Off the Map: Informational Capacity and Local Development in Colonial Ireland

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Abstract

How does the state's informational capacity affect property rights and subsequent development outcomes? We leverage variation induced by a fire in 1711 which partially destroyed the only legally recognized maps of local property boundaries in colonial Ireland. Our research design estimates the effects of this loss of information on local economic development by comparing outcomes between localities which featured on the same physical map, and appear indistinguishable on predetermined covariates, but varied in their exposure to fire damage. We find substantively lower land and building valuations, reduced local investment, and evidence of less secure tenure in fire-affected localities in the long run. These reductions are concentrated in localities previously owned by politically dominant Protestants rather than the marginalized Catholic majority, who had comparatively strong *de facto* property rights protections. The results highlight the distributive implications of state-issued information for *de jure* property rights in stratified contexts.

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1 Introduction

Rulers made maps for millennia, but the introduction of modern surveying techniques in the early 1600s redefined conceptions of governance and ultimately sovereignty itself (Anderson, 1991; Branch, 2014). Modern maps are a key dimension of "informational capacity," the ability of the government to systematically gather and deploy information (Mann, 1984; Scott, 1998). However, we know little about the effects of cartography on local economic development (Nagaraj and Stern, 2020). While historical studies of state development emphasize tax collection (Cantoni, Mohr, and Weigand, 2024; Mayshar, Moav, and Pascali, 2022) and its informational foundations (Garfias and Sellars, 2024; Vom Hau, Peres-Cajías, and Soifer, 2023), even studies of fiscal capacity that highlight the role of maps tend to consider them as an outcome of state-building rather than measuring their impact on local development (Chambru, Henry, and Marx, 2024; Chiovelli et al., 2026). Further, the multidimensional nature of state capacity (Besley and Persson, 2009) suggests that cartography is likely to matter beyond taxes. Recent cross-national evidence, for example, suggests that cadasters impact economic growth by facilitating property rights rather than increasing extractive capacity (D'Arcy, Nistotskaya, and Olsson, 2024).

In this paper, we consider how variation in the coverage of modern maps shaped the distribution of local development outcomes over the long run. Our empirical setting is colonial Ireland where, following a failed rebellion in 1641, the *Down Survey* was created to facilitate the systematic expropriation of Irish Catholic gentry by English Protestants (Bottigheimer, 1971; Prendergast, 1870). Around 1,400 of Ireland's parishes—comprising a majority of the island—were mapped between 1655-57 (Smyth, 2006). These extraordinarily detailed parish maps demarcated the boundaries of each "townland" in a parish, the lowest administrative unit (just over 1 km^2 on average), and documented the name and religious identity of each townland's owner, along with its area. The unprecedented detail and precision of the parish maps (Andrews, 1985) made them uniquely admissible as legal evidence for the resolution of land disputes, which were extremely common throughout this period (Gibson, 1752; Ó Cionnaith, 2022).

We leverage the partial destruction of a set of these maps in a 1711 fire in the Surveyor General's office in Dublin. While some maps were fully destroyed and others survived entirely unscathed, a set of maps—corresponding to 398 parishes across 64 baronies in 18 counties—suffered *partial* fire damage (Commissioners of Public Records, 1813). For these maps, we digitize archival information

pertaining to which parts of each parish's map were destroyed by fire and which survived.[1] Our research design compares subsequent outcomes across historical townlands *on the same parish map* but which varied in whether they fell on the part of the map destroyed by fire—and therefore lost the sole authoritative source of local boundaries and historical ownership. We establish that such 'treated' townlands appear indistinguishable from 'control' townlands across a range of predetermined covariates, including their prior ownership along with their geographical, demographic, and economic characteristics.

While decades of scholarship emphasize the many factors that systematically contributed to Ireland's impoverishment until the late 20th century (Cousens, 1960; Mokyr, 1983; Fernihough and O'Grada, 2022), the importance of agriculture meant the insecurity of rural property rights was a persistent constraint on economic development (de Tocqueville, 1836; Guinnane and Miller, 1997; Solow, 1971). Because the parish maps of the Down Survey were the legal foundation for most Irish land claims for nearly two hundred years (Larcom, 1851), their partial destruction prospectively had substantial consequences for local development outcomes. Existing evidence suggests that, where records were lost, the resolution of disputes came to rely on more informal modes of adjudication (Gibson, 1752), and that such disputes became more frequent, driven by the ease of encroachment, the ubiquity of absentee landlords, and stark local inequality (Mason, 1814a; Commissioners of Public Records, 1813).

Leveraging a wide range of newly digitized data sources from the 18th and 19th centuries, we exploit our within-map variation to estimate the persistent effects of the destruction of state-sanctioned maps on townland-level measures of local economic development, capital investment, and the security of property rights. An original plot-level digitization of *Griffith's Valuation* (1847-64)—the first large-scale enumeration of land tenancy since the Down Survey—establishes that fire damage led treated townlands to have total economic valuations 10-11% lower than control townlands which fell on undamaged portions of the same map. These reductions are comparatively larger for buildings relative to the valuation of land, which depended to a greater degree on immutable geographical characteristics. We demonstrate that these estimates are robust to alternative specifications—including varying the outcome definitions, the inclusion of demanding fixed effects (including by the name of the townland's owner in 1670), and the use of predetermined townland-level covariate controls. Further, we find stable results across various alternative ways to incorporate variation in the extent

[1] Unfortunately, all the original copies of the fire-damaged parish maps were ultimately destroyed by a subsequent fire in 1922. We therefore adjudicate which parts of each parish map were destroyed using the granular report of Commissioners of Public Records (1813).

of our confidence of townlands' assignment to treatment, as well as when using randomization inference to permute the distribution of fire damage across townlands. We find no evidence of spillovers to same-map control townlands spatially proximate to the burned parts of the parish maps. Last, we find contrasting plot-level distributional results, with reductions in building (land) valuations driven by the lower (higher) end of the distribution.

To shed light on these effects, we find evidence consistent with landowners in treated townlands enjoying less secure land tenure, investing less in the maintenance of their properties, and making fewer large-scale investments in either agricultural or industrial infrastructure. To measure the security of property rights, we leverage data on the formal registration of land deeds. Such costly (and voluntary) deed registration tended to occur particularly when individuals anticipated, or were experiencing, land disputes (Roebuck, 1972; Phair, 1966). Exploiting the panel structure of the deeds data, we find rates of deed registration to gradually increase in the decades after 1711 in treated townlands relative to control. We uncover a number of empirical patterns consistent with the heightened frequency of disputes, including the incidence of multiple distinct parties attempting to register deeds pertaining to the same land in the same year. For local investment, we draw on plot-level description data from the *Valuation* along with data on the spatial distribution of agricultural and industrial infrastructure from the *Ordnance Survey* (1829-42). Consistent with the distributional results, we find that treated townlands are more likely to have plots without *any* structures, or to have plots with entirely unproductive land such as bogs. Further, we find modest reductions in the presence of economic infrastructure.

Then, we examine the distributive impacts of the destruction of the parish maps across groups relying more or less on *de jure* property rights protections. During the period under consideration, Protestants constituted a minority group with outsized economic and political influence compared to the marginalized, and far poorer, Catholic majority (Cullen, 1986; McGrath, 1996). Where the Down Survey was missing or destroyed, the resolution of disputes relied on the ad hoc adjudication of local communities—a process considered to potentially advantage Catholics, who otherwise faced systematic discrimination in formal courts for more than a century (Commissioners of Public Records, 1813; Gibson, 1752).

We find that the reductions of townland valuations are particularly large in those townlands which, prior to the fire, were owned by Protestants; especially those bordering a Catholic landlord, or where Protestant landowners held geographically dispersed, and hence potentially harder-to-monitor, estates. By the time of the *Valuation*, we find that Protestant-owned townlands which historically bordered Catholic-owned townlands were substantially more likely to have lessors with last names

commonly associated with Catholic families. Meanwhile, those townlands which had been owned by Protestants with dispersed holdings had substantially more fractionalized landownership. Overall, our results are consistent with an interpretation that the destruction of state-sanctioned maps favored the *de facto* rights of tenants who were overwhelmingly Catholic, as compared to the *de jure* rights of landlords who were overwhelmingly Protestant.

Finally, we assess evidence for alternative channels through which the destruction of the parish maps might have shaped long-run development outcomes. For one, we find some evidence of reductions in fiscal capacity: treated townlands are more likely, for example, to be associated with written-off arrears due to the inability of central revenue officers to locate specific land parcels. However, centrally-administered land taxes were very minimal throughout this period; by contrast, county-level institutions levied far more taxes but also often relied on alternative cartographic sources (Ó Cionnaith, 2022). For another, we rule out that the Great Famine of 1845-52 played an intermediating role in conditioning our primary outcomes. Digitizing townland-level data from the 1841 and 1851 censuses, we find modestly reduced population densities both before and after the Famine and no evidence of its differential impact at such a localized level—a finding consistent with significant prior work (Goodspeed, 2016; Mokyr, 1983).

This paper makes several contributions to the literature on state capacity, property rights, and economic development. First, our results have implications for the sequencing of how the state's capacities develop and its economic consequences. Existing studies tend to focus on fiscal capacities (Besley and Persson, 2009; Cantoni, Mohr, and Weigand, 2024; Chiovelli et al., 2026) and, when considering the prerequisite of the state's ability to collect granular information, tend to examine local variation in tax compliance, particularly in modern settings (Balán et al., 2022; Garfias and Sellars, 2024; Okunogbe, 2025). Our evidence suggests that, in early modern Ireland, granular cartographic information likely had substantial impacts on local development by fostering *legal capacity* through the provision of property rights more than by shaping the fiscal capacity of the central state—which was quite limited at the time. Echoing existing cross-national evidence (D'Arcy, Nistotskaya, and Olsson, 2024), this highlights how the state's informational resources have non-fiscal consequences for development and condition the evolution of its broader capacities over varied time horizons.

A second contribution relates to the vast empirical literature on property rights (Acemoglu and Johnson, 2005; Besley and Ghatak, 2010). Previous studies of property rights, whether theoretical or empirical, tend to measure the effects of positive shocks on property rights for local development (Field, 2007; Hornbeck, 2010). However, even in canonical historic cases (North and Weingast,

1989), the expansion of property rights was hardly linear (Pincus and Robinson, 2014). Our research design allows us to test an implicit assumption of this vast literature by examining whether *decreasing* property rights impacted local development. This is an important contribution given prominent reversals to the expansion of property rights throughout the 18th and 19th centuries (Althoff and Reichardt, 2024; Hornbeck and Naidu, 2014; Banerjee and Iyer, 2005) and in many contemporary settings as well (Balboni et al., 2023; Jacoby, Li, and Rozelle, 2002; Le and Nguyen, 2020). In so doing, we highlight how the loss of states' specific informational resources can reshape property rights and exert persistent effects on local development.

Third, our results underscore significant variation in the impact of the loss of local cartographic information. Our examination of heterogeneous effects across Catholic and Protestant landlords reinforces the crucial distinction between *de facto* and *de jure* property rights (Besley, 1995; Levi and Russell, 2025; Goldstein and Udry, 2008). We provide evidence of particularly pernicious incentives resulting from the fact that, for almost three centuries, many Protestant landowners maintained exclusionary political and economic control yet often failed to monitor or protect their land (Mokyr, 1983). By contrast, Catholics were plausibly better able to secure land in the absence of *de jure* protections but their broad economic precarity may have limited subsequent investments. Consistent with the many of the challenges facing experimental studies of property rights (De La O et al., 2026; Huntington and Shenoy, 2021), this highlights the distributive implications of changes in the state's capacities in stratified settings.

2 Context

In 1641, a rebellion by the Catholic gentry briefly disrupted English rule of Ireland (Perceval-Maxwell, 1994), where the Crown's influence had steadily increased since the establishment of successive "Plantations" during the Tudor period (Andrews, 1985). Short on funds, Parliament passed an act to raise an army to invade Ireland (Bottigheimer, 1971; MacCormack, 1956), but the outbreak of the Civil War in 1642 meant that it was not until 1649 that the New Model Army, led by Oliver Cromwell, invaded Ireland (Cunningham, 2010). Following a violent campaign in which almost a third of Ireland's population was lost to disease, war, and migration (Smyth, 2006, 160-161), a decision was made that all lands held by Catholic Irish gentry involved in the conflict were forfeited to compensate the English Protestants who had either funded the conflict or fought in

it (Brown, 2020; Canny, 2001; Prendergast, 1870).[2]

2.1 Construction of the Down Survey

The problem with this scheme was that a cadastral survey had never been conducted in Ireland, meaning that the English government lacked the information essential for systematically expropriating and redistributing land. After two failed attempts (Ó Domhnaill, 1943), William Petty, a polymath with close ties to Oliver Cromwell's son, was tasked with organizing a new effort based on modern surveying tools (Henry, 2014). The resultant map series, the Down Survey—so-called because surveyors set "down" a chain to calculate distances (Komel, 2024; Ó Domhnaill, 1943; O Siochrú, Brown, and Bartlett, 2018)—resulted in a nested set of around 250 *barony* maps and 1,400 *parish* maps.[3] Figure 1 provides an example of each.[4] Each barony map delineated the boundaries of parishes and the rough locations of the townlands within them. The parish maps, which were up to three feet in length or width, much more precisely demarcated townland boundaries, along with recording the the names of the owners of each townland and its exact area. The parish maps were complemented by a series of "terriers," known as the *Books of Survey and Distribution*, which recorded the ownership of townlands both before, as of 1640, and after, as of 1670, the conflict (Ó Domhnaill, 1943, 382).[5] The combination of the townland maps and the identity of their owners gave authorities the information they needed to expropriate Ireland's Catholic gentry.

The scale and precision of the Down Survey and extent of the expropriation it facilitated encoded deep, and persistent, inequalities. By 1670, the Cromwellian Settlement had dramatically reconfigured landholdings: Catholic landownership fell to 20%, constituting "the single largest shift in land ownership anywhere in Europe (and possibly beyond) during the early modern period" (O Siochrú, Brown, and Bartlett, 2018, 606). Reflecting the extreme degree of inequality, the incomplete *Pender's Census* of 1659 reports 87% of households as being Irish rather than English (Smyth, 2002). Many of those receiving expropriated land, however, never actually settled in Ireland (Lenihan, 2014, 146-147) and by the 1750s observers were already lamenting the "evils" of absentee

[2]This land would be used to pay both the "Adventurers," so-called because they "ventured" capital to fund the initial invasion (Brown, 2020), as well as soldiers who were owed arrears after years of combat (Canny, 2001).

[3]The Down Survey did not construct maps of *every* parish in Ireland; broadly, some had already been mapped under a prior smaller-scale map (the Strafford survey), while in parishes with no Catholic landowners, especially in Ulster where Plantations had been most successful, there was no need to construct a map since no land was expropriated. For a map of the Plantations and associated dates see Figure A8.

[4]All the original Down Survey maps were ultimately destroyed in a fire in 1922; both of these are copies from the respective originals, with the parish map made after the 1711 fire we study.

[5]See Figure A6 for an example.

