t}$ is a dummy indicating whether city i is Protestant in year $t \in \{1523, 1524, \dots, 1530\}$, the various Luther and Erasmus network variables are measures of their presence in a town (via letter, visit, or students) and/or the order in which they ‘entered’ the town in year $t-1$ (see Table 1), Proportion Neighbor Protestant is a measure of the proportion neighboring towns were Protestant in year $t-1$, X_i is a set of time-invariant control variables,⁸ λ_i are city fixed effects, and λ_t are time fixed effects. We report specifications using both OLS and a Cox hazard model. A hazard model is useful in this circumstance because, for the time period in question, once a city converted (i.e., becomes Protestant), there was no turning back (re-conversion began in the 1540s). Hence, these regression coefficients can be interpreted as the “hazard” of turning Protestant. In all specifications, we cluster standard errors by city.

This specification permits a preliminary test of each of the five hypotheses. Hypothesis 1 states that a town’s neighbor’s being Protestant should affect a town’s likelihood of being Protestant. This implies that $\alpha_5 > 0$ in the regression. Hypothesis 2 focuses only on Luther’s network, implying that all coefficients on Luther variables ($\alpha_1, \alpha_2, \alpha_4$) should be positive. Hypothesis 3 indicates that competition between Luther and Erasmus may lead to ambiguous results in cities in which they both had contacts, but unambiguous results in towns where only one had a contact (i.e., $\alpha_3 < 0$ and $\alpha_4 > 0$). Hypothesis 4 argues that if Erasmus was successful at ‘inoculating’ a town, those towns in which he arrived at first should be less likely to be Protestant ($\alpha_1 \leq 0$), while those towns he arrived at after Luther should be more likely to be Protestant ($\alpha_2 > 0$). It also implies that uninoculated towns that have a Luther contact are more likely to become Protestant ($\alpha_4 > 0$). Finally, Hypothesis 5 indicates that Luther’s “fire” is not put out in towns which Luther visits after Erasmus ($\alpha_1 > 0$), while some of the fires he started will be doused in towns that Erasmus visits after Luther

($\alpha_2 \leq 0$). It also implies that towns that have a Luther fire that Erasmus does not attempt to put out are more likely to become Protestant ($\alpha_4 > 0$). Table 2 summarizes these predictions.

Table 2: Hypotheses, Regression Coefficients

Hypothesis	Predictions
1: Spatial Diffusion	$\alpha_5 > 0$
2: Luther's Network	$\alpha_1 > 0; \alpha_2 > 0; \alpha_4 > 0$
3: Contested Diffusion, Market Competition	$\alpha_3 < 0; \alpha_4 > 0$
4: Contested Diffusion, Ideological Inoculation	$\alpha_1 \leq 0; \alpha_2 > 0; \alpha_4 > 0$
5: Contested Diffusion, Firefighting	$\alpha_1 > 0; \alpha_2 \leq 0; \alpha_4 > 0$

Not all of the hypotheses are mutually exclusive, although some are. For instance, Hypothesis 1 may be correct along with any of the other 4 hypotheses, since its only prediction regards α_5 , which is not addressed in the other hypotheses. Likewise, Hypotheses 2 and 3, or 3 and 4, or 3 and 5 can jointly hold. Meanwhile, Hypotheses 2, 4, and 5 yield different predictions regarding α_1 or α_2 and cannot simultaneously hold.

VIII. Regression Analyses

We proceed to econometrically test various permutations of equation (1). The results are reported in Table 3. Columns 1-2 report OLS results and columns 3-4 report hazard ratios from a Cox hazard model. In columns 3 and 4, a hazard ratio greater than 1 suggests an increased “risk” of becoming Protestant, while a ratio below 1 suggests a lower risk. While columns 1-2 include time and city fixed effects, columns 3-4 include city-specific controls.⁹ The Cox hazard regression results (columns 3-4) are preferred because in the period under question, adoption of Protestantism was an absorbing state—once a town adopted, it did not turn back. We report the results of regressions in which city fixed effects are included (columns 1 and 2). City fixed effects control for city-specific unobservables that may bias the coefficients of interest.

Before we discuss the results, note that the networks of neither Erasmus nor Luther were randomly established. While their networks were likely not established with pro- or anti-reform sentiments in mind (prior to 1523, at least), there may be unobservables affecting both the formation of their networks and the likelihood that a town eventually adopted the Reformation. Hence, we do not give the results reported in Table 3 a causal interpretation. This is especially true of the “Erasmus before Luther” variable, which takes a value of one if Erasmus had a contact in the town prior to Luther. Erasmus was 17 years older than Luther, and he was famous much earlier than Luther. Hence, both men having a contact in the city, with Erasmus having one first, could be indicative of many unobservable features of a town, including its perceived importance, its Humanist leanings, upper-tail human capital, and so on. We are therefore hesitant to interpret these coefficients as causal. This is less of an issue with the other coefficients. A simulation allows us to consider counterfactual networks. Nonetheless, these results can provide some preliminary insight into the five hypotheses laid out in previous sections.

These results have implications for each of the Hypotheses proposed above. First, they reveal strong support for Hypothesis 1 (spatial diffusion): the coefficient on “Proportion Neighbors Protestant” (α_5) is large, positive, and highly significant in all regressions (keeping in mind that hazard ratios less (greater) than one indicate a lower (higher) “risk” of becoming Protestant). The evidence is much weaker for Hypothesis 2 (only Luther’s influence mattered). The “Luther before Erasmus” coefficient (α_2) is always small and never statistically significant. This suggests that Erasmus may have mattered. The support for Hypothesis 3 (market competition) is also weak. Although the sign on the “Erasmus only” variable (α_3) is negative in three of the four regressions (or below 1 in the Cox hazard regressions), it is statistically insignificant in all four specifications.

There is strong support for Hypothesis 5 (firefighting), however. This hypothesis predicts a positive coefficient on the “Erasmus before Luther” (α_1) and “Luther only” (α_4) variables. The “Luther only” coefficient is positive and strongly significant in all specifications, and the “Erasmus before Luther” coefficient is positive and strongly significant in the Cox hazard regression. Meanwhile, this hypothesis leaves open the possibility that the “Luther before Erasmus” coefficient (α_2) is 0 (i.e., Erasmus was able to put out some, but not all, of Luther’s fires). This is what we find. Finally, there is evidence contradictory to Hypothesis 4 (ideological inoculation). This hypothesis predicts that the “Erasmus before Luther” coefficient (α_1) should be negative. It is positive in all specifications, and it is highly statistically significant in the Cox hazard model specification.