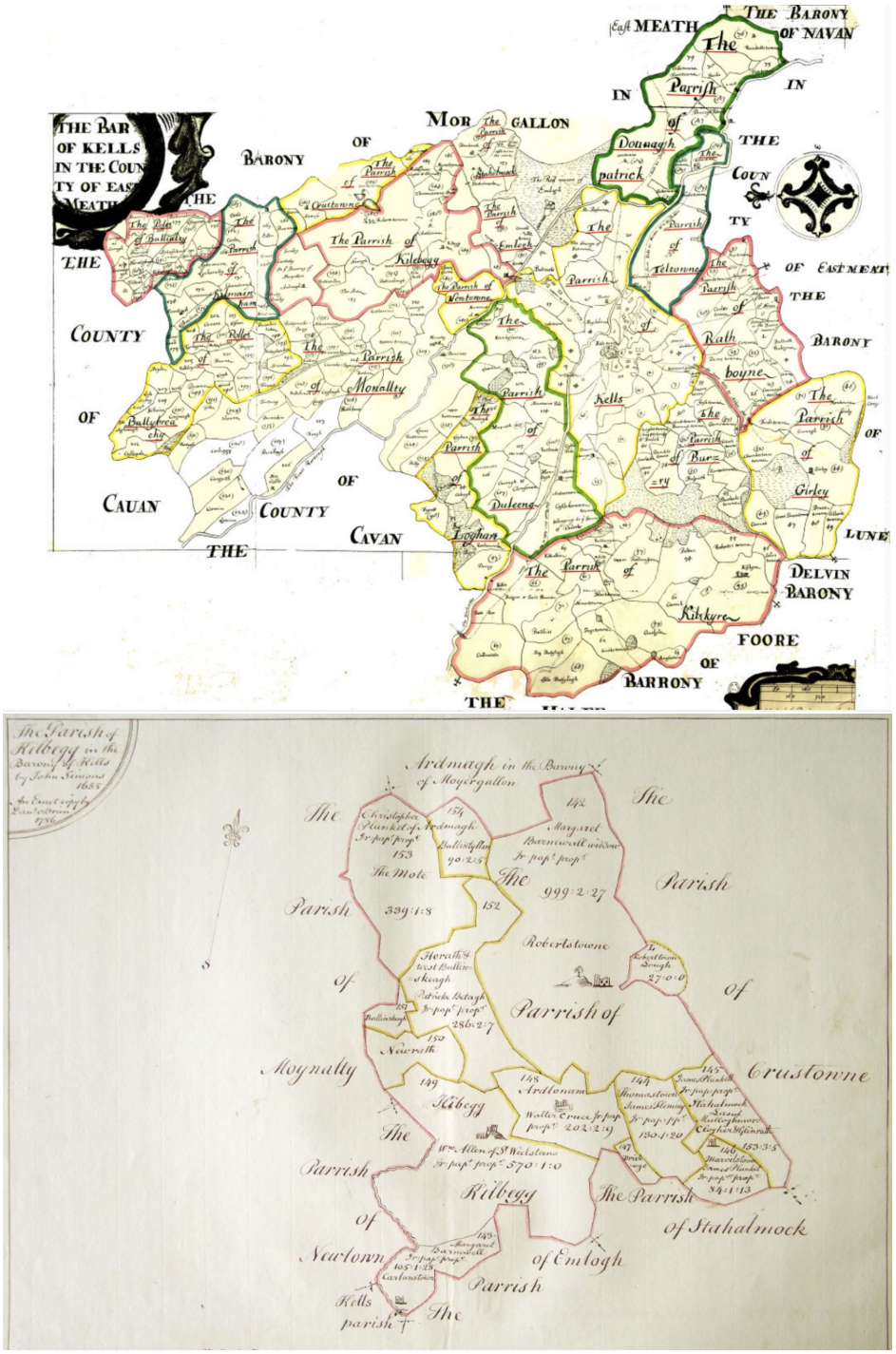


Figure 1: Down Survey map copies for barony of Kells (top) and parish of Kilbegg, barony of Kells (bottom)

landlords (Prior, 1745). By facilitating the expropriation of the Irish gentry, the Down Survey set the stage for the persistence of a landed elite who were not Irish and often rarely visited their vast estates which dominated the countryside (Campbell, 2009).

2.2 Property disputes

Over the course of the 18th and 19th centuries the extended nature of leases, combined with high rates of absentee landlords, facilitated encroachment or the outright expropriation of parcels by opportunistic neighbors or untrustworthy local agents, leading to a massive increase in court cases over land and a general decline in the security of property rights (Ó Cionnaith, 2022).[6] In the words of one contemporary observer:

> "The principal cause of the bad cultivation of land may be classified under two heads, *insecurity of title*, and *want of capital;* and these causes affect the land whether we look to the owner of the property—unable to prove his title, embarrassed by heavy mortgages, and bound up by settlements,—or to the pauper tenant in possession, holding his land at a rent which leaves him a bare subsistence, and without any motive for improving a property of which he has no certain tenure" (Pim, 1847, 6).

The Down Survey maps remained the foundation of property rights claims across much of Ireland for nearly two centuries.[7] As Thomas Larcom, the director of the later Ordnance Survey which eventually supplanted the Down Survey, acknowledged, "the Down Survey stands to this day ... [as] the legal record of the title on which half the land of Ireland is held" (Larcom, 1851, 338).[8] Due to their precise measures of townland boundaries, land areas, quality, and ownership, the parish maps, often in combination with the terriers, were indispensable in resolving property disputes (Bermingham, 1720; Howard, 1776; Trenchard, 1702). One legal case in 1732 refers to the maps as "the strongest and best evidence" for establishing the border of disputed property (Barker, 1732, 1). In contrast, the baronial maps were considered too aggregated to provide much guidance in cases of local property disputes (see Appendix C for more discussion on this point).

[6] See Barker (1714); Bermingham and Brown (1730); Brown (1779); Hamilton (1718); Rowley (1774) for examples.

[7] The Down Survey played a relatively limited role in tax administration. While a handful of centralized land-based taxes were directly or indirectly linked to cartographic information in the Down Survey, these were small in substantive magnitude. Local taxes, by contrast, had few plausible connections to the Down Survey beyond the townlands it delineated constituting the unit of local cess taxation. We return to this point in Section 5.4.1 and Appendix H.

[8] As Ó Cionnaith (2022, 136) notes, "The importance that this resource was afforded can often be hard to comprehend from a modern perspective, given the wealth of geographic reference material currently available."

Their persistent influence is attributable to the fact that—despite subsequent advances in surveying techniques—*only* the parish maps were considered legally valid in court due to concerns over the inaccuracy of cartographic sources provided by private surveyors commissioned by wealthy litigants (Gibson, 1752, 285).[9] The refusal to legally recognize the work of private surveyors meant that the original maps remained the only state-sanctioned cartographic means to assess the integrity of competing claims when property disputes went to court (Barker, 1732). Appendix B, drawing on a range of archival sources, illustrates the centrality of the parish maps in these cases. To provide one illustrative example, Gabriel Stokes, a prominent early private surveyor, was asked to look into a border dispute by a client in County Kildare between 1728 and 1730. After consulting the Down Survey, Stokes wrote that "the Down Survey pronounces otherwise, therefore entertain no thoughts of that piece of ground" (Ó Cionnaith, 2022, 125).

2.3 Partial destruction of the parish maps

Exactly one official copy of each Down Survey parish map was made and stored in the Surveyor General's office on Essex Street in Dublin, where they could be readily referenced to resolve conflicting claims over land. In 1711 a fire broke out in this office which caused substantial damage to this priceless cartographic collection (Ó Domhnaill, 1943). In total, 67 of the (less detailed) baronial maps were lost. Across the folios containing the detailed parish maps, 320 maps were partially damaged by the fire, 780 remained intact, and many were completely destroyed (Commissioners of Public Records, 1813).[10] Appendix A provides additional detail on the original storage of the maps and the fire, which we return to in our research design.

The loss of a subset of the sole official parish maps presented the colonial government with a serious challenge. The costs of a new survey of equivalent detail would have been enormous and taken years (Ó Cionnaith, 2022). A second concern was political: as William Shaw Mason, an early statistician, lamented nearly 100 years after the fire, "[the fire] happened in the year 1711; but, upon such occasions, it almost always unfortunately follows as a consequence that the mischief done is by no means confined to the ravages of the flames" (Mason, 1814a, xviii). The definitive parliamentary inquiry on the issue noted, by the early 1800s, that so much land had been encroached upon that commissioning new maps would lead to "endless litigation between old and new interests"

[9] See Webb (1744) for a clear legal example, and Andrews (1985, Appendix B) for examples from a review of public disputes between rival surveyors between 1743-1798.

[10] This suggests that somewhere around 200 parish maps were entirely destroyed by fire, although it is impossible to provide an exact estimate given the lack of a surviving authoritative list of the universe of parish maps originally made by Petty.

(Commissioners of Public Records, 1813, 498). Faced with a set of unenviable choices the colonial government did what many governments do when confronted with unpleasant policy alternatives: nothing.

The partial destruction of the Down Survey parish maps in the 1711 fire, and the absence of any alternative state-sanctioned local maps, worsened the steadily growing problem of property rights insecurity and disputes in the Irish countryside. For example, in 1813, a witness before a parliamentary inquiry described the challenges confronting land owned by a hospital in Nodstown, rural County Tipperary:

> "One half of the mearing [boundary] of those Lands, in the Down Survey existing, is destroyed...The Blue-coat Hospital have lost all that part which was destroyed [by fire] in the Down Survey" (Commissioners of Public Records, 1813, 500).

In areas where the Down Survey was missing or destroyed, property rights were not frozen but adjudicating disputes had a necessarily more informal character. As Gibson (1752, 285) reports, in the case of suspected land theft, "If it [Down Survey parish maps] is to be had, this readily discovers the fraud; if not, the matter is determined by the evidences of the oldest persons of honest repute in the neighbourhood." And, as noted sixty years later by evidence in Commissioners of Public Records (1813, 540), "since the [fire] destruction [...] the well-meaning Subjects of this Kingdom are frequently drawn into suits and controversies on account of the metes and bounds of their respective properties; and have no other way of deciding the same, but by the verdict of twelve men, of their neighbours, who are frequently misled."

2.4 Theoretical and empirical implications

To inform our empirical analyses, we illustrate particular theoretical channels through which variation in the destruction of the parish maps could have exerted long-run effects on the levels and distribution of local development outcomes. In the spirit of our research design described below, consider two otherwise identical landlords who own townlands depicted on the same partially damaged parish map: Landlord A's townland falls on a portion of the map that survived intact, while the portion depicting Landlord B's townland was destroyed. Because the parish maps were, as documented above, the sole authoritative record of townland boundaries and historical ownership, the fire destroyed state-sanctioned information about B's property that no other source could entirely replace.

A large body of scholarship, both theoretical (Arrow, 1979; Demsetz, 1966) and empirical (Firmin-Sellers, 1995; Ferree et al., 2023; Libecap, Lueck, and O'Grady, 2011), emphasizes the

role of information in the enforcement of property rights.[11] The direct implication is that Landlord B's property rights are less secure than A's. Without an authoritative record, boundary disputes with neighbors should become easier to initiate and harder to resolve (Alston, Harris, and Mueller, 2012; Sánchez, López-Uribe, and Fazio, 2010), a vulnerability potentially compounded for the many landlords who resided in Dublin or London and relied on local intermediaries to monitor their estates. As the loss of records gradually became common knowledge (Gibson, 1752), ambiguity would potentially also invite deliberate—and hard to indefinitely deter—encroachment, for which B could only rely on more informal local adjudication (Fergusson, 2013).

Facing both disputes and the weakened security of tenure, B should invest less in the improvement and maintenance of their land and property (Besley and Persson, 2009; Libecap, 1986), gradually reducing its value relative to A's. At the same time, attenuating any such effects, the protections conveyed even by surviving maps had limits: in an analysis of land held by religious institutions, for example, Mason (1814b) documents a host of intrusions upon land even where the relevant parish maps survived.[12]

Property rights are, however, fundamentally political (Albertus and Klaus, 2025; Besley, 1995; Goldstein and Udry, 2008). Landlord B might treat the absence of authoritative boundaries not as a threat but rather an opportunity to expand into common land or the holdings of neighbors poorly positioned to resist (Alston, Libecap, and Mueller, 1999). To the extent that contested land was underutilized, successful encroachment could even raise measured development, whatever its distributive character (Robinson, 2008; Skaperdas, 1992). The net effect of the fire on the value of affected townlands is therefore ambiguous *a priori*, as is the question of whether any losses reflect value destroyed or value merely redistributed toward neighboring claimants. Both are empirical questions, which we take up below.

The distinction between *de facto* and *de jure* property rights protections provides some guidance on *who* should bear any losses (Balán et al., 2026; Levi and Russell, 2025). Throughout the "Protestant Ascendancy," spanning 1691–1829, the formal apparatus of property enforcement—courts, juries, and registries—served the Protestant minority, whose claims overwhelmingly derived

[11] One of the virtues of the "rectangular system" for demarcating property, which was *not* used in Ireland, but was common throughout other parts of the British Empire, was that it dramatically "reduced informational costs" (Libecap, Lueck, and O'Grady, 2011, 306)

[12] For one perhaps optimistic example, Mason (1814b, 117) notes: "Ballyvoorney is united to no other parish. The glebe, according to the Down Survey, lies immediately about the church, on which there is a house, now a sporting lodge, belonging to Sir Nicholas Conway Colthurst: it is universally believed that it was usurped by one of his ancestors, [...] Sir Nicholas, the present proprietor of the estate, seems to be a young gentleman of a generous and enlarged mind, and probably will, upon being shewn the map of the glebe out of the Down Survey, yield back a property to which he can have no legal title."

from the confiscations that the Down Survey was created to administer (McGrath, 1996). The Penal Laws, meanwhile, imposed severe constraints on the *de jure* rights of the Catholic majority, including prohibitions on purchasing or inheriting land from a Protestant owner and on holding leases of longer than 31 years (Simms, 1960).[13] While historians debate the extent of their effective enforcement (Cullen, 1986), these laws largely excluded Catholics from the formal channels through which the parish maps derived their value. Catholics relied instead on comparatively strong *de facto* protections: local knowledge, community adjudication, and their numerical predominance among tenants and witnesses. Indeed, Commissioners of Public Records (1813, 540) laments that parties to disputes were most often misled "by Irish evidence [...] intentionally to sow dissension amongst Protestants, in order to weaken our common interest."

The loss of the Down Survey records would plausibly weaken precisely the *de jure* margin on which Protestant, but rarely Catholic, claims depended. Its burden might therefore fall most heavily on landowners most dependent on formal enforcement—Protestants rather than Catholics and, among Protestants, those with landholdings at higher risk of encroachment due either to their neighbors or geography.

Finally, self-interest and a willingness to defend claims can, in principle, create a stable "self-help" equilibrium in which property rights are respected absent state intervention (Grossman, 2001). In this setting, however, Landlord B could not simply commission a survey of their property because privately made maps carried little evidentiary weight. Restoring the informational foundation of property rights instead required state action—the formal recognition of private surveys or a new public survey—and, for the reasons described in the previous section, neither was forthcoming for more than a century, until the Ordnance Survey (1824–46) at last replaced the Down Survey as the authoritative record of Ireland's boundaries (Ó Cionnaith, 2022). We return to the sources of this persistence, and its implications for interpreting our estimates, below.

3 Empirical strategy

Our research design seeks to leverage townland-level variation in exposure to the 1711 fire, then to examine the effects of this shock on subsequent local development outcomes. While we would ideally be able to evaluate impacts over various time horizons, *another* fire—the Four Courts fire of 1922 in the midst of the Irish civil war—destroyed the bulk of disaggregated historical records

[13] Additionally, rather than primogeniture, upon the death of a Catholic landowner land was supposed to be equally divided among his surviving sons, a system known as gavelkind. Furthermore, if a Catholic son converted to Protestantism he enjoyed a far stronger claim on his father's land than his brothers.

from the 18th century, a fact long noted by historians of Ireland (Roebuck, 1972; Phair, 1966).[14] Given this paucity of disaggregated short-run outcome data sources, we mostly focus on the long-run consequences of the damage to the parish maps (we return to a discussion of persistence in Section 6.1). In this section we outline our empirical strategy, with specific outcome data sources and measures introduced alongside the results.

3.1 Fire damage to the parish maps

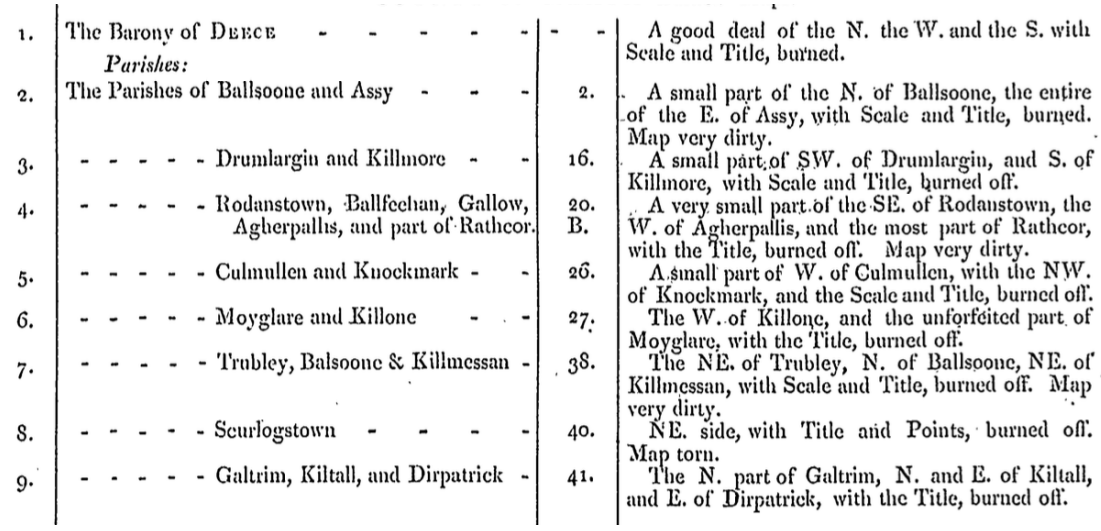
Our research design relies on a measure of the extent of destruction of the parish maps as a "treatment." Because of the destruction of *all* then-surviving parish maps in the 1922 fire (Ó Domhnaill, 1943), we cannot directly observe the extent of fire damage on the original parish maps. In lieu of a direct measure, we digitize a granular catalog of the condition of each map using Commissioners of Public Records (1813), which provides a first-hand account of the extent of fire damage resulting from the 1711 fire as determined by a Parliamentary inquest in 1813.[15] The Down Survey maps were stored in a set of 31 folios. Within a folio, maps were stored separately by barony, with the coarse barony map lying on top of the disaggregated parish maps. These folios varied in the extent of their exposure to the fire, with 4 counties' records entirely destroyed, 10 counties entirely unscathed, and the residual 18 counties—our primary empirical focus—which were exposed to *partial* damage (see Figure 3a).

Figure 2 provides an example of the catalog's structure and illustrates several important points. First, as discussed above, because the parish maps were far more detailed—including both landowner names and exact townland boundaries and areas—they were of unique utility in adjudicating disputes relative to the barony maps (see Appendix C for significant additional evidence on this point). As a result, we focus only on the parish maps in the analyses that follow. Second, multiple parishes were sometimes colocated on the same physical map. We therefore split the catalog dataset to be defined at the *parish* ($n = 1,687$), rather than *map* ($n = 1,192$), level. We then code the extent of burn damage by following the cardinal directions reported to have been burned, again defined at the *parish* level. For example, in the second row of Figure 2, we define one observation for Ballsoone parish and one for Assy parish, and record burn damage only to the north of Ballsoone and the east

[14] Data on wills and deeds from the 18th century, which we leverage below, only survived due their housing in a different location unaffected by the 1922 fire.

[15] As we discuss in Appendix C, this report was part of the extremely protracted process of assessing the necessity of replacing the lost parish maps. Importantly, even though it was recorded a century later, the damage recorded in Commissioners of Public Records (1813) is specifically related to the 1711 fire. In cases where parts of the parish maps were exposed to other damage, such as tears or general wear, this is specified separately to the comments on the cardinal directions of each parish which had been damaged by fire.

Figure 2: Fire damage to maps in barony of Deece, county Meath



1.	The Barony of DEECE - - - - - -	- -	A good deal of the N. the W. and the S. with Scale and Title, burned.
	Parishes:		
2.	The Parishes of Ballsoone and Assy - - -	2.	A small part of the N. of Ballsoone, the entire of the E. of Assy, with Scale and Title, burned. Map very dirty.
3.	- - - - - Drumlargin and Killmore - -	16.	A small part of SW. of Drumlargin, and S. of Killmore, with Scale and Title, burned off.
4.	- - - - - Rodanstown, Ballfeehan, Gallow, Agherpallis, and part of Rathcor.	20. B.	A very small part of the SE. of Rodanstown, the W. of Agherpallis, and the most part of Rathcor, with the Title, burned off. Map very dirty.
5.	- - - - - Culmullen and Knockmark - -	26.	A small part of W. of Culmullen, with the NW. of Knockmark, and the Scale and Title, burned off.
6.	- - - - - Moyglare and Killone - - -	27.	The W. of Killone, and the unforfeited part of Moyglare, with the Title, burned off.
7.	- - - - - Trubley, Balsoone & Killmessan -	38.	The NE. of Trubley, N. of Ballsoone, NE. of Killmessan, with Scale and Title, burned off. Map very dirty.
8.	- - - - - Scurlogstown - - - -	40.	NE. side, with Title and Points, burned off. Map torn.
9.	- - - - - Galtrim, Kiltall, and Dirpatrick -	41.	The N. part of Galtrim, N. and E. of Kiltall, and E. of Dirpatrick, with the Title, burned off.

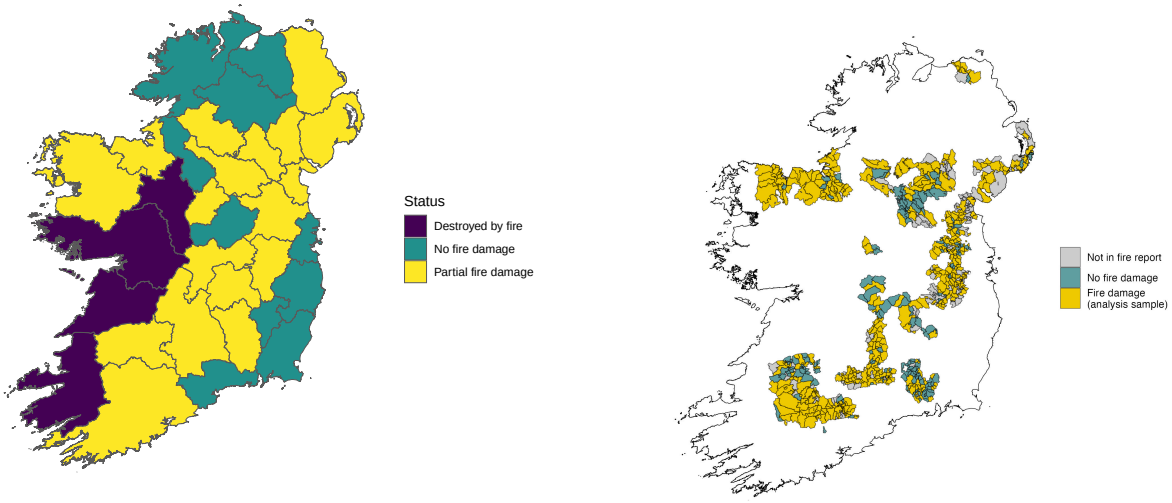
of Assy.[16] 64 baronies contain at least one parish map with recorded burn damage, which we call our *baronial sample*. In total, these baronies contain 562 listed parishes across 399 maps. From these, 398 parishes across 320 maps have burn damage reported to at least one cardinal point. Finally, we exclude 18 parishes which are either listed on multiple maps or where the recorded extent of their burn damage is ambiguous, leaving us with an *analysis sample* of 380 historical parishes.[17]

We then construct shapefiles reflecting boundaries for all historical parishes in the baronial sample as defined in the 1650s. Beginning with parish shapefiles from the 1841 census from Fernihough and O'Grada (2022), we manually reconstruct 1650s parish boundaries using an array of sources including surviving copies of the baronial and parish maps, Ó Siochrú, Brown, and Bailey (2013), and the *Books of Survey and Distribution* (see Appendix D for more detail). Across the baronial sample, we recover the boundaries of 677 parishes in total (with a median area of 17 km^2), which exceeds the number recorded in Commissioners of Public Records (1813) for two reasons. First, parishes without any land eligible for expropriation during the Cromwellian Settlement typically went unmapped in Petty's parish maps.[18] Second, some parish maps were likely entirely destroyed

[16]Importantly, Commissioners of Public Records (1813) reports fire damage to the cardinal points of *parishes* rather than maps. At the time of the Down Survey it was uncommon to use the cardinal direction of North at the top of a map. This means that many parish maps were often rotated such that, even across maps within a barony, there is a good deal of variation in which cardinal points of the parish were exposed to fire.

[17]The handful of parishes appearing on multiple maps are generally cases where a parish comprised two non-contiguous areas, so it is therefore difficult to know which part fell on which map. In a small number of cases, the catalog does not report cardinal directions of the fire damage and hence we exclude these from the sample.

[18]Consistent with this point, Figure 3b shows relatively more 'missing' parishes in the northernmost Ulster province, which was heavily Protestant, and hence contained relatively less land to be expropriated, prior to the Cromwellian



(a) County-level exposure to fire damage in 1711 (b) Distribution of parishes in baronial sample

Figure 3: Down Survey map survival and parish distribution

or missing by 1813. Figure 3b plots the spatial distribution of our analysis sample of historical parishes exposed to partial fire damage.

Within the baronial sample, using the predetermined covariates introduced below, Table A2 documents that parishes exposed to fire damage (whether at all or based on the share of cardinal points burned) systematically vary from those not exposed. Consistent with the storage of the maps, those maps which were physically higher in the relevant folio were more exposed; further, these parishes differ along a number of geographical, historical, and economic dimensions.[19] The non-randomness of *which* parish maps were affected by the fire, combined with the missingness of some parish maps, motivates our focus on *within-map* variation in exposure to fire damage.

3.2 Townland characteristics

The townland therefore constitutes our unit of analysis. "Modern" townlands have been essentially unchanged since the 1830s, with 9,357 modern townlands lying within one of the historical parishes

Settlement.

[19] Commissioners of Public Records (1813) reconstructs the original storage order of the parish maps within a given barony (see the leftmost column of Figure 2), enabling us to understand how the fire affected parish maps depending on their physical position within a folio. Parishes on maps with a higher order number (that is, which lay lower in the physical folio) were less likely to be affected by any fire damage, though conditioning on barony fixed effects attenuates this correlation.

in our analysis sample. Despite striking persistence in administrative geography, relying only on modern townlands risks the units themselves being endogenous to our treatment: while the delimitation of modern townlands required surveyors to hew to Down Survey era boundaries, this continuity is less plausible in cases where the original maps themselves had been damaged.[20] We therefore link our analysis sample of *modern* townlands back to *historical* townlands as defined in the 1650s. We do this primarily using the existing work of Ó Siochrú, Brown, and Bailey (2013), which spatially links the near-universe of modern townlands to their names as recorded in the 1650s. We supplement this, as detailed in Appendix D.2, using alternative sources of townland name histories as needed. Using these, we link the 9,357 modern townlands back to 6,231 *historical* townlands which become our baseline unit of observation.

We draw on several data sources to assess the pre-fire characteristics of townlands. Primarily, we draw on a recent digitization of the *Books of Survey and Distribution* (1675) to identify landholders' identity, religious denomination, and the extent of their holdings in 1641 (before the rebellion that led to the reinvasion of Ireland by the New Model Army) and in 1670 (after the Cromwellian Settlement) (Ó Siochrú, 2013). We supplement this data by drawing on a digitization of the full list of properties expropriated following the Williamite Confiscations in 1703.[21]

We draw on data from the incomplete *Pender's Census* (1659) to identify the total number of households in each townland in 1659 as well as the share of "Irish" households. To assess the productivity of land in these historic townlands, we use the Caloric Suitability Index of Galor and Özak (2016) focusing on the primary agricultural crops of Ireland during this period (Porter, 1850). To account for different geographic features apart from the suitability of soil for crops we exploit the fact that Irish townland name stems typically indicated the historical presence of different natural resources or physical structures (Nash, 1999).[22] Finally, to account for diferential levels of agricultural investment *prior* to the 1711 fire we draw on a comprehensive list of 17$^{\text{th}}$ century mills.

[20]The delineation of administrative boundaries in the 1830s relied heavily on the Down Survey: despite using the most modern surveying tools and techniques available, "Ordnance Survey surveyors had the authority to accurately survey the boundaries, but not to change or delete them, thus creating the strong continuity between Petty's surveyors and property boundaries as they exist in the present" (Ó Siochrú, Brown, and Bailey, 2013). The *Boundary Survey (Ireland) Act* of 1825, illustratively, allowed enumerators to consult local informants to inform boundary delimitations where they lacked more authoritative sources of information.

[21]For more details see Section F in the Appendix. The Williamite Confiscations were the last large-scale land expropriation prior to the fire at the Surveyor Generals office in 1711 and thus provide us with a definitive measure of the distribution of townlands by religious denomination prior to treatment, though we only observe the *names* of landowners in 1670.

[22]For example, "derry" in a townland name, such as in "Edenderry," signifies oak trees; "ard" signifies a high point; "carrick" signifies rocks; "down" signifies a fortified structure; "knock" signifies a hill; and "kil" signifies a religious structure.

3.3 Illustrating treatment assignment

Assigning our analysis sample of townlands to treatment (that is, where the portion of the parish map representing that townland was destroyed in the fire), or control (in which it survived), requires us to link a written description of burn damage to the historical townlands falling in that parish. Figure 4 illustrates our treatment assignment process for Ardmayle parish, quoting the extent of fire damage for the relevant parish map from Commissioners of Public Records (1813) at the top (see Figure A10 for additional examples). We divide each parish into octants, where the center is defined by the parish centroid. We then code fire damage reported to the "north east" of a parish as affecting townlands between 0° and 90° of the centroid; "east" as affected those between 45° and 135° degrees; "south east" as affecting those between 90° and 180°, and so on. The townland of Nodstown, our example cited above, is accordingly narrowly assigned to treatment.

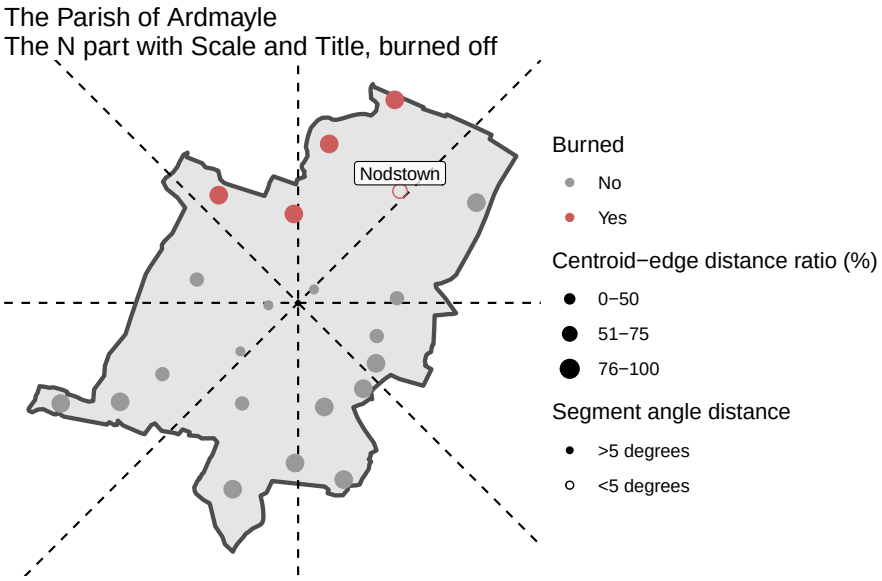


Figure 4: Visualization of treatment assignment of townlands in Ardmayle parish

Notes: Parish centroid marked in black with octants used to assign cardinal point of each townland. Red townlands indicate assignment to treatment. Description of fire damage to parish map from Commissioners of Public Records (1813) printed at top. Hollow points indicate exclusion of that townland from baseline estimating sample due to proximity to segment boundaries.