Table 3: Reformation Adoption and Erasmus’s and Luther’s Presence

Specification:	DV: Protestant in year t			
	(1) OLS	(2) OLS	(3) Cox	(4) Cox
Erasmus before Luther (α_1)	0.059 (0.094)		1.347** (0.085)	
Luther before Erasmus (α_2)	0.015 (0.063)		0.888 (0.117)	
Erasmus only (α_3)	-0.050 (0.033)	-0.058 (0.037)	1.007 (0.088)	0.995 (0.089)
Luther only (α_4)	0.109* (0.047)	0.112* (0.045)	1.113** (0.047)	1.118** (0.046)
Erasmus and Luther presence		0.035 (0.056)		1.123 (0.081)
Proportion Neighbors Protestant (α_5)	0.287** (0.047)	0.287** (0.047)	1.256** (0.066)	1.239** (0.066)
N	4,680	4,680	4,152	4,152
R ²	0.724	0.724		
City-specific controls	N	N	Y	Y
City FE	Y	Y	N	N
Time FE	Y	Y	N	N

** p < 0.01; * p < 0.05; columns (1)-(2) estimated with OLS, columns (3) and (4) estimated with Cox hazard model. Panel of 585 cities over 8 years. Hazard ratios are reported in columns (3) and (4). The omitted category is “neither Erasmus nor Luther.”

These results can be summarized as follows:

Result 1: There is strong support for Hypothesis 1 (spatial diffusion). The proportion of a town's neighbors that were Protestant is strongly related to the town adopting Protestantism.

Result 2: There is support for Hypotheses 5 (firefighting). Towns where only Luther had a contact or towns where Luther made a contact after Erasmus were much more likely to adopt Protestantism. Towns where Erasmus made a contact after Luther were neither more nor less likely to adopt Protestantism, suggesting that Luther's influence was suppressed.

Result 3: There is no support for Hypothesis 2 (only Luther mattered), Hypothesis 3 (market competition), or Hypothesis 4 (ideological inoculation). Towns where Erasmus made a contact before Luther were neither more nor less likely to adopt Protestantism, refuting Hypothesis 2. Towns where only Erasmus made a contact were not more or less likely to adopt Protestantism, refuting Hypothesis 3. "Inoculated" towns in which Luther subsequently made a contact were more likely to adopt Protestantism, which refutes Hypothesis 4.

As noted above, we are cautious not to interpret these results as causal. The endogeneity of Erasmus's and Luther's networks means that the coefficients reported in Table 3 may be biased. To add greater weight to the inferences we wish to draw concerning personal influence, we proceed to a simulation analysis. This analysis allows us to directly address counterfactuals with respect to the network formation of both men, thus deriving predictions that can be more confidently considered causal.¹⁰

IX. Simulation Analysis

Overview

Regressions do not allow us to causally estimate contending personal influence independent of confounding omitted variables. Furthermore, such regressions do not allow us to test alternative mechanisms of Reformation adoption, such as the spread of the Reformation via trade routes, or whether Luther's influence is sufficient to explain the adoption of the Reformation. We thus utilize computer simulations to experiment with different scenarios and probe our framework of contested diffusion.

Simulations have widely been utilized in the social sciences as strategies to tease out mechanisms (Ermakoff 2022; Flache, Mäs and Keijzer 2022) because of two advantages. First, simulations can help explore causal effects, as the researcher can “turn on” or “turn off” factors and examine subsequent outcomes without worrying about confounders. Second, simulations allow for *interdependent processes* between factors.

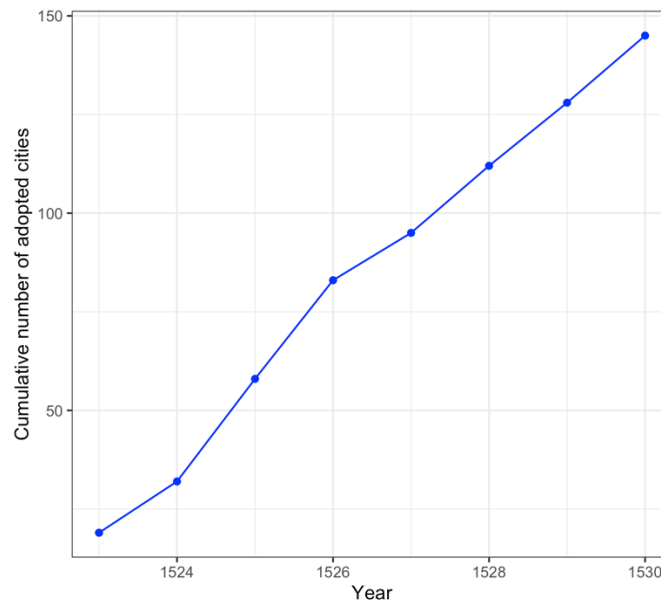
We propose several scenarios/models of diffusion, aiming to recover the mechanisms of historical diffusion. To evaluate the plausibility of the simulations, we identify simulation targets from historical data. Scenarios that produce results close to the historical targets make the mechanisms plausible, while scenarios that produce results far from them are unlikely to reflect the historical reality. Thus, in contrast to pure simulations that explore a very wide range of possible outcomes (Baldassarri and Bearman 2007; Centola and Macy 2007; Heckathorn 1996; Marwell et al. 1988), our approach is rooted in empirical data and explores mechanisms within a limited set of observed possibilities (Becker et al. 2020; Hsiao 2021; Manzo et al. 2018).

Simulation Target

Each focal city decides to adopt or not adopt the Reformation based on a decision rule which varies by scenario. Because our data are longitudinal, ranging from years 1523-1530, for each year the focal city will decide whether to adopt based on information in the previous year.

We follow Manzo et al. (2018) and identify the empirical adoption curve as the target of simulation, which we report in Figure 5. The x-axis is the year, and the y-axis is the number of cities that adopted the Reformation by that year. This curve is generated by the actual data, and the simulations will ideally generate adoption curves that are as close to this empirical curve as possible.