This process implies variation in the confidence of treatment assignment along two dimensions. First, those townlands close to the edge of the parishes depicted on a map are more likely to have been affected by fire damage than townlands close to the map centroid; illustratively, most of the descriptions in Commissioners of Public Records (1813) note fire damage only to the edges of

the relevant parishes.[23] We therefore compute the *centroid-edge distance ratio* which measures a townland's relative distance from the centroid of its parish and the closest outer boundary of the parishes on that map. Second, those townlands far from a segment line delineating treatment from control are more likely to have been treated: in the illustration, Nodstown (at 43°) is less likely to be treated than a townland at 0°, just as a townland at 90° is more likely to be non-treated than one at 46°. Indeed, as highlighted in Section 2.3, records suggest that only *some* of the map pertaining to the townland of Nodstown was destroyed (Commissioners of Public Records, 1813, 500). For all townlands, we therefore compute a *segment angle distance* measuring its decimal degree proximity to a segment line which distinguishes treatment from control (for example, with 0 indicating a townland falling precisely on such a segment line, and with Nodstown taking on a value of 2).

3.4 Empirical specification

We compare subsequently observed outcomes between historical townlands which fell on the portions of parish maps destroyed in the 1711 fire to those townlands, on the same parish map, which did not. Our main estimating equation is:

$$y_{ipm} = \beta \text{Burned}_{ip} + \mu_m + \gamma \mathbf{X}_i + \epsilon_{ipm}, \tag{1}$$

where outcome y for townland i in parish p on map m is regressed onto an indicator for the assignment of that townland to treatment, Burned_{ip}, parish map-level fixed effects μ_m (with most maps representing only one parish), and a set of geographical covariates $\mathbf{X}_i$ discussed below. In auxiliary specifications, we add a vector of LASSO doubly-selected predetermined covariates, from the full set of variables in Table A3, following Belloni, Chernozhukov, and Hansen (2014). Throughout, we cluster standard errors by map.[24]

Considering the two dimensions of treatment assignment confidence noted above, Figure A14 provides their distributions. In our baseline specification, as reflected in Figure 4, we condition our sample to comprise those townlands with a centroid-edge distance ratio above 0.75 (retaining 60% of the sample) and a segment angle distance above 5 degrees (retaining 94%). These restrictions,

[23] For example, 38% of the parish maps affected by fire note record fire damage to the "edge," "boundary," or that only a "small part" was lost to fire. For experimental evidence consistent with the outer edge-based pattern see Ahn et al. (2018, Figure 8).

[24] Because Griffith's Valuation was conducted over a nearly twenty year period, starting immediately following the Great Famine when the cost of agriculture staples was extremely low, these fixed effects additionally help address concerns about disparities in the estimated value of properties, which even contemporary scholars noted differed dramatically across Ireland (Irish Land Committee, 1880, 15).

which we systematically vary below, leave us with an estimating sample of historical townlands where we can be relatively confident in their assignment to burn damage on the relevant parish map.

The key identifying assumption is that a given townland's assignment to treatment is as-if random conditional on the map representing it. This would be violated if the cardinal points of a given parish map exposed to fire damage systematically correlated with pre-fire characteristics of townlands lying within those quadrants compared to other parts of the map. We assess the plausibility of this identifying assumption using balance tests, leveraging the linkage of the spatial townland data to geographical features along with pre-fire covariates.

Table A3 provides these estimates using Equation (1) (omitting the $\mathbf{X}_i$ controls). A joint F-test supports that treated townlands overall appear indistinguishable from control ($p = 0.38$). Considering geographical features, more southerly townlands were somewhat more likely to be damaged by fire, reflecting slight correlation in the orientation of parishes across different maps.[25] To account for this marginal imbalance, we include controls for longitude and latitude in our baseline specification.[26] We also add a control for townland area to improve precision since our primary outcomes, such as land valuations, are mechanically highly correlated with area. We find good balance on historical landownership and demographic characteristics in panel B, including the religion of prior landowners and the distribution of their holdings, as well as measures of economic production in panel C. Last, we find balance on the relative centrality of townlands across treatment and control as well as their linkage to our primary outcome data source.[27] Overall, the balance tests suggest that townlands' assignment to treatment is plausibly orthogonal to characteristics which might otherwise confound the estimation of effects on subsequent development outcomes.

4 Effects on townland valuation

With evidence supporting the validity of the research design in hand, we examine treatment effects on the levels and distribution of townland valuations.

[25] Consistent with this point, at the map level Commissioners of Public Records (1813) records burn damage to the northern quadrant of 30% of parishes, the eastern quadrant in 28% of parishes, the southern quadrant in 36% of parishes, and the western quadrant in 26% of parishes. Appendix A provides more details on the storage of the parish maps prior to 1711.

[26] As Table A4 shows, our main outcomes are uncorrelated with latitude but correlated with longitude, with more easterly townlands (holding fixed the parish map) showing significantly greater land, building, and total valuations.

[27] The segment angle distance measure is imbalanced by construction: for example, if we code townlands only in the northern segment as treated, the variable mechanically takes on a maximal value of 22.5 for treated townlands but 135 for control townlands.

4.1 Data source: *Griffith's Valuation*

We rely for our primary outcome measures on data from *Griffith's Valuation* (1847-1864). This comprehensive survey of all land plots in Ireland was designed to provide a "uniform basis" for local taxes (Irish Land Committee, 1880, 4) and was the first comprehensive enumeration of land tenancy across Ireland since the Down Survey two centuries prior (Appendix E.1 provides more details on its implementation). The *Valuation* covered all townlands and included a wide range of tenancy configurations, crops, and geographic features. Returning to the example of Nodstown in Ardmayle parish in rural Tipperary (see Section 2.3), Figure 5 illustrates the granularity of recorded information. For every plot, nested uniquely within townlands, the *Valuation* records the names of the *occupier* of the plot, which was generally the household head, and the *lessor*, which could be the actual owner of the property, but often was a local intermediary who managed the property for someone else.[28] Leases, in this setting, tended to last multiple decades. A brief description is provided of the physical infrastructure in the plot, such as houses, offices, or gardens, and its area.

Figure 5: Example townland information from Griffith's Valuation

PARISH OF ARDMAYLE.

No. and Letters of Reference to Map.	Names of Townlands and Occupiers.	Names of Immediate Lessors.	Description of Tenement.	Content of Land.	Net Annual Value.		
					Land.	Buildings.	Total.
	NODSTOWN. (*Ord. Sr.* 52 & 53.)						
1 ABCADE	John Devane,	James Graham,	House, offices, & land,	104 0 24	96 19 0	8 9 0	105 8 0
A a	William Tyrrell,	John Devane,	House & small garden,	—	—	0 2 0	0 2 0
B a	Michael Mulcahy,	John Devane,	House,	—	—	0 14 0	0 14 0
D a	Vacant,	John Devane,	House,	—	—	0 14 0	0 14 0
b	Vacant,	John Devane,	House,	—	—	0 8 0	0 8 0
E a	Vacant,	John Devane,	House,	—	—	1 6 0	1 6 0
b	Vacant,	John Devane,	House,	—	—	0 17 0	0 17 0
c	Margaret Dwyer,	John Devane,	House,	—	—	0 5 0	0 5 0
d	Vacant,	John Devane,	House,	—	—	0 9 0	0 9 0
e	Vacant,	John Devane,	House,	—	—	1 0 0	1 0 0
2	John Russell,	James Graham,	House, offices, & land,	12 2 20	12 9 0	1 0 0	13 9 0
3 a	Mary Russell,	James Graham,	House and land,	16 1 27	15 1 0	1 7 0	16 8 0
b	Michael Ryan,	Mary Russell,	House and garden,	0 1 2	0 3 0	0 2 0	0 5 0
4 ABCAD	John Maher,	James Graham,	House and land,	44 3 29	56 1 0	1 18 0	57 19 0
— A a	John Maher,	James Graham,	House,	—	—	0 6 0	0 6 0
5 ABac	Honoria Storman,	James Graham,	House and land,	85 1 15	70 6 0	3 2 0	73 8 0
6	Edmond Stokes,	James Graham,	House and land,	14 2 6	12 2 0	0 17 0	12 19 0
7	John Keogh,	James Graham,	House and land,	16 1 31	15 1 0	1 6 0	16 7 0
8	James Donnell,	James Graham,	House and land,	46 1 5	35 2 0	2 1 0	37 3 0
9	Laurence Donnelly,	James Graham,	House and land,	43 0 35	41 15 0	2 18 0	44 13 0
10	William Maher,	James Graham,	House and land,	38 1 22	36 4 0	1 15 0	37 19 0
11 AaB	James Graham,	Trustees of Blue Coat Hospital,	House and land,	24 1 14	22 8 0	2 12 0	25 0 0
— A b	Denis Doogan,	James Graham,	House,	—	—	0 14 0	0 14 0
— B a	Vacant,	James Graham,	House,	—	—	0 8 0	0 8 0
12 a	William Dwyer,	James Graham,	House and land,	14 0 39	11 9 0	0 5 0	11 14 0
b	Edward Heffernan,	William Dwyer,	House,	—	—	0 5 0	0 5 0

Most importantly, the *Valuation* records the "Rateable Annual Valuation" of each plot. Subdi-

[28] Here, for example, the Blue Coat Hospital remains the lessor of a single plot while the rest of the land is attributed to a handful of other lessors (mostly James Graham, with John Devane subleasing several of his buildings).

vided into "Land" and "Buildings," these estimates were based primarily on a careful evaluation of the price of key agricultural commodities in the case of land, and estimated rents and upkeep in the case of property.[29] The final column provides a summation. While correlated with market values, these formally reflect the tax indemnity of land and property for each plot.[30]

While the names of occupiers and lessors in the *Valuation* had previously been digitized to facilitate genealogical research (Ask About Ireland, 2025), the plot descriptions along with all numerical columns had not. After obtaining the full set of scans from Eneclann, we filtered down to parishes falling within the baronial sample. Our data extraction pipeline, described fully in Appendix E.1, relied on a combination of large language models and manual digitization, and ultimately performs extremely well. Illustratively, in our extracted data, townlands' sum of individual plot valuations correlates with the reported total figure for that townland at a rate above 0.95. Across 7,385 pages of the *Valuation* we digitize data on over 350,000 plots. Finally, we linked our extracted data to the universe of administrative units from the *existing* partial digitization of the *Valuation* using state-of-the-art record linkage (Arora and Dell, 2023), which enables us to aggregate the data to the historical townland level and assign units to treatment.

4.2 Main results

In Table 1 we estimate treatment effects on our main outcomes drawn from Griffith's Valuation, comprising townlands' land, buildings, and total valuation. In our primary specification of panel A we estimate treatment effects using OLS, while panel B uses Poisson regression. Across the various specifications, coefficients are nearly identical, but generally more precisely estimated, with the inclusion of LASSO-selected predetermined covariates.

We find that treatment assignment—a townland falling in a segment of the relevant parish map damaged by fire—significantly reduces townlands' total valuation compared to other townlands on the same map. Broadly, we find larger relative reductions for the valuation of buildings compared to land. In columns 1-2, we find that treated townlands have land valuations £22 lower than townlands which were represented on the same parish map but were unaffected by the 1711 fire ($p < 0.05$). Using the coefficient estimates from the Poisson regression, this reflects a 6% reduction ($p < 0.05$). In columns 3-4, we find reductions in the valuation of buildings equal to £19 ($p < 0.01$) or, using

[29] We discuss critiques of Griffith's Valuation in Appendix E.2.

[30] As one government study noted, "Neither landlord nor tenant regards the valuation as a measure of the rent, or even as a guide to its amount; it is referred to solely for the purpose of ascertaining the probable amount of poor-rate, or other local taxation, to which the farm is liable, an element which both landlord and tenant are bound to take into account" (Irish Land Committee, 1880, 15).

Table 1: Effects on townland valuation

	Land valuation		Buildings valuation		Total valuation	
A. OLS	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-22.26**	-23.97***	-18.87***	-19.46***	-36.43***	-38.67***
	(8.90)	(6.22)	(7.26)	(6.88)	(12.48)	(9.63)
Control townland mean	213.12	213.12	59.75	59.75	258.01	258.01
Control townland std. dev.	226.61	226.61	197.03	197.03	328.96	328.96
B. Poisson						
Burned	-0.06**	-0.07***	-0.29**	-0.31***	-0.10**	-0.11***
	(0.03)	(0.03)	(0.13)	(0.12)	(0.04)	(0.03)
Control townland mean	213.12	213.12	59.75	59.75	258.01	258.01
Control townland std. dev.	226.61	226.61	197.03	197.03	328.96	328.96
Observations	4,159	4,159	4,159	4,159	4,159	4,159
Clusters	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓

Notes: Outcomes: Columns 1-2: Annual valuation of land in townland; 3-4: Annual valuation of buildings in townland; 5-6: Total annual valuation of townland. Panel A uses OLS, panel B uses Poisson regression. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

panel B, 29% ($p < 0.05$). In columns 5-6, aggregating the preceding results, we find that treated townlands have total valuations £36 lower than control townlands ($p < 0.01$), equal to a 10% reduction ($p < 0.05$).

4.3 Robustness of main results

We probe the robustness of these results to different specifications and sample inclusion criteria. In Table A5 we vary our specification by: using a log-transformed outcome variable (panel A); replacing the parish map fixed effects with parish fixed effects (panel B); adding 1670 landowner name fixed effects to the baseline specification (panel C); and excluding the $\mathbf{X}_i$ vector of geographical controls (panel D). No modification substantively affects our results. The log-transformed specification has similar point estimates to the Poisson specification, with the exception of a smaller coefficient for building valuation—a divergence driven by this outcome, but not land or total valuation, having extensive margin variation, a point we return to below. Varying the fixed effects, we find quite stable estimates for total valuation with consistently relatively larger treatment effects on the valuation of buildings. This holds even when we add 1670 landowner name fixed effects where such names are observed, which implies an extremely granular comparison. Finally, while excluding the geographical controls somewhat attenuates our estimates for land valuation, estimates of treatment effects on the valuation of buildings and the total townland valuation remain stable.

Second, we assess robustness to our treatment assignment confidence criteria. In Figure A16 we modify the minimum centroid-edge distance ratio (top) or segment angle distance (bottom) for inclusion in the estimating sample. Across each, we find that estimates grow in magnitude as we refine the sample to comprise townlands closer to parish map edges (or more confidently assigned to treatment due to their greater distance to treatment segment boundaries) before attenuating as, at higher values of either threshold, the effective sample shrinks in size. In Table A6, we include *all* townlands and instead weight by these two dimensions. While this modestly attenuates our treatment effect estimates by including units highly unlikely to have been treated—recall that often only the edges of parishes were recorded as being burned—we continue to find quite stable reductions.

Third, we use randomization inference to assess the robustness of our inferences and again validate the research design. We implement three approaches to the randomized permutation of treatment assignment: in the first, we hold fixed the *share of octants* of a given parish which are assigned to treatment compared to the realized set; in the second, we hold fixed the relative spatial distribution of treated octants but randomize the *rotation of treated octants* compared to the realized

set.[31] In each permuted sample, we then estimate Equation (1). In Figure A17, we find that our observed treatment effects are at the left tail of the randomization null distributions; taking the former (latter) approach, we find exact p-values below 0.02 (0.03) across the three main outcomes. In the last approach, we permute our observed distribution of treated and control octants across parishes within the baronial sample but *without* any fire damage recorded. These placebo treatment effects in Figure A18 are normally distributed around zero, suggesting that the geometry of our treatment assignment is not mechanically generating effects.

Fourth, we examine different subsets of our sample. In Table A7 we illustrate the robustness of our main results by dropping: parishes with fewer than ten townlands (panel A); parishes lacking townlands assigned to the four main cardinal points (panel B); and parishes where the summed total of extracted plot-level valuations does not closely match the extracted townland-level total valuation (panel C).[32] While these restrictions trim up to a third of the sample, rendering some effects more imprecisely estimated, coefficient estimates are consistent throughout. Last, in Figure A19 we sequentially drop parish maps (top) or baronies (bottom) to examine the sensitivity of our results to outliers. We find little evidence that specific units drive our results.

4.4 Spillover and aggregate effects

The treatment effects in Table 1 potentially conflate changes in the valuation of treated townlands with spillovers on the valuation of same-map control townlands. Whether such spillovers would bias the magnitude of the treatment effect estimates upwards or downwards is ambiguous. Consistent with a downward bias, a high share of burned townlands on a given map might, by reducing the overall quality and condition of the whole map, reduce its utility for determining property boundaries for proximate townlands on its surviving parts as well. Or, consistent with an upward bias, damage to some parts of a parish map—particularly given the scale of many estates—could induce a substitution of effort and investment towards other nearby areas not affected.[33]

To adjudicate, we conduct a battery of tests in the spirit of recent contributions to the estimation of general equilibrium effects (Egger et al., 2022; Faridani and Niehaus, 2024; Muralidharan, Niehaus,

[31] Since some maps have multiple (non-adjacent) burn damage across cardinal points, this latter version attempts to hold fixed the relative distance between treated and control townlands.

[32] For this latter restriction, see Figure A2 where we highlight the townland-level valuations we extract alongside the plot-level valuations. While we did not prioritize optimizing the quality of the townland-level extractions, correlating these with the summed plot-level valuations (within a given townland) provides a heuristic extraction quality metric which we discuss above. In panel C of A7, we drop townlands where these measures vary by more than 5%.

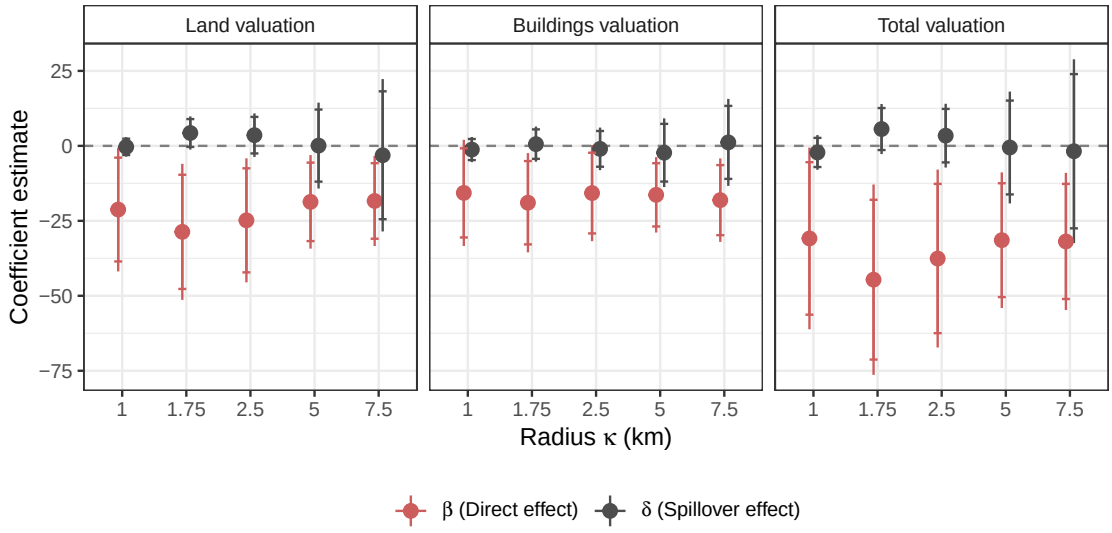
[33] We note, however, that the sample restrictions conditioning on minimal segment edge distances (where treatment assignment is uncertain) potentially also excludes those units most likely to experience spillovers of this form.

and Sukhtankar, 2023). Following Faridani and Niehaus (2024), we estimate Equation (2) across different geographical distance bandwidths:

$$y_{ipm} = \beta \text{Burned}_{ip} + \delta \text{Exposure}_{im}^{d<\kappa} + \gamma N_{im}^{d<\kappa} + \mu_m + \gamma \mathbf{X}_i + \epsilon_{ipm}, \tag{2}$$

where $\text{Exposure}_{im}^{d<k}$ counts the normalized number of *other* treated townlands on the same map within κ kilometers of townland i, $N_{im}^{d<\kappa}$ counts the density of any type of townland with that same distance on the same map, and the other terms are as per Equation (1).[34] β estimates the direct effect of treatment assignment while δ estimates the spillover effect by contrasting townlands represented on the same physical map but varying in their number of nearby treated townlands.

Figure 6: Estimates of direct and spillover effects on valuation outcomes



Notes: Estimates of β and δ from Equation (2) across different distance thresholds (κ) for outcomes described in Table 1. Direct effect measures townland's own treatment status. Spillover effect measures the number of treated other townlands within a given κ. Specification controls for total density of *all* other townlands within a given κ. 90% and 95% confidence intervals plotted.

Figure 6 provides the resulting estimates of β and δ at bandwidths between 1km and 7.5km (with the upper bound comprising essentially the entire sample). While β remains stably estimated, at no value of κ do we find clear evidence of a spillover effect operating through δ.[35] Motivated by the

[34] Following Faridani and Niehaus (2024), we normalize the exposure measure by the sample mean of treatment on a map such that δ reflects the effect of one sample average's increase in the share of treated proximate townlands. Table A8 provides balance tests of both Burned_{ip} and $\text{Exposure}_{im}^{d<\kappa}$ using the same covariates as in Table A3 and a baseline κ of 2.5km, with no evidence of confounding beyond the same marginal imbalance on the latitude of townlands.

[35] Implementing a version of the κ bandwidth selection procedure from Faridani and Niehaus (2024) generates optimal bandwidths between 1 and 1.5km. Because the exposure measure becomes nearly collinear with the map fixed effects at the high values of κ, estimates of δ become somewhat noisier.

mechanical correlation of Burned_{ip} and $\text{Exposure}_{im}^{d<\kappa}$ implied by the spatially clustered treatment assignment, in Figure A20 we implement various more restrictive tests to probe these results. In Figure A20a, we construct the exposure and density variables while *excluding neighbors in the same segment* as townland i to reduce this correlation; in Figure A20b, we instead define exposure using the *share* of treated townlands within a given radius (noting that this affects the estimating sample across values of κ). Last, to assess whether the null aggregate estimates of δ mask any heterogeneity by treatment status, in Figure A20c we estimate Equation (2), while omitting the Burned_{ip} term, only among control townlands. Throughout, we find no evidence of within-map spillovers either on average or based on treatment assignment status.

Fully adjudicating the aggregate effects of the 1711 fire is rendered inferentially challenging for a number of reasons, not least due to the censoring of maps potentially entirely destroyed (see the discussion in Section 3.1). In place of a full accounting, we provide simple bounds on the total effect of the *realized* damage within our observed analysis sample of parishes (see Figure 3b). Assuming that $\delta = 0$, given our evidence above, within our baseline estimating sample—where treatment assignment is relatively high-confidence—our estimates of β imply a total loss of £59,203 using the linear model (or $£46,536$ using a Poisson-derived estimate). If we instead include the full sample and leverage the confidence-weighted estimates (see Table A6), we obtain an estimated loss of £51,675. Last, if we use the computed values of $\delta \neq 0$ at the optimal κ (see footnote 35), our estimate is £42,570. Across the various permutations, this reflects a loss of between 3 and 5% of the total valuation of the townlands in the analysis sample of parishes.

4.5 Distributional effects on valuation outcomes

Our larger estimated treatment for buildings valuations in Table 1 likely reflects the extent to which such valuations were responsive to local investment rather than comparatively immutable geographical characteristics. While the valuation of land considered many different inputs, much of the variation in assessed tax liability was driven by differences in underlying soil quality and local prices for key crops (Smyth, 2008, 9).[36] Land valuations thus reflected a composite assessment of investments through irrigation, fertilizer, and upkeep, as well as more fixed characteristics shaping economic productivity (such as elevation and soil suitability). In contrast, building valuations considered differences in the presence, age, materials, and condition of structures like houses, offices, and out-buildings (Smith, 1882, 31), all of which reflect direct investments by tenants and owners.

[36]These were wheat, oats, barley, flax, butter, beef, mutton and pork (Smith, 1882, 7). Importantly, valuations were intended to capture the productive *potential* of the land rather than its actual utilization.

Consistent with these differences, we find much more of the variation in building valuation to be within-parish relative to land valuation.[37]

Table 2: Effects on within-townland distribution of plot valuations

	10^{th}		25^{th}		50^{th}		75^{th}		90^{th}	
A. Land valuation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Burned	-0.65	-0.65	-0.95	-0.95	-1.47	-1.47	-2.70*	-2.70**	-2.70	-2.88*
	(1.02)	(0.93)	(1.05)	(0.96)	(1.14)	(1.05)	(1.45)	(1.30)	(1.80)	(1.68)
Control townland mean	4.87	4.87	6.50	6.50	10.85	10.85	19.88	19.88	33.16	33.16
Control townland std. dev.	22.43	22.43	23.18	23.18	26.13	26.13	33.04	33.04	44.66	44.66
B. Buildings valuation										
Burned	-0.39**	-0.39**	-0.38*	-0.38*	-0.35	-0.35	-0.46	-0.46	-0.65	-0.65
	(0.18)	(0.19)	(0.19)	(0.20)	(0.22)	(0.23)	(0.34)	(0.32)	(0.54)	(0.51)
Control townland mean	0.76	0.76	1.05	1.05	1.64	1.64	2.89	2.89	5.32	5.32
Control townland std. dev.	4.74	4.74	5.04	5.04	5.96	5.96	8.32	8.32	12.29	12.29
C. Total valuation										
Burned	-1.40	-1.40	-1.58	-1.58	-1.91	-1.91	-3.73**	-3.90**	-4.25*	-4.55**
	(1.16)	(1.08)	(1.21)	(1.12)	(1.38)	(1.27)	(1.82)	(1.63)	(2.18)	(1.97)
Control townland mean	6.70	6.70	8.78	8.78	13.93	13.93	24.46	24.46	39.71	39.71
Control townland std. dev.	25.93	25.93	27.05	27.05	31.19	31.19	39.97	39.97	54.43	54.43
Observations	4,112	4,112	4,112	4,112	4,112	4,112	4,112	4,112	4,112	4,112
Clusters	347	347	347	347	347	347	347	347	347	347
LASSO-selected covariates		✓		✓		✓		✓		✓

Notes: Outcomes defined at the plot level as the level of the valuation corresponding to a given quantile of the valuation distribution within a townland, from 10^{th} percentile (columns 1-2) to 90^{th} percentile (columns 9-10). Panel A uses land annual valuation, panel B uses buildings annual valuation, panel C uses total annual valuation. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Probing this further, we leverage the fact that our outcome data is ultimately defined at the plot level, with an average of 33 plots per townland, to consider distributional effects. In Table 2, we define *plot-level* valuations by percentile within a given townland (Table A9 provides the same using the Poisson specification). We find somewhat contrasting patterns. Considering land valuations in panel A, the aggregate reductions from Table 1 are primarily driven by the higher end of the distribution: for the 75^{th} (25^{th}) percentile, the negative treatment coefficient equates to 0.08 (0.04) sd

[37] A vector of parish fixed effects explains 33% (9%) of the variation in townland land (building) valuations in our sample. These figures reflect the adjusted R^2 of a regression of valuation outcomes on a vector of parish fixed effects. Similar differences persist to the plot level, where a vector of townland fixed effects explains 19% (9%) of land (building) valuations.

compared to levels in control townlands. Considering building valuations in panel B, the observed reductions are mostly concentrated at the lower end: at the 25th (75th) percentile, we find a reduction equal to 0.08 (0.05) sd. Reflecting the greater contribution of land valuations to total valuation, in panel C we find that reductions are modestly larger at higher percentiles. The distribution of treatment effects for land valuation suggests that the loss of state-sanctioned maps prohibited the development of land parcels with particularly high value for agricultural output, likely reflecting less costly investment in soil quality. By contrast, the distributional treatment effects for plot-level building valuations highlights that treatment led more plots to have no, or very few, structures at all.

5 Evidence on mechanisms

In this section, we evaluate evidence for three complementary channels helping to explain the reduced valuation of townlands exposed to fire damage in 1711: the security of property rights, the incidence of capital-intensive investments, and compositional changes in landownership and tenancy, before considering alternative explanations for the results.

5.1 Heightened insecurity of property rights

Intuition. Our primary data source pertaining to the security of property rights comes from the registration of deeds between the 18th and early 19th century. While systematic data on court cases no longer exists at a level assignable to individual townlands, the registration of deeds provides an intuitive alternative measure. Established in 1708, the Registry of Deeds was a centralized registry for deeds, including freehold transfers, leases, wills, mortgages, settlements, and more. Most such deeds directly involved claims over property and, at least initially, helped to further the security of tenure of Protestant landowners (O'Rourke and Polak, 1994, 58). While deed registration was never mandatory for the period under consideration, it was incentivized because in a court of law, deeds that were registered were given "legal precedence" over deeds that were not registered (Phair, 1966, 260). Since deed registration involved a number of costly hurdles, the incentives to register were particularly high where registrants were experiencing, or anticipated, challenges to their claims over land (Roebuck, 1972, 67). Intuitively, therefore, the *reduced* security of property rights implied by the destruction of the parish maps might have induced greater rates of deed registration—either as an attempt to partially substitute for lost records or as a direct measure of the occurrence of disputes.

Data. We draw primarily on the *Irish Deeds Index* (Registry of Deeds Index Project Ireland,

2026). This crowd-sourced initiative includes transcriptions for a subset of digitized entries from the Registry of Deeds. While the underlying structure of the registry is quite complex, we leverage the *Land Index* which associated each deed with set of specific locations (which could be the land parcels relevant for the deed or the residences of the relevant parties). Assigning these to historical townlands, we then merge in deed-specific data from the *Memorial Index* which provides the names of the individuals involved in the deed, the year of registration, and information on the type of deed. For wills, we use the comprehensive transcriptions of abstracts published in Eustace (1954, 1956) and Ellis and Eustace (1984), which span from 1708 to 1832. For each will, we extract the location of the lands it references and the year in which it was made. Together, we obtain information on over 30,000 deeds assigned to historical townlands in our sample.

Empirical specification. Due to the different purposes of various deed types, with only some directly reflecting land claims (rather than residences), we define our data at the *deed type* level, and focus mostly on freehold transfers, leases, and wills. After assigning each deed to townlands in our sample using the townland index, we construct measures of the frequency of each deed type and the parties involved in their registration. Many townlands are associated with no deeds at all—a result consistent with the point that many deeds (probably most) were never formally registered despite the legal advantages conveyed by doing so.

The Registry of Deeds was created in 1708, just three years prior to the fire. This short interval means that we have a limited pre-period to examine outcomes before the fire; as a result, our main specification primarily leverages deeds registered after the fire. We use this over time variation to construct a panel version of Equation (1) in which we use variation by deed type and decade across townlands to estimate:

$$y_{idpmt} = \beta \text{Burned}_{ip} + \eta_d + \mu_{mt} + \gamma \mathbf{X}_i + \epsilon_{idpmt}, \tag{3}$$

where outcomes are defined at the townland, i, by deed type, d, by decade, t, level. We include deed type fixed effects (η_d), geographical controls ($\gamma \mathbf{X}_i$), parish map by decade fixed effects (μ_{mt}) and continue to cluster by parish map.[38]

Results. Table 3 provides our baseline estimates, where the outcome represents the number of distinct deeds of a given type registered in a townland in a decade. We 'stack' across deed types in columns 1-2, standardizing by deed type, and split out several of the main unstandardized constituent

[38]For specifications including LASSO-selected predetermined covariates, we select these by averaging post-period outcomes to the townland level then applying the selected covariates to the panel specification.

deed types in columns 3-8 (see Table A10 for the other, less common, deed types). In panel A, we estimate treatment effects using Equation (3). In panel B, we add the short pre-1711 period along with townland fixed effects to Equation (3) and report the difference-in-differences estimate of treatment interacted with an indicator for the decades after the fire.