Figure 5: Empirical curve of Reformation adoption



To assess model performance, we use the root mean squared prediction error, defined as the square root of the mean squared error (RMSPE). Formally, for a given year t , let \mathbf{y}_t be the empirical number of adopted cities in year t , and $\hat{\mathbf{y}}_t$ be the predicted number of adopted cities

based on the simulations, then $RMSPE = \sqrt{\frac{\sum_{t=1}^T (\hat{y}_t - y_t)^2}{T}}$. As our simulations are probabilistic, the presented RMSPE is the average RMSPE across simulations.

It is possible that the results yield multiple solutions where multiple parameter combinations generate the same average RMSPE. In such cases, we compare the RMSPE in years 1530 and 1529, which are the final two years of the dataset. The reason we weight the latter years over the earlier years is theoretical: our aim is to reconstruct the final diffusion outcome of the Reformation. Thus, compared to models that better explain the early spread of the Reformation but have lower explanatory power in the latter years, we favor models that may have some error in reconstructing early diffusion processes but accurately depict the final picture of the Reformation status.

General Simulation Procedure

For each scenario, we conduct the following general steps.

1. Based on the empirical data from the year 1523, we set the adopted cities to be the ones that already adopted by 1523.
2. Depending on the scenario, the *decision rule* for subsequent adoption will change. For each iteration, each city will either adopt or remain unadopted depending on the decision rule. Once a city adopts the Reformation, it cannot revert to unadopted status. We make this assumption because we find no evidence of reversion prior to the onset of religious warfare that began well after 1530.
3. We run the simulation until year 1530 and document the number of adopted cities for each year, which generates a simulated adoption curve. We then compare the simulated adoption curve and the empirical adoption curve and compute the RMSPE. If multiple parameter values yield similar RMSPEs, we weight towards solutions that produce less error in 1530 and 1529.

4. Since each simulation is a stochastic process, the outcome would be different for each simulation. We replicate the simulations 500 times and calculate the average RMSPE.

We emphasize that the goal of the simulations is to examine *the general mechanisms* by which diffusion occurred in the Reformation. We do not pretend that the simulation is an empirical test of our model. Our primary interest is to compare theoretical scenarios rather than calibrate exact parameter values for the decision rules. Although the parameters affect the simulation outcomes, they are not of primary interest. For example, whether the presence of Luther increases the probability of Reformation adoption by 10% or 11% is theoretically uninteresting, as the parameter value is tied to the case of the Reformation. However, whether the Reformation spread via spatial diffusion, Luther's influence, or a contested diffusion process between Luther and Erasmus's influence is theoretically important.

Theoretical Scenarios

Scenario 1: pure spatial diffusion (no network diffusion via Luther or Erasmus)

In this scenario, which follows from Hypothesis 1, the Reformation spreads solely based on spatial diffusion via trade networks. The relevant network is the trade route network. There are several micro-mechanisms that could foster a stepwise diffusion process (Centola and Macy 2007; Chwe 2000). These micro-mechanisms encompass a wide range of possible varieties of social influence or rational coordination. However, our goal is to examine the *city-level* mechanisms of how the Reformation spread between cities. Hence, for purposes of this simulation we are agnostic as to which micro-mechanism is the most likely.

The specific algorithm for Scenario 1 is as follows:

1. Based on the empirical data on year 1523, we set the adopted cities to be the ones that already adopted by 1523.
2. For each city, let $p_{i,t}$ be the probability of city i adopting the Reformation in year t . Then:

$$p_{i,t} = \alpha + \beta * \mathbf{ProportionAdoptedNeighbors}_{i,t-1}$$

α is the baseline probability that a city adopts in the absence of any adopted neighbors, ranging from 0 to 1 because probabilities are bounded from 0 to 1.

$\mathbf{ProportionAdoptedNeighbors}_{i,t-1}$ is the cumulative proportion of neighboring cities that adopted the Reformation up through the previous year, which captures the process of spatial diffusion. For example, if a focal city is connected to 4 cities via trade and 2 of these cities adopted up to (and including) the previous year, then $\mathbf{ProportionAdoptedNeighbors}_{i,t-1} = \frac{2}{4} = 0.5$. For the handful of cities (mostly on the borders of the HRE) that do not have links to our trade routes, the value is 0 as we do not anticipate any spatial diffusion influence. β is the coefficient for the spatial diffusion effect which ranges from 0 to 1.

3. We run the simulation until year 1530 and document the number of adopted cities for each year, which generates a simulated adoption curve. We then compare the simulated adoption curve and the empirical adoption curve and compute the RMSPE. If multiple parameter values yield similar RMSPEs, we weight towards solutions that produce less error in 1530 and 1529.
4. Since each simulation is a stochastic process, the outcome is slightly different for each simulation. We replicate the simulations 500 times and calculate the average RMSPE.

Scenario 2: spatial diffusion and Luther's influence

The second scenario, which follows from Hypothesis 2, examines how Luther's influence affected the diffusion of the Reformation in addition to spatial diffusion. This perspective focuses on the role of innovation and pro-innovation actors, which is consistent with most of the network diffusion literature. This approach is also consistent with Becker et al. (2020), who contend that the spread of the Reformation was a multiplex network process of the combination of Luther's influence and spatial diffusion. To test this scenario, our steps are as follows:

1. Based on the empirical data on year 1523, we set the adopted cities to be the ones that already adopted by 1523.
2. For each city, let $p_{i,t}$ be the probability of city i adopting the Reformation in year t . Then:

$$p_{i,t} = \alpha + \beta * \mathbf{ProportionAdoptedNeighbors}_{i,t-1} + \gamma * \mathbf{LutherInfluence}_{i,t-1}$$

α is the baseline probability that a city adopts in the absence of any adopted neighbors. $\mathbf{ProportionAdoptedNeighbors}_{i,t-1}$ is the cumulative proportion of neighboring cities that have adopted the Reformation in the previous year, which captures the process of spatial diffusion. The critical addition is $\mathbf{LutherInfluence}_{i,t-1}$, which is a binary variable indicating that there was Luther's influence (either via letters, visits, or students) in the previous year. For this variable, we assume *lasting influence*. If Luther had influence in a city, the influence continues. For instance, if Luther visited a city in 1527, then we assume that Luther's influence will be present for the years 1527-1530.

3. We run the simulation until year 1530 and document the number of adopted cities for each year, which generates a simulated adoption curve. We then compare the simulated adoption curve and the empirical adoption curve and compute the RMSPE. If multiple parameter values yield similar RMSPEs, we weight towards solutions that produce less error in 1530 and 1529.