Table 3: Treatment effects on deed registration

			Deed type:					
	Stacked		Leasehold transfers		Freehold transfers		Wills	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Post-fire cross-sectional								
Burned	0.040**	0.041**	0.016*	0.016*	0.009	0.009	0.003	0.003
	(0.018)	(0.019)	(0.009)	(0.009)	(0.006)	(0.006)	(0.002)	(0.002)
Control mean	0.000	0.000	0.017	0.017	0.032	0.032	0.012	0.012
Control std. dev.	1.000	1.000	0.241	0.241	0.274	0.274	0.129	0.129
B. Difference-in-differences								
Burned × Post	0.047**	0.047**	0.018**	0.018**	0.013	0.013	0.002	0.002
	(0.023)	(0.023)	(0.009)	(0.009)	(0.010)	(0.010)	(0.003)	(0.003)
Control mean	0.000	0.000	0.015	0.015	0.031	0.031	0.012	0.012
Control std. dev.	1.000	1.000	0.231	0.231	0.269	0.269	0.124	0.124
Observations	152,892	152,892	50,676	50,676	50,676	50,676	50,676	50,676
Clusters	374	374	350	350	350	350	350	350
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes defined at the townland by deed type by decade level. Panel A restricts sample to post-fire period and reports cross-sectional treatment coefficient; panel B includes pre-fire period and reports difference-in-differences treatment coefficient. Columns 1-2 stack across deed types and standardize by deed type, columns 3-4: number of leasehold transfers; columns 5-6: number of freehold transfers; 7-8: number of wills. All specifications include parish map by decade fixed effects and geographical controls. Stacked estimates include deed type fixed effects. Panel B adds townland fixed effects. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

We find positive effects of treatment assignment on deed registration. Considering the stacked estimates in columns 1-2, townlands exposed to map fire damage were subsequently associated with 0.04 standard deviations more deed registrations in a decade compared to other townlands, on the same parish map and in the same decade, which were not damaged. These estimates are slightly larger and more precisely estimated in the difference-in-differences specification, corresponding to a 0.05 sd increase. Disaggregating by deed type, while there are positive effects across all types of deed, most of the positive pooled effect is driven by an increase in the registration of leases, which increase by 84% (0.06 sd) compared to levels in control townlands.

The panel structure of the deed registration data allows us to assess *when* these changes took place. Focusing on the stacked estimates, Figure 7 reports estimates of Equation (3) where we interact treatment with decade indicators (see Figure A22 for this disaggregated by deed type). While brief, there is no difference in deed registration for the limited period prior to the fire. Treatment

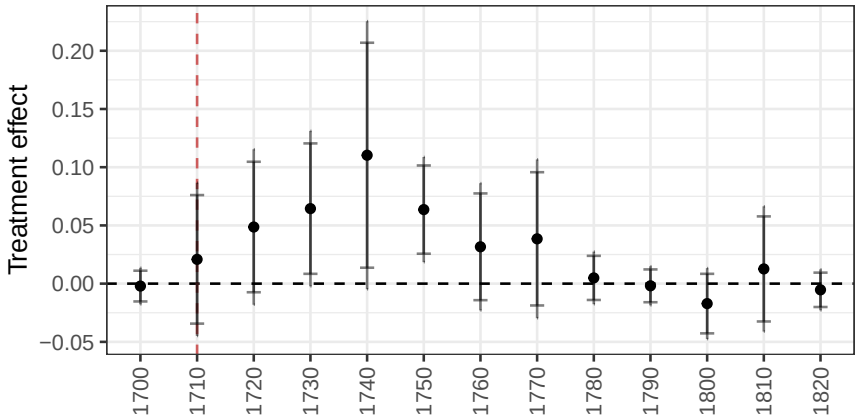


Figure 7: Event study estimation of deed registration

Notes: Figure presents estimates of Equation (3), stacking across deed types, where we interact the treatment indicator with decade indicators. 90% and 95% confidence intervals plotted.

effects gradually increased over the course of several decades before attenuating towards the end of the 18th century (we return to this point below). The absence of an immediate treatment effect is intuitive given that the parish maps were mostly consulted during property disputes. In the immediate aftermath of the fire, landowners, or rival claimants, were likely unaware of the extent of the damage to the relevant portions of the Down Survey. As this damage became common knowledge, more and more leases and deeds concerning treated townlands were registered in Dublin, despite the significant additional costs in time and money this process entailed.

While we cannot fully disentangle the extent to which the increased rate of deed registration owes to precautionary motives versus disputed property claims, the available evidence is consistent with an increase in realized property disputes. For example, we find comparatively modest treatment effects for the registration of wills, the most clearly precautionary deed type. Consistent with contestation, in Table A11 we assess whether the treatment effects are driven by the presence of *any* or *multiple* deeds of the same type in a given townland and year; we find evidence for both margins being relevant with similar treatment effect magnitudes. In principle, contemporaneous deed registration could reflect either the partition of land by landowners or its exchange between subsequent buyers. To adjudicate between these competing explanations, Table A12 assesses treatment effects on how many distinct parties registered the *same* types of deed within a short time period pertaining to the *same* townland. In panels A and B, we find treatment effects on the number of distinct parties registering deeds in the same decade or an indicator for multiple parties doing so. In panel C, for our strictest test, we construct an indicator for whether multiple parties registered the same deed

type *in the same year* in a given decade. While extremely rare, we find positive treatment effects on contemporaneous deed registration. Such clustering of deed registration, overall, appears consistent with efforts to establish rival claims over land.

5.2 Reduced investment in physical infrastructure

Data. To assess whether the destruction of the parish maps reduced investment, we draw on two data sources: plot-level descriptions of physical infrastructure in the *Valuation* (see Section 4.1) and data from the first *Ordnance Survey* (1829-42). Beyond delineating administrative units, the Ordnance Survey comprehensively mapped the presence of both agricultural and industrial infrastructure (see Figure A12 for an example). Among structures associated with agricultural production, these included lime kilns (primarily used for fertilizer), wells and sluices (both used for rural agricultural water management), and windmills. While less common, structures associated with industrial production included foundries, gas works, gravel pits and quarries (mostly used for road building), and trams (used to service quarries). Several other types of facility, including mills and water pumps, could indicate either agricultural or industrial production.[39] For the modern-day Republic of Ireland, we use data already geocoded by Tailte Éireann. For modern-day Northern Ireland, we geocoded the presence of each facility using Ordnance Survey map scans provided by OSNI.

Results. Across each source, in Table 4 we estimate Equation (1) and find evidence of reduced capital investment in townlands exposed to map fire damage compared to those unaffected by the fire. Leveraging the description data in the *Valuation*, we construct three measures for the extent of local investment at the townland level: whether any plots in a townland are categorized as comprising only unproductive land (as was the case for bogs, mountains, or "waste" lands); whether a townland contains *no* valuation-relevant buildings (primarily houses or offices); and whether a townland contains any derelict plots.

Panel A provides the results of these specifications. In columns 1-2, we find that treatment assignment increases the probability of a townland containing any entirely unproductive plots by 3.9 percentage points (or 22% compared to control townlands). In Table A13, where we disaggregate this indicator by specific types of unproductive land, we find the effect is entirely driven by the increased presence of bogs. Bogs constituted a major constraint to agricultural productivity and economic development throughout the 18th and 19th centuries (Feehan and O'Donovan, 1996; Ó Gráda, 1994) in part because draining bogs required significant capital investments by landlords or their tenants

[39]The Ordinance Survey did not provide an indication of the extent or valuation across these different categories.

(Mokyr, 1983). Because ownership of bogs was often ambiguous, unless landowners were certain about tenure they were unlikely to invest the significant capital and labor necessary for drainage (Bog Commissioners, 1810–1814; Donnelly, 1973). The greater persistence of bogs in treated townlands is consistent with lower levels of investment. In columns 3-4, we find that treated townlands are 1.5 percentage points more likely to contain no valuation-relevant buildings. As we disaggregate in Table A14, this is mostly driven by a reduction in the presence of houses in treated townlands, which are nearly ubiquitous in control townlands.[40] Interestingly, in columns 5-6 we find no differences in the presence of derelict or disused structures either overall or, in Table A15, by constituent indicator. This would appear to be inconsistent with buildings in treated townlands being abandoned after the Great Famine, and more consistent with an argument that due to concerns about the security of tenure, landlords and tenants were simply less likely in treated townlands to construct housing at all.

Using the Ordnance Survey data, we can also evaluate more intensive forms of investment by counting the frequency of different types of infrastructure essential for farming or early industry. This infrastructure varies significantly in its frequency and capital cost. We distinguish two broad categories: infrastructure associated with agricultural production (such as lime kilns) or industrial production (such as foundries). For all facilities, along with these two groups, we construct standardized z-score indices as our primary outcomes and estimate treatment effects using Equation (1). Panel B of Table 4 provides results, which are generally sharper with the inclusion of LASSO-selected covariates. We find that loss of the maps in the 1711 fire modestly reduced the presence of economic infrastructure overall by 0.06 sd ($p < 0.1$ with controls). Effects are quite similar in magnitude between agricultural and industrial facilities, with negative treatment effects of 0.06 sd for agricultural infrastructure ($p < 0.1$ with controls) and noisier negative effects for industrial facilities. In Tables A16 and A17 we disaggregate these results by specific type of facility. While the reductions for agricultural infrastructure are broad, if noisy, across specific types, the reductions for industrial infrastructure are concentrated in reductions of the most common such facilities (quarries and gravel pits). At the time, these facilities would have been most commonly used for making and maintaining rural roads, which were a key responsibility of local landlords (Garnham, 1999).

[40] This finding is particularly remarkable given that valuators were instructed to include even buildings made with mud walls and thatch, the most humble building materials available at the time (Smyth, 2008, 113). The absence of any such buildings is therefore consistent with land that was totally uninhabited, a rarity in Ireland before (Fernihough and O'Grada, 2022), or even after, the Great Famine (Cousens, 1960).

Table 4: Effects on measures of local investment

	Any unproductive plots		No buildings		Any derelict plots	
A. Physical structures	(1)	(2)	(3)	(4)	(5)	(6)
Burned	0.039**	0.039***	0.015*	0.015**	-0.002	-0.002
	(0.015)	(0.015)	(0.008)	(0.007)	(0.006)	(0.005)
Control townland mean	0.17	0.17	0.03	0.03	0.01	0.01
Control townland std. dev.	0.38	0.38	0.18	0.18	0.11	0.11
Observations	4,156	4,156	4,156	4,156	4,156	4,156
Clusters	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓
	All		**Agricultural**		**Industrial**	
B. Economic infrastructure	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-0.058	-0.063*	-0.061	-0.067*	-0.042	-0.046
	(0.044)	(0.034)	(0.052)	(0.035)	(0.044)	(0.038)
Control townland mean	0.00	0.00	0.00	0.00	-0.00	-0.00
Control townland std. dev.	1.00	1.00	1.00	1.00	1.00	1.00
Observations	4,223	4,223	4,223	4,223	4,223	4,223
Clusters	350	350	350	350	350	350
LASSO-selected covariates		✓		✓		✓

Notes: Outcomes defined at the townland level as z-score indices standardized relative to control townlands. Columns 1-2: index of all facilities; columns 3-4: index of facilities primarily associated with agricultural production (lime kiln, sluice, well, windmill); columns 5-6: index of facilities primarily associated with industrial production (quarry, tram, gravel pit, gas work, foundry). All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.3 Compositional effects on ownership and tenancy

Intuition. Next, a large body of historical evidence emphasizes the extremely high levels of ethnoreligious inequality which characterized the Irish countryside throughout this period (de Tocqueville, 1836; Mokyr and O'Grada, 1988). In our discussion above, we noted how the loss of state-sanctioned maps might particularly disadvantage those who would otherwise benefit from stronger *de jure* rather than *de facto* property rights protections. Throughout this period, the Protestant minority held near-complete control over formal political and economic institutions while the marginalized Catholic population represented a substantial majority. Given the informal character of dispute resolution in the absence of the Down Survey noted above, Catholics potentially therefore had—at least relatively—stronger *de facto* ability to secure land.

We examine heterogeneity in the treatment effects along three dimensions: the religious affiliation of the 1670 landowner (Catholic or Protestant); then, among townlands owned by Protestants, whether their townland was bordered by a Catholic-owned townland or whether they owned dispersed estates across multiple counties.[41] In the wake of the Cromwellian Settlement a relatively small number of Protestant landowners, many of whom lived in London or Dublin, came to possess vast estates across Ireland (Campbell, 2009; Donnelly, 1973). Landlords holding many rural properties would have found it difficult to personally monitor the utilization of their land and were presumably especially vulnerable to the destruction of parish maps in the 1711 fire—particularly when close to rival landowners. Given the nearly century and a half before the replacement of the Down Survey with the Ordnance Survey, landlords would either face costly investments to protect their claims (for example, by including their property in the Registry of Deeds in Dublin) or run the risk of slowly ceding territory to gradual encroachment, disputed subletting, or outright loss of property.

Results. The results in Table 5 are consistent with relatively larger reductions in townland valuation among Protestant townlands with more limited ability to monitor and secure property rights in the presence of weakened *de jure* protections. In panel A, while imprecisely estimated due to the paucity of Catholic landownership in 1670 (with only 8% owned by Catholics), we find that treatment effects in these townlands are essentially null compared to the large reductions in Protestant-owned townlands. In panel B, we find that the reductions in the valuation of Protestant-owned townlands are concentrated among townlands which bordered Catholic-owned townlands; in panel C, we find similarly concentrated reductions among townlands owned by Protestants with geographically

[41] For this, we estimate a fully saturated interaction of each variable with the covariates in Equation (1).

Table 5: Heterogeneous effects on townland valuation

	Land valuation		Buildings valuation		Total valuation	
A. Full sample	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-23.30**	-26.13***	-20.92***	-21.85***	-37.48***	-41.13***
	(9.81)	(8.34)	(7.79)	(7.70)	(13.21)	(11.54)
Burned × Catholic (1670)	30.74	38.52**	18.99	21.87	35.32	44.82
	(20.21)	(16.94)	(27.14)	(27.06)	(37.93)	(35.25)
Burned + Burned × Catholic (1670)	7.45	12.39	-1.93	0.03	-2.16	3.68
	(17.74)	(14.72)	(26.44)	(26.39)	(35.40)	(33.10)
Control townland mean	213.12	213.12	59.75	59.75	258.01	258.01
Control townland std. dev.	226.61	226.61	197.03	197.03	328.96	328.96
Observations	4,159	4,159	4,159	4,159	4,159	4,159
Clusters	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓
B. Variation in bordering townlands						
Burned	-10.76	-14.40*	-4.91	-4.91	-17.34	-22.07**
	(10.27)	(8.31)	(6.98)	(6.98)	(13.12)	(10.96)
Burned × Bordering Catholic	-45.17*	-32.62	-57.91*	-57.91*	-77.06**	-59.56*
	(27.02)	(23.24)	(30.29)	(30.29)	(36.34)	(32.22)
Burned + Burned × Bordering Catholic	-55.93**	-47.02**	-62.82**	-62.82**	-94.39***	-81.63***
	(25.99)	(21.74)	(30.25)	(30.25)	(35.38)	(30.61)
Control townland mean	182.46	182.46	53.66	53.66	224.18	224.18
Control townland std. dev.	182.60	182.60	182.66	182.66	278.01	278.01
Observations	2,494	2,494	2,494	2,494	2,494	2,494
Clusters	288	288	288	288	288	288
LASSO-selected covariates		✓		✓		✓
C. Variation in dispersion of landholdings						
Burned	-6.70	-5.70	-6.16	-6.16	-5.45	-4.06
	(15.24)	(11.90)	(11.55)	(11.55)	(17.94)	(11.78)
Burned × Dispersed across counties	-24.66	-27.17*	-23.98	-23.98	-45.17*	-48.66***
	(19.09)	(15.01)	(17.92)	(17.92)	(25.77)	(18.71)
Burned + Burned × Dispersed across counties	-31.37**	-32.88***	-30.14**	-30.14**	-50.62***	-52.72***
	(12.21)	(9.81)	(13.45)	(13.45)	(18.36)	(15.13)
Control townland mean	182.46	182.46	53.66	53.66	224.18	224.18
Control townland std. dev.	182.60	182.60	182.66	182.66	278.01	278.01
Observations	2,494	2,494	2,494	2,494	2,494	2,494
Clusters	288	288	288	288	288	288
LASSO-selected covariates		✓		✓		✓

Notes: Outcomes: See Table 1. Interacted covariates: Panel A: Indicator for townland in 1670 being owned by a Catholic landowner; Panel B: Indicator for townland in 1670 bordering a Catholic-owned townland; Panel C: Indicator for townland in 1670 being owned by a landowner with estate dispersed across multiple counties. Panels B and C restrict sample to Protestant-owned townlands in 1670. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. Interacted covariate is fully interacted with all fixed effects and covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

dispersed holdings. In both of these subsets, the risk of encroachment or expropriation may have been particularly high.

To assess how treatment assignment shaped levels of local inequality, we examine whether treatment assignment shaped compositional outcomes over *who* owned, or occupied, land across townlands. We consider outcomes pertaining to religious affiliations and the concentration of land. While we do not directly observe the religion of the lessors and occupiers recorded in the *Valuation*, we use a rough imputation based on the full-count 1901 census (where names and religions are provided) to approximate the share of a townland's total area with lessors or occupiers classified as Catholic.[42] For local inequality, we compute the Herfindahl-Hirschman index of the concentration of land held within a given townland across individual lessors and occupiers.

In Table A18, we examine heterogeneous treatment effects on these outcomes across the same subsets as in Table 5. In panel A, we find that among Protestant townlands which, in 1670, bordered Catholic townlands, treatment leads to a 9 pp greater share of Catholic lessors by the time of the *Valuation*, with a 7 pp increase among occupiers. We find positive, though insignificant, increases in the concentration of land among lessors. In panel B, we find that, among *non-dispersed* Protestant townlands in 1670, treatment modestly increases the rate of Catholic lessors; on the other hand, among townlands with owners of dispersed estates, the concentration of land among these lessors falls. Considering average effects across the full sample, we find broadly null effects on our somewhat noisy measure of religious composition (see Table A19) and modest increases in land concentration, though only among occupiers (see Table A20).[43]

5.4 Alternative channels

Particularly given the long-run nature of our outcomes, alternative channels might also play a role in the reduced valuation of townlands. Here, we consider two: effects on fiscal capacity and the potentially intermediating role of the Great Famine.

[42] Using the full-count census, we compute the conditional probability of a given name reflecting a Catholic using a naive Bayes classifier; we then apply these probability tables to the names *actually* observed in the *Valuation* to assign the probability of an individual being a Catholic. While this imputation relies on relatively strong assumptions, we are not aware of any other data that would allow us to directly measure the religious denomination of lessors from this period across Ireland. Table A19 intuitively highlights fewer Catholic lessors (around 40%) relative to occupiers (around 70%), but 40% substantially exceeds reasonable estimates of Catholic landownership during this period.

[43] Taking the maximal share measures in Table A20, we similarly find little systematic difference among lessors but again find greater concentration among occupiers. Across each measure, the extremely high degree of concentration among lessors is evident regardless of treatment—the largest lessor in a given townland, for example, "owned" an average of 82% of its land area.

5.4.1 Effects on fiscal capacity

Intuition. While the bulk of historical work emphasizes the relevance of the parish maps for property rights, the Down Survey played a more limited role in tax administration. Localized reductions in fiscal capacity due to the partial destruction of the parish maps could, in principle, play a role in explaining the long-run local effects we find and even our primary outcome data source, a measure of tax liability, has fiscal clear dimensions.

Appendix H provides more detail on the administration of various taxes and their potential linkages to the Down Survey. Of the various kinds of taxes levied during the early modern period several centralized taxes had clear connections to the Down Survey, although their magnitude was generally quite small. The clearest example comprises *quit rents*, which were half-yearly payments made by landowners. Liability for these payments, collected from the 1650s until well into the 20th century, was specifically based on land allotments recorded in the Down Survey. Quit rents would sometimes go unpaid because revenue collectors could not identify the relevant townlands or parcels of land in the absence of the Down Survey parish maps—though the baronial maps (unlike for property disputes) occasionally sufficed (Commissioners of Fees, 1806, 72). Because quit rents were fixed in absolute terms, they came to constitute a decreasing share of public revenues: by 1806, for example, these comprised only around one percent of total revenues.

A second case comprises the imposition of fines for the illegal distillation of spirits. An endemic problem for much of the 18th and 19th centuries, efforts to regulate and tax the production of spirits led to vast amounts of evasion (Dawson, 1977). In an effort to force landowners to coordinate in tackling the problem, the state came to impose fines on *townlands* as a whole where illegal stills were found therein. The ability of revenue agents, often supported by army officers, to levy such fines was conditioned by their certainty of a still being located in a particular townland (Commissioners of Revenue, 1823). While deeply unpopular, such townland fines contributed only a tiny share of revenue and were mostly perceived as a deterrent (Connell, 1968).

Data. We collect data on quit rents and still fines as examples of the central state's fiscal capacity. For quit rents, we rely on disaggregated data from 1809, 1811, and 1823 reported in Commissioners of Fees (1813) and Commissioners of Revenue (1824), where quit rent arrears are reported for the extreme cases where revenue officers could not figure out where the relevant plot of land (as recorded in the Down Survey) actually was and so the taxes were written off. The bulk of these recorded arrears had been accruing for nearly a century. Using our range of historical locality name sources, we geolocate each recorded entry. While a rare event, with only 1.7% of the townlands in

the analysis sample associated with an arrear, such arrears capture clear reductions in the capacity of the state to extract revenues. For stills fines, we rely on a report of the imposition of such fines in House of Commons (1817). This documents whether, and how many, fines had been imposed on a given townland in the prior year. While again a rare outcome, with only 1.2% of townlands in our sample associated with a fine, reductions in this measure plausibly reflect a reduced capacity to detect fiscal noncompliance.

Results. Table A22 provides some evidence of reduced fiscal capacity in treated townlands compared to control. Taking the quit rent outcome in panel A, we find that treated townlands are 1.1 pp more likely to be associated with any written-off arrear by 1823 ($p < 0.05$), which roughly doubles the rate observed in control townlands. For the stills fines outcome in panel B, treated townlands are 0.8 pp *less* likely to have been fined for illegal distillation ($p < 0.1$ with controls).[44] Together, these results suggest a reduced ability to extract taxation or monitor noncompliance.

Despite these effects, we consider it unlikely that changes in fiscal capacity play a significant role in our main results. First, the amount of resources extracted through centralized taxes both overall, and among those which plausibly relied on information in the Down Survey, is very small as an overall share of public revenues. Illustratively, in several years the Quit Rent Office appears to have cost more to run than it raised (Fitzsimons, 2015). Throughout this period, local cess taxes and tithes were far larger land-based taxes and neither one relied, even indirectly, on information in the parish maps given they were administered by counties (or parishes) rather than the central state. Cess taxes, for example, were imposed flatly across townlands rather than based on any more granular cartographic information.[45]

Second, relevant for theories of tax bargaining, very few public goods were supplied by the central state until well into the 19$^{\text{th}}$ century (Bowles, Koehler-Derrick, and Olson, Forthcoming). In our analysis sample, for example, we find no distinguishable differences in the presence of National Schools, which were the most salient of these. By contrast, most public goods and infrastructure tended to be supplied through county-level grand juries which, often, even used their own maps rather than relying on the already-outdated Down Survey (Ó Cionnaith, 2022).

[44] Using the plot description data from the *Valuation*, we find no statistical difference in the presence of distilleries, though this is recorded several decades later.

[45] Given the flat rate across townlands, justifying treatment effects would then likely require that county-level institutions *no longer knew* about the existence of treated townlands. Gross inequalities in the effective incidence of these flat rates of local taxation—due to the varied economic development of different townlands both at the time of the Cromwellian Settlement and in the the centuries afterwards—were a primary motivator for the eventual construction of the Ordnance Survey and Griffith's Valuation (Ó Cionnaith, 2022).

5.4.2 Effects on exposure to the Great Famine

Intuition. While many of our outcome measures predate the devastation of the Great Famine (1845-52), in which almost 1.7 million Irish people either perished (Cousens, 1960; Guinnane, 1994) or immigrated (Ó Grada and O'Rourke, 1997; Ó Gráda, 2019), the fact that Griffith's Valuation was enumerated in its wake (1847-64) raises the possibility that our main results on townlands' valuation could reflect its intermediating role. However, existing evidence suggests that variation in Famine exposure tended to be coarsely regional rather than local (Mokyr, 1983; Goodspeed, 2016). This suggests that despite the temporal proximity between the Great Famine and the *Valuation*, the granularity of our empirical comparisons is likely to mean that exposure to the Famine was largely equivalent across the treated and control townlands in our sample.

Data. While the combination of mortality and emigration implies significant inferential obstacles to measuring the incidence of the Famine, we follow much existing work in comparing local populations between the 1841 and 1851 censuses (e.g. Fernihough and O'Grada, 2022). In particular, we digitize townland-level records from each census relating to townland populations, numbers of houses, and poor law valuations (for 1851). These valuations are particularly helpful since they reflect a composite: for the large majority of places where the *Valuation* had not yet reached by the time of the 1851 census, they are based instead on a coarser earlier effort to estimate the valuation of townlands (without individually enumerating plots and tenements or separating between land and buildings) undertaken between 1826 and 1836.

Results. In panel A (B) of Table A23 we estimate treatment effects on the size of the population (number of houses) in 1841, 1851, and the percentage change between the two censuses. We find modestly negative, though noisy, treatment effects on the levels of the outcomes in the two census years: for example, treated townlands report 12-13 fewer people in 1841 compared to the 137 people in control townlands ($p < 0.1$ with controls). Given the good balance on reported area (columns 1-2 of panel C), this suggests reductions in population density both before *and* after the Famine. We find no detectable difference in the *change* in these measures between 1841 and 1851: both types of townlands report around 26% fewer people after the Famine compared to ten years prior.

Effects in panel C using the coarser census-based valuation measures replicate the main results of Table 1. Using the composite measure in the 1851 census, we find that treated townlands have total valuations £25 lower, compared to average valuations of £218 in control townlands ($p < 0.01$). And, when restricting to townlands not yet reached by the *Valuation* by 1851, and hence reflecting coarser

pre-Famine estimates, we find nearly identical reductions of £24 compared to average valuations of £198 in control townlands ($p < 0.05$). These analyses serve to validate the main analysis, by providing consistent results defined pre-Famine, and provide little evidence of differential impacts of the Famine based on treatment assignment.

6 Discussion

The above evidence suggests that our results are primarily driven by the ambiguities and uncertainties caused by the loss of the "metes and bounds" delineating individual townlands in treated portions of the parish maps. While we find evidence of heightened deed registration in the decades after the 1711 fire, the gradual attenuation of these effects towards the end of the 18th century suggests that many such rival claims became progressively, if inefficiently, settled. The temporal pattern is consistent with landowners more reliant on *de jure* protections registering deeds to ward off claims over their land before their holdings gradually eroded. Our compositional results, with rising shares of Catholic lessors in treated townlands bordering Catholic-owned land, and the fractionalization of dispersed estates—suggest that this erosion eventually led to groups with stronger *de facto* protections (though much poorer on average) taking up land. The reduced physical investment we observe in the 19th century, along with reduced townland valuations overall, then reflect the accumulated impact of disputed claims alongside shifts in the characteristics of those in treated townlands.

6.1 Persistence

Our results suggest that the partial destruction of the parish maps in 1711 had persistent effects for, at least, a century and a half. While our outcome data sources span this period—with 'short-run' evidence from the registration of deeds, evidence from the early 1800s pertaining to fiscal capacity, the 1830s for physical infrastructure, the 1840s for census enumeration, before our primary outcome measures from the *Valuation*—this still implies a striking degree of persistence.

Historical evidence highlights a number of reasons supporting the plausibility of such implied persistence. Most obviously, a range of contemporary observers noted the enduring impact of the fire on property rights (Gibson, 1752; Mason, 1814b). Because the parish maps were uniquely valuable evidence, while private maps were generally disregarded for property claims (Ó Cionnaith, 2022), newspaper accounts of court cases continued to describe the Down Survey being invoked by lawyers to support evidence for clients' claims to boundaries and title (The Patriot, 1826; Cork Examiner, 1844). This is true even after the Ordnance Survey eventually replaced the Down Survey

in the 1830s—with the delineation of its administrative boundaries, by design, closely matching those defined nearly two centuries earlier (Larcom, 1851).

A second reason why the divisions drawn in the 1650s remained so influential owed to the Penal Laws' calcifying effects on landownership and constraints on the property rights of the Catholic majority. As one historian quips, the Penal Laws were more concerned with "property rather than souls" (Wall, 1961, 12).[46] Legal impediments to Catholic ownership (Phair, 1966; Roebuck, 1972), combined with a steadily growing population, meant that even the worst landlords had no shortage of tenants and little incentive to sell their land (O'Rourke and Polak, 1994). Recent evidence emphasizes the remarkable continuity in the identity of the largest landowning families in Ireland, where "more than two-thirds of great landowners in 1881 were the descendants of the men and women who had colonized Ireland in the early modern period" (Campbell, 2009, 21). While Catholic Emancipation would ease some of these legal constraints, landlords faced few practical obstacles to expelling their tenants if they chose to do so. As late as 1870, most Irish farmers were "tenants at will," lacking any formal lease agreement beyond the rights dictated by custom (Guinnane and Miller, 1997, 593).

6.2 Limitations and generalizability

Several limitations qualify our conclusions. Perhaps most importantly, the destruction of so much of Ireland's vast archival records in the Four Courts fire of 1922 means that we rely on indirect measures for several aspects of the analysis. First, while we systematically demonstrate robustness to alternative operationalizations of our treatment assignment, we remain unable to *directly* validate assignment against the original parish maps. Second, the paucity of surviving data sources from the 18$^{\text{th}}$ century at a level assignable to individual townlands implies a lengthy window before our primary outcomes are measured. Third, since systematic data on property disputes appear not to have survived the Four Courts fire, our indirect proxy measure draws on data from crowd sourced efforts to digitize data on deeds. Although we test for obvious problems in these data and do not find glaring issues, this is far from an ideal measure.

Despite these obstacles, our results provides new evidence of the substantively large and persistent effects of administrative maps for local development. A natural concern is whether these results generalize outside Ireland. We think our findings are likely to extend beyond Ireland for at least three reasons. First, perhaps the most unusual feature of our empirical setting is the creation of such detailed maps at such an early point in history.[47] There is significant temporal variation

[46] For more details, see Section F.