4. Since each simulation is a stochastic process, the outcome is slightly different for each simulation. We replicate the simulations 500 times and calculate the average RMSPE.

Scenario 3: spatial diffusion and contested diffusion

In Scenario 3, we test the core argument of contested diffusion: whether incorporating Erasmus's influence yields better model prediction than in Scenario 2 where there was only Luther's influence. We test three mechanisms of contested diffusion:

Scenario 3-1: spatial diffusion + market competition (Hypothesis 3)

Scenario 3-2: spatial diffusion + ideological inoculation (Hypothesis 4)

Scenario 3-3: spatial diffusion + firefighting (Hypothesis 5)

These three sub-scenarios yield slight differences in how we operationalize Erasmus's influence in step 2 of the simulation procedure, with the steps as follows:

1. Based on the empirical data on year 1523, we set the adopted cities to be the ones that already adopted by 1523.
2. For each city, let $p_{i,t}$ be the probability of city i adopting the Reformation in year t . Then:

Scenario 3-1:

$$p_{i,t} = \alpha + \beta * ProportionAdoptedNeighbors_{i,t-1} + \gamma *$$

$$LutherInfluence_{i,t-1} + \delta * ErasmusInfluence_{i,t-1}$$

$ErasmusInfluence_{i,t-1}$ is a binary variable that equals one if Erasmus had an influence on the city via letters, visits, or students in the previous year. In this “market competition” scenario, Luther and Erasmus each exert influence on the focal city with γ ranging from 0 to 1 and exerts a positive influence on adoption, where δ ranges from 0 to -1 and exerts a negative influence on adoption.

Scenario 3-2:

$$p_{i,t} = \alpha + \beta * \textit{ProportionAdoptedNeighbors}_{i,t-1} + \gamma *$$

$$\textit{LutherInfluence}_{i,t-1} * \delta * \textit{ErasmusFirst}_{i,t-1}^{11}$$

*ErasmusFirst*_{*i,t-1*} is a binary variable that indicates whether Erasmus had influence on the focal city *prior to* Luther’s influence. In this “ideological inoculation” scenario, Luther’s influence is discounted by a factor of δ (ranging from 0 to 1) if Erasmus already had prior influence on the city, thus creating an “inoculation effect.” For cities that Erasmus had influence first, we set the algorithm so that there is no discount (i.e., $\delta = 1$).

Scenario 3-3:

$$p_{i,t} = \alpha + \beta * \textit{ProportionAdoptedNeighbors}_{i,t-1} + \gamma *$$

$$\textit{LutherInfluence}_{i,t-1} * \delta * \textit{ErasmusSecond}_{i,t-1}^{12}$$

*ErasmusSecond*_{*i,t-1*} is a binary variable that indicates whether Erasmus had influence on the focal city after Luther’s influence. In this “firefighting” scenario, Luther’s influence is discounted by a factor of δ (ranging from 0 to 1) if Erasmus has influence on the city after Luther’s presence. In other words, after Luther generates “sparks”, Erasmus is trying to “put out the fire.” For cities that Erasmus did not have secondary influence, we set there algorithm so that there is no discount (equivalent to $\delta * \textit{ErasmusSecond}_{i,t-1} = 1$).

3. We run the simulation until year 1530 and document the number of adopted cities for each year, which generates a simulated adoption curve. We then compare the simulated adoption curve and the empirical adoption curve and compute the RMSPE. If multiple parameter values yield similar RMSPEs, we weight towards solutions that produce less error in 1530 and 1529.

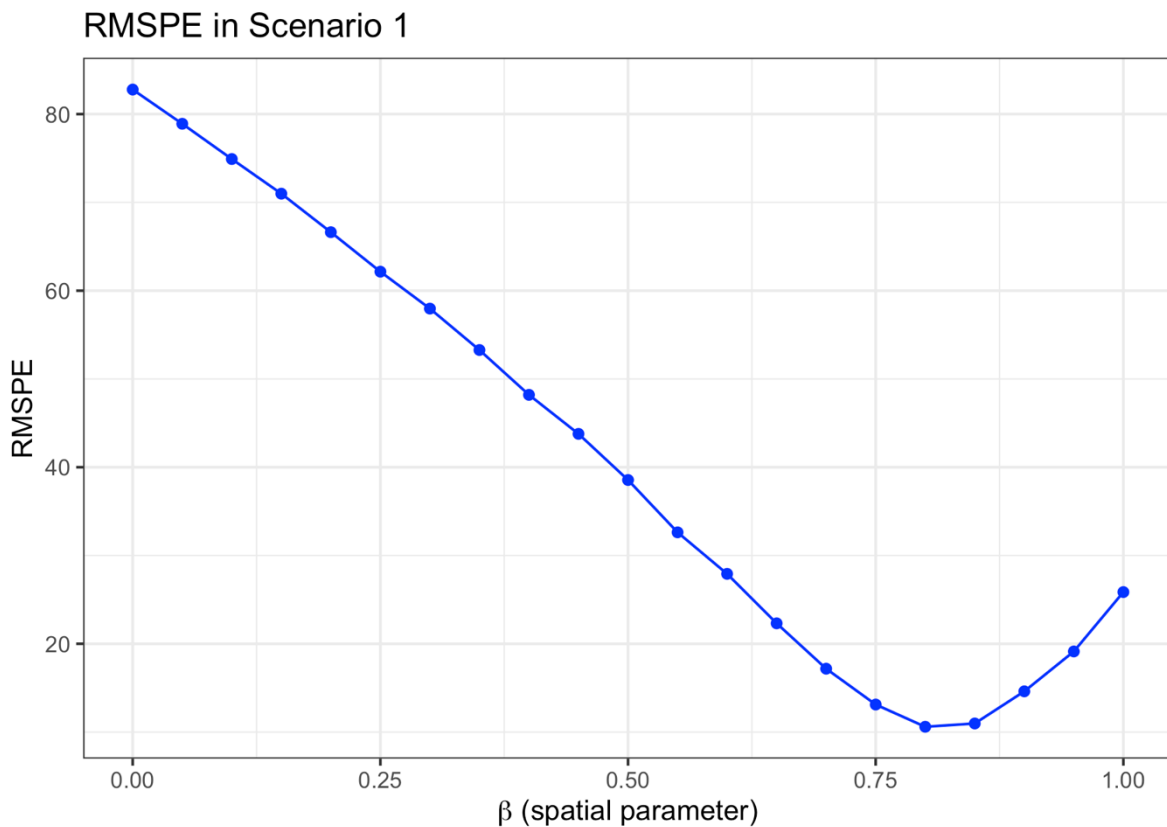
4. Since each simulation is a stochastic process, the outcome is slightly different for each simulation. We replicate the simulations 500 times and calculate the average RMSPE.

Simulation Results

Scenario 1: pure spatial diffusion

We first show the simulation results for Scenario 1 in Figure 6. We do not present the intercept parameter α because all the results with the lowest RMSPEs occur when $\alpha = 0$. The x-axis is the value of β while the y-axis is the average RMSPE across simulations. As seen, β values of 0.8 or 0.85 yield the lowest RMSPEs of around 10.50.

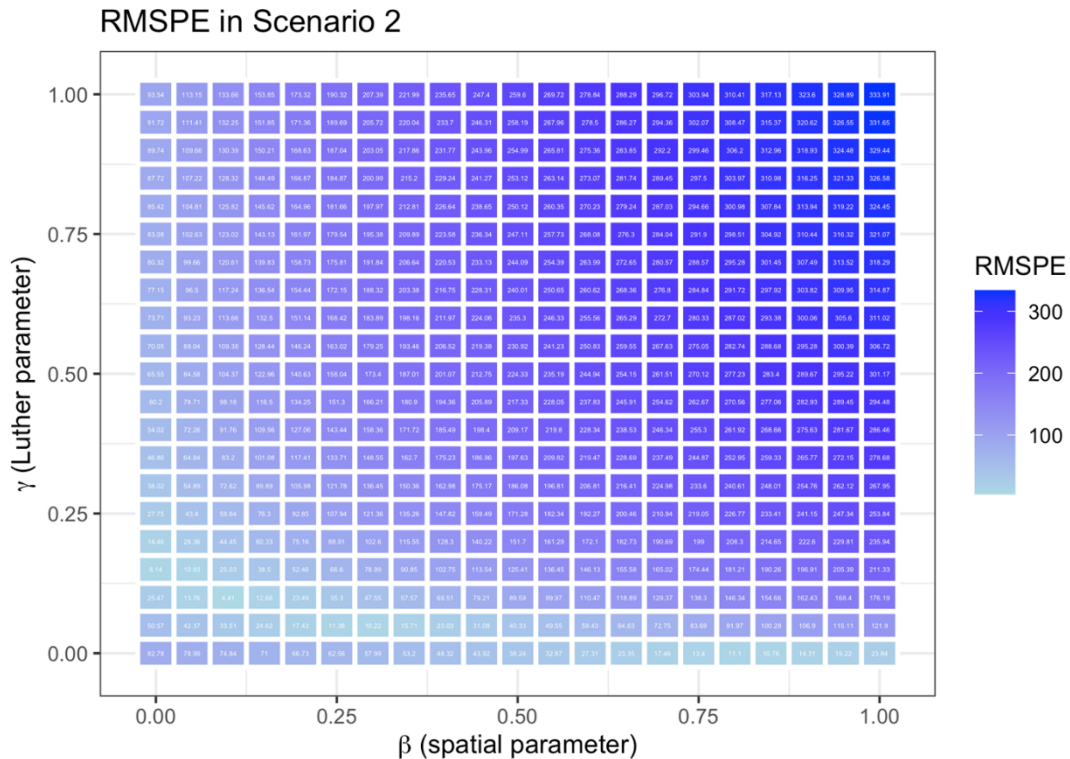
Figure 6: Simulation results for Scenario 1



Scenario 2: spatial diffusion and Luther's influence

Figure 7 shows the simulation results for Scenario 2. Because we now have two parameters of interest—the spatial parameter β and the Luther influence parameter γ , we use a heat map to present the results. The x-axis is the value of the spatial parameter β . The y-axis is the value of the Luther influence parameter γ . Darker blue colors indicate a larger RMSPE, while lighter colors indicate a smaller RMSPE. As seen, most parameter values have large RMSPEs, but for a limited combination of low to moderate values of β (from 0 to 0.10) and low to moderate values of γ (from 0 to 0.15) the RMSPEs are lower. The lowest RMSPE occurs at one specific combination of $\beta=0.1$ and $\gamma=0.1$ (RMSPE = 4.41). There is one parameter combination that yields a RMSPE of 8.14, and six parameter combinations that yield RMSPEs of 8.14-12. Overall, except for that specific parameter combination, results from Scenario 2 are a modest improvement over results from Scenario 1. The errors in years 1529 and 1530 are also similar across the two scenarios.

Figure 7: Simulation results for Scenario 2



Scenario 3: contested diffusion

We proceed to explore the core dynamics of contested diffusion and the three potential mechanisms. We show the results for Scenario 3-1 (the *market competition scenario*) in Table 4.¹³ In general, the simulation results are an improvement over the results in Scenario 2, as there are 19 parameter combinations that have RMSPE values ranging from 3.88 to 4.99. In other words, the “good fit” of low RMSPEs is robust across many parameter assumptions, whereas in Scenario 2 there was only one specific parameter combination that yielded a low RMSPE.

Table 4: Parameter combinations with RMSPE less than 5 in Scenario 3-1

γ (Luther)	δ (Erasmus)	β (Spatial)	RMSPE	Error 1529	Error 1530
0.15	-0.95	0.15	3.88	3.98	2.724
0.15	-0.7	0.15	4.09	4.426	3.548
0.15	-0.55	0.15	4.1	4.554	3.2
0.15	-0.6	0.15	4.15	4.772	3.466
0.15	-0.45	0.15	4.2	4.73	3.346
0.15	-0.65	0.15	4.22	4.852	3.562
0.15	-1	0.15	4.28	4.748	3.51
0.15	-0.9	0.15	4.36	5.192	3.992
0.15	-0.4	0.15	4.39	5.018	3.782
0.15	-0.15	0.1	4.46	-3.21	-5.872
0.15	-0.35	0.15	4.48	5.392	4.076
0.1	0	0.1	4.5	1.458	2.928
0.15	-0.3	0.15	4.57	5.444	3.936
0.15	-0.25	0.15	4.6	5.716	4.378
0.15	-0.75	0.15	4.61	5.468	3.938
0.15	-0.5	0.15	4.69	5.866	4.538
0.15	-0.8	0.15	4.77	5.77	4.634
0.15	-0.85	0.15	4.82	6.08	4.87
0.15	-0.2	0.15	4.99	6.342	5.312

The results for the *ideological inoculation* hypothesis are presented in Table 5. While there are fewer parameter combinations with low RMSPEs (7 combinations), the RMSPEs are comparable to the results in Scenario 3-1.

Table 5: Parameter combinations with RMSPE less than 5 in Scenario 3-2

γ (Luther)	δ (Erasmus)	β (Spatial)	RMSPE	Error 1529	Error 1530
0.1	1	0.1	4.36	1.944	3.462
0.1	0.95	0.1	4.61	0.572	1.586
0.1	0.85	0.1	4.7	-0.21	0.71
0.1	0.25	0.15	4.77	2.616	4.588
0.1	0.9	0.1	4.87	-0.612	0.746
0.1	0.2	0.15	4.91	1.078	2.72
0.1	0.15	0.15	4.98	-0.298	1.06

Finally, in Table 6 we report the results for Scenario 3-3 (firefighting), which was also what our regressions suggested. There are six parameter combinations that produce low RMSPEs. Again, the RMSPEs are comparable to Scenario 3-1 and Scenario 3-2.

Table 6: Parameter combinations with RMSPE less than 5 in Scenario 3-3

γ (Luther)	δ (Erasmus)	β (Spatial)	RMSPE	Error 1529	Error 1530
0.1	0.9	0.1	4.5	0.062	1.006
0.1	0.95	0.1	4.76	0.648	2.078
0.1	1	0.1	4.81	1.082	2.62
0.1	0.25	0.15	4.83	3.306	5.424
0.1	0.2	0.15	4.9	1.136	3.012
0.15	0.35	0.05	4.98	-1.262	-4.604

The above results show that contested diffusion scenarios, whether based on market, inoculation, or firefighting mechanisms, produce better predictions over scenarios based solely on spatial diffusion or a combination of spatial diffusion and Luther's influence. Nonetheless, as Scenarios 3-1, 3-2, and 3-3 produce similar RMSPEs, can we further distinguish these mechanisms? As previously noted, when there are multiple solutions that produce similar RMSPEs, we weight towards the latter years of 1529 and 1530. To further distinguish model performances, Table 7

compares the “best” parameter combination for each scenario that has the lowest RMSPE’s then compares the RMSPEs for only years 1529 and 1530. As seen, while all three scenarios have similar RMSPEs, Scenario 3-3 (the firefighting scenario) clearly has better predictive power for years 1529 and 1530. In other words, while Scenarios 3-1 and 3-2 better explain the early diffusion process, Scenario 3-3 better explains the final state of the Reformation. Thus, consistent with the regression results, the simulations suggest that the firefighting mechanism is the most important one driving contested diffusion in the case of the early Reformation.

Table 7: Comparison of RMSPEs for years 1529 and 1530 for the lowest RMSPE parameter combinations for each scenario

Scenario	RMSPE	RMSPE for 1529	RMSPE for 1530
Scenario 3-1	3.88	3.98	2.724
Scenario 3-2	4.36	1.944	3.462
Scenario 3-3	4.5	0.062	1.006

X. Do historical cases suggest mechanisms of contested diffusion?

Beyond regression and simulation analyses, qualitative evidence provides insight into how Luther and Erasmus’s influence networks affected the adoption of Protestantism. There are many accounts of how literate townsmen and humanists felt obliged to side with or against Luther or Erasmus (see e.g., Bietenholz and Deutscher 1985; Massing 2018). However, a few cases help illustrate how the contest unfolded. We consider cities in which the Reformation was adopted through 1530 and where it was not. In each case, we note the presence of visits, correspondents, and students.

Antwerp: Erasmus knew the city well, had visited before 1517, and had many acquaintances there. Nevertheless, Luther’s influence was felt. Monks who had been students at Wittenberg and Luther’s correspondents began to agitate for reform. In 1522, Erasmus’ former patron, the Bishop

of Cambrai, moved to crush Luther's movement. With Habsburg backing, ecclesiastical rulers found it easy to repress Lutheranism because it relied so heavily on people connected with him. With the help of the faculties of Louvain and Cologne, they readily identified, expelled, and punished followers of Luther (Kim and Pfaff 2012; Tracy 1990: 152-160). The severity of the repression threatened to make Protestant sympathizers. Although Erasmus backed the repression, he urged mercy and forgiveness for the contrite. Erasmus's support sped the rehabilitation of humanists who professed loyalty to Church and emperor (Bietenholz and Deutscher 1985: 99, 114, 123). Inoculation against Luther apparently played no role, in spite of the more than a hundred Antwerp students who had enrolled at Louvain in the years between 1517 and 1522. Firefighting sealed the defeat of the Lutheran movement.

Freiburg im Breisgau and Breisach: Firefighting is clearly in evidence in these cities. The contemporaneous Peasants' War, a rebellion that defenders of the established order blamed on Luther, heavily affected the cities of the upper Rhine. Habsburg authorities in the region feared that the common people were being won to Protestantism (Ocker 2006; Scott 2005). In fact, there is evidence of limited Lutheran inroads in the region; Luther had a correspondent in Freiburg and two student contacts in that city and three more in Breisach.

Luther never visited either city, whereas local humanists celebrated Erasmus on his visit to Breisach in 1518. In Freiburg, there were only five Basel students exposed to the Erasmian curriculum but the circle of admiring humanists was large and Erasmus could count on his friendship with the famed law professor Ulrich Zasius (Bietenholz and Deutscher 1985: 468-73). Following the publication of Erasmus' diatribe against Luther, Zasius mobilized the university faculty decisively against the Reformation—banning the matriculation of any student who had

been to Wittenberg—and the city remained firmly in the Catholic camp (Lins 1909). The victory was so complete that Erasmus and the cathedral chapter of Basel were invited to take refuge in Freiburg after Basel adopted the Reformation.

Nuremberg: In 1518, en route to Augsburg to appear before the papal ambassador, Luther was warmly received by Nuremberg's Augustinian monks and their abbot Wenzelas Linck, a former Wittenberg theologian and Luther correspondent. During his visit, the noted preacher Andreas Osiander enthusiastically embraced him and Luther won the backing of the city's best-known humanists, including the patrician Willibald Pirckheimer. Pirckheimer was impressed by his meeting with Luther, corresponded with him, and convinced the city council to fill clerical vacancies with recent Wittenberg graduates.

Defenders of the Roman Church struck back. In advance of the city's hosting of the annual imperial diet, the pope excommunicated Pirckheimer and other prominent citizens in 1522. Erasmus had his own contacts in Nuremberg that pre-dated 1517 and he urged his friends to use their powers to suppress Protestantism (Bieler 2017; Bietenholz and Deutscher 1985: 268; Strauss 1976: 172). For instance, he was a good friend of Pirckheimer and his sister, Caritas, a humanist abbess. Erasmus' letters persuaded them to reject Luther and, in exchange, Erasmus restored Pirckheimer's reputation and standing in Rome and at the imperial court. Furthermore, he persuaded the artist Albrecht Dürer, an admirer of Luther, to abandon his movement. Nevertheless, Lutheran agitation, propelled in large part by more than sixty students who had enrolled at Wittenberg (Erasmus had only a single student contact in Nuremberg), Protestantism was formally adopted by the city council. Though divided in their loyalties, the civic elite realized "that the Wittenberg cause had taken too firm a root in Nuremberg to permit turning back" (Strauss 1976:

166). Although Erasmus did not succeed in stopping the adoption of the Reformation, his firefighting efforts are clear.

In each of these cases, the evidence suggests the market mechanism was not a decisive factor because personal exposure to both men was present (and their publications made their ideas widely known in any event). Nor does ideological inoculation seem to have played a role, even in cities where Erasmus had long-standing connections that predated Luther's rise to prominence. However, the cases do suggest firefighting as a mechanism. Erasmus did not always succeed in smothering Lutheran fires, but he tried to intervene in local disputes by countering Luther's claims and trying to rally a loyalist coalition. In Antwerp, Breisach, and Freiburg, Erasmus' influence bolstered a coalition of university faculty, city councils, and regional rulers. Their united opposition blocked the Reformation.

X. Conclusion and Implications

Research on diffusion tends to have a pro-innovation bias (Everton and Pfaff 2022). Innovation is generally modeled based on personal adoption, rather than on institutional adoption, which is more complex. Actions that promote the diffusion of the new social behavior are modeled but action that rallies resistance is neglected, even though orthodox social networks routinely thwart institutional innovations (Kim 1998; Kim and Pfaff 2012). The case of the Reformation suggests that adoption of innovations is not only a feature of structural positions in networks, but rather of strategic action through networks. Capturing action expressed through networks helps to overcome the old structure/agency dualism: actors construct relations with others but the resulting structure of ties dynamically constrain and enable action (Knoke et al. 2021; Padgett and Ansell 1993).

The theory of complex diffusion (Centola 2018; Centola and Macy 2007) was developed to challenge the simple viral diffusion model (exposure to contagion → adoption). Rather than mere information about an innovation leading to its adoption, when an innovation challenges vested interests or existing institutions, resistance is to be expected. Investment in existing institutions as well as status quo bias increase thresholds for embracing the new. We have argued that adoption also tends to be complex when an innovation is costly and involves uncertainty. Actors considering complex adoption might be driven by the potential benefits of adoption, but in the case of complex adoption there are also dangers that are hard to judge and make calculation of payoffs difficult. Persuasion and social reinforcement become decisive.

Combined, our regression and simulation analyses suggest that unidirectional diffusion models may overstate the degree to which a network is responsible when that diffusion is contested. Ideological innovations, particularly ones that upset the status quo, are more likely to diffuse throughout pre-existing networks only when there is sufficient support for them at various nodes in the network. The diffusion of Protestantism relied on such social reinforcement regardless of social influence. Squashing an innovation at one node may have numerous downstream effects, as it could have spread throughout the network more generally, even in the absence of direct connections made by the ideological entrepreneur. Our analysis therefore suggests that contestation may be central to our understanding of how controversial ideas spread—or are contained—across pre-existing networks.

In the case of the Reformation, we find clear evidence of contested diffusion. Luther's influence is associated with increased odds of Protestant adoption, but places subsequently contested by Erasmus did not have greater odds. Erasmus played a role in rallying opposition to Protestantism but we find little evidence that Erasmus either inoculated cities against the Protestant

bacillus or seeded the ground for Protestant success. Reactionary critics accused Erasmus of inadvertently triggering the Reformation. They claimed that Erasmus' Humanism and skepticism toward dogma "laid the egg" that Luther hatched (Rummel 200: 11). Our findings do not support that interpretation. At least during the early phase of the Reformation, places that were exposed to Erasmus' influence were not more likely to adopt Protestantism. Quite to the contrary, Erasmus's influence appears to have had a "firefighting" effect. Where Luther shed sparks by trying to recruit a city, those places where Erasmus subsequently had contact were more successful at dousing the flames. This mechanism did not avert the Reformation but it may have contained the spread of Protestantism, possibly laying the groundwork for a broader and better coordinated counter-assault during the subsequent era of the Counter-Reformation.

Besides its contribution to network diffusion models, this paper adds to the growing literature revealing the socio-economic causes of the Reformation. Many of the causes ascribed in the literature are not mutually exclusive, and include the spread of the printing press (Rubin 2014, 2017; Dittmar and Seabold 2022; Boerner, Rubin, and Severgnini, 2021), rival student networks (Kim and Pfaff 2012), local political influence (Cantoni 2012), exposure to the cult of the saints (Pfaff 2013), political incentives (Pfaff and Corcoran 2012), Ottoman incursions (Iyigun 2008), rent-seeking by the Church (Ekelund, Hebert and Tollison 2006), and Luther's personal influence network (Becker et al. 2020). We have shown that opinion leaders exerted persuasion and social pressure from the inception of the Reformation and that the spread of Protestantism may have been more extensive absent the contestation of Erasmus, Luther's most important intellectual rival.

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APPENDIX TABLES

Table A.1: Reformation Adoption and Erasmus's and Luther's Presence, by type of contact

Specification:	<u>DV: Protestant in year t</u>					
	(1)	(2)	(3)	(4)	(5)	(6)
Contact Type:	Letters		Visits		Students	
	OLS	Cox	OLS	Cox	OLS	Cox
Erasmus before	0.201	1.101	-0.324**	---	0.611**	---
Luther (α_1)	(0.143)	(0.146)	(0.020)		(0.065)	
Luther before	0.296*	1.212*	-0.354**	---	---	---
Erasmus (α_2)	(0.149)	(0.115)	(0.025)			
Erasmus only (α_3)	-0.053	1.044	-0.187**	1.119	0.096	1.248**
	(0.038)	(0.082)	(0.018)	(0.093)	(0.126)	(0.105)
Luther only (α_4)	0.239**	1.162**	0.270	1.009	0.049	1.105
	(0.075)	(0.062)	(0.140)	(0.057)	(0.042)	(0.061)
Proportion Neighbors	0.283**	1.261**	0.279**	1.250**	0.288**	1.247**
Protestant (α_5)	(0.047)	(0.066)	(0.048)	(0.064)	(0.047)	(0.066)
N	4,680	4,152	4,680	4,152	4,680	4,152
R ²	0.727		0.723		0.723	
City-specific controls	N	Y	N	Y	N	Y
City FE	Y	N	Y	N	Y	N
Time FE	Y	N	Y	N	Y	N

** p < 0.01; * p < 0.05; Panel of 585 cities over 8 years. Hazard ratios are reported in columns (2), (4), and (6). The omitted category is "neither Erasmus nor Luther."

Table A.2: Reformation Adoption and Erasmus’s and Luther’s Presence, varying number of years after contact a town remains part of the network

Specification:	DV: Protestant in year t					
	(1)	(2)	(3)	(4)	(5)	(6)
Length of Contact:	One Year		Five Years		Ten Years	
	OLS	Cox	OLS	Cox	OLS	Cox
Erasmus before	0.016	1.398*	-0.093	0.914	-0.058	1.292**
Luther (α_1)	(0.121)	(0.226)	(0.072)	(0.323)	(0.083)	(0.086)
Luther before	0.026	1.614**	0.095	0.967	0.037	0.713
Erasmus (α_2)	(0.143)	(0.235)	(0.053)	(0.160)	(0.050)	(0.157)
Erasmus only (α_3)	-0.022	1.080	-0.016	1.078	-0.001	1.084
	(0.037)	(0.097)	(0.032)	(0.086)	(0.041)	(0.082)
Luther only (α_4)	0.054*	1.311**	0.106**	1.169**	0.120**	1.135**
	(0.026)	(0.066)	(0.031)	(0.054)	(0.039)	(0.051)
Proportion Neighbors Protestant (α_5)	0.289**	1.269**	0.287**	1.262**	0.288**	1.264**
	(0.047)	(0.068)	(0.047)	(0.065)	(0.047)	(0.066)
N	4,680	4,152	4,680	4,152	4,680	4,152
R ²	0.722		0.725		0.724	
City-specific controls	N	Y	N	Y	N	Y
City FE	Y	N	Y	N	Y	N
Time FE	Y	N	Y	N	Y	N

** p < 0.01; * p < 0.05; Panel of 554 cities over 8 years. Hazard ratios are reported in columns (2), (4), and (6). The omitted category is “neither Erasmus nor Luther.”

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² Potential applications include presidential campaigns with two main contenders; or two-sided campaign for/against; forces pro/contra a referendum etc.

³ It is possible that institutional innovations, once adopted, can be abandoned or overthrown. In the case of the Reformation, the reversal of institutionalized Protestant reforms only occurred after our period of study with the onset of the organized Counter-Reformation (beginning in 1545) and the wars of religion in the HRE (beginning in 1546).

⁴ For reviews of the rapidly growing literature on the contribution of the social sciences to studies of the Reformation, see Becker, Pfaff, and Rubin (2016) and Becker, Rubin, and Woessmann (2021).

⁵ Heersink, Peterson, and Peterson (2021) consider both the positive (mobilization) and negative (countermobilization) effects of visits from presidential candidates in the 2016 US presidential election. Like most of the literature, this paper focuses on *unidirectional* influence; although it also notes that there may be counter-productive consequences of expanding one’s network.

⁶ The “de facto” HRE did not include Switzerland, the Netherlands, or northern Italy, all of which gained some form of independence by the period in question. These regions are a necessary component of our analysis, as Erasmus spent considerable time in Switzerland and the Netherlands (his place of birth).

⁷ The descriptive statistics of the resulting network: Avg. degree: 3.63; Diameter: 17; Avg. path length: 7.18; Density: 0.006; Avg. clustering coefficient: 0.365; Number of triangles: 315.

⁸ Control variables include dummies for presence of a printing press by 1500, independent city status, presence of a university, presence of a bishop, rule by a lay magnate, and member of the Hanseatic league. It also includes the log of population in 1500, market potential, log distance to Wittenberg, log distance to Geneva, number of Luther’s works

printed, number of Erasmus’s works printed, and three measures based on the trade network (degree, between, and eigenvector centrality).

⁹ Because hazard models predict death/failure within a city using the time dimension, these regressions do not include city or time fixed effects.

¹⁰ In the Appendix, we report results from two sets of additional specifications. The first (Table A.1) breaks down the type of contact by letters, visits, and students. This regression is difficult to interpret for two reasons. First, it is not obvious we should be comparing only “like with like”; a visit by one of the opponents could “put out the fire” ignited by a letter sent by the other, for instance. This regression would not account for this. Second, there were simply too few places that both men visited or had students to gain meaningful identification off of the “Erasmus before Luther” and “Luther before Erasmus” coefficients. Hence, while we report these results, we do not take great stock in them. Second, we report results in which the effect of Erasmus and Luther’s influence dies out over either 1, 5, or 10 years. In the regressions reported in Table 3, it is assumed that once a contact is made it lasts indefinitely. These results are reported in Table A.2. Unsurprisingly, results are similar when influence dies out over 10 years, and broadly similar when influence dies out over 5 years. Also unsurprisingly, some results are different when influence dies out over one year. In these regressions, if a town does not become Protestant in the year after first contact, the past influence of Erasmus or Luther is not accounted for. We believe this is an unlikely scenario.

¹¹ If $ErasmusFirst = 0$, we drop the term $\delta * ErasmusFirst_{i,t-1}$ (i.e., in mathematical terms, we set this term to 1).

¹² If $ErasmusSecond = 0$, we drop the term $\delta * ErasmusSecond_{i,t-1}$ (i.e., in mathematical terms, we set this term to 1).

¹³ Because there are now three parameter combinations that yield low RMSPEs, we use a table instead of 3-D figures given the difficulty of comprehension of 3-D figures.