[47] As one of the foremost authorities on the Down Survey notes, "Nothing as systematic or on such a large scale exists

in the cross-national diffusion of cadastral surveys (D'Arcy, Nistotskaya, and Olsson, 2024), but maps of equivalent detail became increasingly common throughout the 19th (Degrave, 2026) and 20th centuries (Sánchez-Talanquer, 2020). Cadasters were typically implemented first in sovereign nations, but in colonial settings as varied as India (Edney, 2009) and Egypt (Lyons, 1908), maps of comparable granularity were produced decades before independence and continue to play a key role in the administration of property rights today. Second, while our natural experiment relies on the partial destruction of such maps, the frequent destruction of archival or historical records ought to present similar empirical opportunities for studying shocks to states' informational capacity elsewhere (e.g. Jerven, 2013). Third, as we note the government opted not to recognize privately financed maps where original maps had been lost or destroyed. While seemingly idiosyncratic, work on property rights across the social sciences underscores their highly politicized administration (Albertus and Klaus, 2025; Levi and Russell, 2025), a finding widely supported by evidence from studies of land titles in economics (Di Tella, Galiani, and Schargrodsky, 2007). This is particularly true in colonial settings where authorities often faced strong incentives to conduct policy "on the cheap" (Cogneau, 2026), enjoyed enormous discretion over local administration, and where property rights were highly stratified based on religion, ethnicity, or both. For one illustrative example, previous research demonstrates that in colonial India the amount of information available to colonial authorities differed dramatically across localities (Lee, 2019) and ethnic groups (Cassan, 2015), with huge repercussions for both the structure of land tenure and property rights that would shape local development for decades after independence (Banerjee and Iyer, 2005).

7 Conclusion

This paper provides new evidence on how localized changes in the state's informational capacity shape development over the long run. We find that reduced economic valuations in localities exogenously exposed to the destruction of local maps were accompanied by the greater insecurity of property tenure, as proxied by the registration of deeds, and reduced investment in infrastructure. Given the stark economic and political disparities which characterized rural Ireland during the period, these consequences varied across landowners. We find the reductions in valuations to be particularly large among those Protestant landowners who were plausibly least able to monitor the use of their land and prevent encroachment. Our results suggest that the partial destruction of the parish maps likely favored the *de facto* rights of tenants—overwhelmingly poorer Catholics—over

anywhere else in the world during the early modern period" (O Siochrú, Brown, and Bartlett, 2018, 598).

the *de jure* rights of Protestant landlords.

Our findings suggest a number of directions for future work. First, the results suggest that variation in the survival of the parish maps primarily shaped long-run development outcomes through conditioning the state's *legal* capacity rather than fiscal extraction. Understanding how states' access to systematized information conditions the sequencing of the development of its other capacities over varied time horizons presents an interesting avenue for future research. Second, given frequent historical reversals in state-building processes and the protection of property rights, our results highlight the value of studying other canonical theories of development "in reverse." Last, while colonial Ireland represents an extremely stratified context, future work might fruitfully evaluate the generalizability of our findings about the heterogeneous effects of changes in the state's capacities across politically salient groups.

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Appendix: Table of Contents

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Appendix

A Map Storage Before the Fire

Prior to the fire in 1711, both the original baronial and parish maps were held by the Surveyor General, who was the figure responsible for the creation and maintenance of all public buildings in Ireland until the 1760s (McParland, 1995, 91). William Petty, who organized the Down Survey, was Surveyor General from 1660-1667, and at the time of the fire the title was held by Thomas de Burgh, a prominent military engineer and architect. Despite the importance of the office of the Surveyor General and the priceless nature of the Down Survey maps, at the time of the fire the maps were held in a house on Essex Street in Dublin (Commissioners of Public Records, 1813, 501). This short street, created in 1674, was outside the city wall but a short distance from Dublin Castle, the government's administrative headquarters. While it is unclear why such valuable documents were not initially kept in Dublin Castle, this may have been a question of convenience: Essex Street was an early hub for the nascent surveying industry with many surveyors' offices close by.[48]

The building used for the Surveyor General's office at the time of the fire, which appears to have been on the corner of Essex Street and Crane Lane, shared its premises with a Council Office. Supporting this point:

1. Archivist Herbert Wood, who notes that "the building in which the Council Office and the Surveyor-General's Department were located, and which was situated in Essex Street" (Wood, 1912).
2. Commissioners of Public Records (1813, 451), quoting a 1719 summons, comments on the "Council Office, near which the Surveyor General's Office was then kept."
3. A 1776 text on the Exchequer refers to "the original maps or such of them as escaped the flames at the time the council office and other offices in Essex Street were burnt" (Howard, 1776, 115).
4. The early surveyor Robert Gibson describes the property as the "Treasury Office in Essex Street" (Gibson, 1752, 284).

Figure A4 below, reproducing an archival map from 1720 held at the National Library in Dublin, indicates there was a property labeled "former Council Chamber" just opposite the Customs House, most likely losing its earlier functions following the fire.[49] A map from the Wide Streets Commission of 1721, reproduced in Figure A5, confirms the layout, name, and location of the property and indicates that it measured about 105 feet by 87 feet. Prior to the fire, both the baronial and parish maps were available for consultation either by private surveyors or by court officers who needed to introduce them as evidence in legal disputes.

[48] Perhaps most prominently that of Gabriel Stokes, who both provided and repaired surveying instruments and would himself serve as Deputy Surveyor General from 1748-1752 (Ó Cionnaith, 2011, 98).

[49] We are grateful to Finnian Ó Cionnaith for his help in identifying this location.

The large physical dimensions of the parish maps, the fact there were well over a thousand of them, and the need to organize these maps in such a way as to be readily accessible, all suggest that they would have been stored in a large cabinet or bureau. While we have not located a precise description of how the maps were stored, the idea that the maps were kept in a large bureau or cabinet seems speculatively plausible based on two points. First, a parliamentary inquest refers to "the weakness of the paper on which the [original] maps were drawn" (Commissioners of Public Records, 1813, 497), which suggests that the original parish maps were most likely made on rag paper. Given that rag paper starts to break down at temperatures of around 200°C (Ahn et al., 2018, 2), our intuition is that far fewer maps would have been preserved at all if they had not been protected by some kind of cabinet. Second, surviving evidence documents how the maps were stored *after* the fire. As part of its work enumerating the surviving maps of the Down Survey, the Irish Record Commission illustrated the so-called "Down Survey Press," a large, custom-built cabinet, about 9 feet wide and 12 feet tall, that stored the surviving maps—which were moved to the Record Tower of Dublin Castle and away from the "very old and ruinous [former office]" (Commissioners of Public Records, 1813, 541) in the wake of the fire. Figure A7, reproducing this image, shows that surviving maps were grouped by county in descending alphabetical order.

The parish maps were grouped into folio books (Commissioners of Public Records, 1813, 499), and these large folios contained multiple baronies from a given county (Commissioners of Public Records, 1813, 541-542). These baronies were organized primarily based on the divisions and groupings which structured the earlier "Civil Survey" of 1654-1656, and in turn shaped the administrative organization of the Down Survey. Our assumption is that one county was stored per drawer, although some smaller counties may have been grouped together as was clearly the case after the fire as depicted in Figure A7.

The 1711 fire appears to have started in the Council Office and then spread to the Surveyor General's office: evidence from the 1719 summons cited above, quoted in Commissioners of Public Records (1813, 541), comments on "the Fire which happened in the Council Office, and burned [the] Memorialist's Office" and that "such Records of his Office as are now remaining, were saved from the fire in the Council Office." We have not uncovered any description of how the fire originally broke out, or what actions were taken by those in the building after the fire started, but the fact that maps pertaining to so many of the wealthiest counties in the east were entirely preserved, while maps for so many of the poorest counties in the west were entirely destroyed (see Figure 3a), is consistent with the idea that employees in the Essex Street office may have had sufficient time to prioritize some counties over others.[50]

Regarding the duration of the fire, recent research suggests that vellum starts to exhibit serious damage when even briefly exposed to temperatures above 120°C (Cappa et al., 2020). Recent experimental evidence suggests that fire causes damage to the edges of rag paper materials first (Ahn et al., 2018, 8), and that temperatures reaching 750°C at the top of a bookshelf can be reached in less than 15 minutes (Ahn et al., 2018, 1). This suggests that within counties, maps closer to the top of the folio within a drawer would have been more likely to be damaged, and that damage on the surviving maps should be concentrated at the edges. Consistent with this experimental evidence we find that, of the partially burned maps in Commissioners of Public Records (1813), almost all

[50]County Donegal is the obvious exception to this hypothesis.

references to fire damage refer to the edges of parishes rather than their centers.

While this evidence is suggestive, it does not tell us much about variation in the damage to maps within counties or folios. Helpfully, the catalog of Commissioners of Public Records (1813) reconstructs the *original physical order* of each parish map, as existing prior to the fire, within a given folio, along with the physical order of each map *as existing in 1813*: "The restoration of that original order has been attempted by the Sub-Commissioners, in the following Catalogue, to which they have annexed the present arrangement of the Office in a separate column" (502). In Panel A of Table A2, we regress a parish-level measure of fire damage (whether any burn damage or the share of cardinal points reported as burned) onto both the reconstructed original order and the later "office mark" measure. Using county folio fixed effects in columns 3-4, we find that *higher* order numbers (i.e., maps further down within a folio) are associated with less fire damage, while those towards the top are conversely more likely to have been exposed to any fire damage.[51] Instructively, the later "office mark" measure, reflecting the maps' organization in 1813, has no effect on fire damage. This combination of qualitative and quantitative evidence on the storage of the parish maps underscores the non-random assignment of fire damage *across* counties, baronies, and parishes and helps to motivate our focus on *within-map* variation in fire damage for our research design.

B Qualitative Evidence on the Influence of the Down Survey

In this section, we summarize in tabular format evidence from a host of primary sources that specifically referenced the Down Survey between the years 1702 and 1857. To construct the table below, we searched for the exact phrase "Down Survey" in two datasets of primary sources from the 18th and 19th centuries which includes pamphlets, newspapers, and legal documents (Gale Publishing, 2026a,b). We supplement this search by looking for the same phrase in Google Books, to identify discussions of the Down Survey in contemporary reference books, as well as the *Parliamentary Papers* database.

While of course a non-representative sample, this approach turns up a sufficiently wide-range of types of primary document, as well as references to the Down Survey, that we believe it constitutes a reasonable overview of the ways in which the Down Survey was discussed in print throughout the 1700 and 1800s. Table A1 provides more detail. For each primary case, we highlight the channel linking the destruction of the Down Survey and local property rights, in all instances in which a specific townland or parish is mentioned in the original primary source.[52] For each mention of a specific townland, we include its treatment status in our research design, the mechanism(s) of property rights referenced explicitly in the text, the category of land referenced (commons/endowments/private), and the type of primary source document (Correspondence, Legal, Newspaper, Pamphlet, Parliamentary Report, or Reference).

[51] These estimates attenuate with the inclusion of barony fixed effects in columns 5-6, likely since many baronies comprised relatively few parishes and so there is limited variation to exploit.

[52] We include more general references to the Down Survey, for example its invocation as an authoritative source in legal disputes for example, throughout the paper.

Table A1: Selected primary source references to Down Survey

Townland(s)	County	Map Status	Mechanism	Land Category	Source Type	Citation
Kilcooly & Grange Kilcooly	Meath	Burned	Encroachment	Private	Legal	(Barker, 1732, 1)
Farranagh, Farrenglasse, Farran Eglish	Queens	Intact	Encroachment	Endowment	Reference	(Ledwich, 1796, 21-29)
Herbert's Town	Limerick	Intact	Dispute	Private	Reference	(Trenchard, 1702, 33)
Ballyvoorney	Cork	Intact	Encroachment	Endowment	Reference	(Mason, 1819, 117)
Carne	Wexford	Intact	Encroachment	Endowment	Reference	(Mason, 1819, 131)
Aghaboe	Queen's	Intact	Encroachment	Endowment	Reference	(Mason, 1814a, 55)
Kilmokea	Wexford	Intact	Expansion	Endowment	Reference	(Mason, 1814b, 546)
Nodstown	Tipperary	Burned	Encroachment	Endowment	Reference	(Mason, 1814b, xviii)
Kilkea	Kildare	Intact	Dispute	Private	Correspondence	Quoted in (Ó Cionnaith, 2022, 125)
Greencastle, Moville, Whitecastle	Tyrone	Intact	Dispute	Administrative Border	Legal	(McLaughlin, 1857, 138)
Banagher	King's	Intact	Encroachment	Endowment	Report	(Great Britain Parliament House of Commons, 1814, 4)
Clonmel	Tipperary	Unclear	Encroachment	Commons	Reference	(Smith, 1746, 110)

C Replacing Maps Lost to Fire

A full set of copies of the Down Survey's *baronial* maps were intercepted by French pirates in 1707 while en route from Dublin to London. These copies, which were only "discovered" by the British ambassador to France in 1774, were then copied in 1789 by General Charles Vallancey (Ó Cionnaith, 2024). The Vallancey copies raised hopes that perhaps these 'faithful' reproductions might address the gaps caused by the 1711 fire. While the idea seems to have had little initial support, pressure appears to have increased in the early 19th century as it became increasingly apparent that the Down Survey was no longer sufficient to meet the technical and logistical demands of the courts in adjudicating property rights disputes. However, a modern surveying effort on the scale of the British Ordnance survey (1791) would take decades. In 1813, a parliamentary inquiry was held as part of a series of annual reports on public records. A committee assessed the condition of all the surviving Down Survey maps in order to gauge the accuracy of Vallancey's copies of the *barony* maps (and hence whether they could be used for official purposes). While the report finds the Vallancey copies to be relatively accurate, it notes the limited utility of the barony maps in general for adjudicating property rights disputes relative to the parish maps (for which no such high quality copies of those original maps destroyed in 1711 had survived):

> "*These Copies [...] do not appear to us competent to supply the places of the lost Parochial Maps; [...] and the Parochial Maps appear to us, from the largeness of the Scale on which they were drawn, and also from the Evidence we have had before us, to be much more valuable documents, and much more frequently used in evidence than the Baronial Maps.*" (Commissioners of Public Records, 1813, 496)

Indeed, reporting on one individual interviewed as part of the commission, the committee notes that "The Witness has never known the Baronial maps to be called for in evidence, but the Parochial maps only" (498). This report ultimately advised against introduction of the Vallancey maps as legal evidence, regardless, due to concerns over the amount of property rights disputes it might give rise to: that such an act would "strengthen the Claims of the Church and occasion great litigation" (498) and lead to "endless litigation between old and new interests" (499). The evidentiary weaknesses of the baronial maps is emphasized by Ó Domhnaill (1943):

> "*The parish was treated as a unit; in consequence, the map of the parish became the official map of the [Down] survey. The governing authority was not greatly concerned with what the map of the barony contained [...] The barony maps were not necessary for the purpose of the survey. [...] The map of the barony, with very rare exceptions, gave scarcely any detail. The boundaries of the parishes within the barony, the names of the parishes, striking natural features such as mountains, lakes, and bogs, often unnamed, with pictorial representations of castles and churches, again very frequently unnamed, formed the sum total of the detail of the barony maps.*" (Ó Domhnaill, 1943, 382-383)

While copies were made of the parish maps which survived the 1711 fire in good condition—see, for example, Figure 1—all of the original parish maps (including the set damaged by the 1711 fire) were ultimately destroyed in the 1922 Custom House Fire (Ó Domhnaill, 1943). For those parish



Figure A1: Example of a traced Down Survey parish map

maps partially damaged in the 1711 fire, only low quality tracings now exist (see, for example, Figure A1), while no records survive for most of the parish maps entirely destroyed in the 1711 fire.

D Reconstructing Historical Administrative Units

Our empirical strategy requires us to reconstruct the baronies, parishes, and townlands as defined in the Down Survey. To begin, we define our analysis sample of baronies using Commissioners of Public Records (1813), which provides map-level information about the extent of fire damage for each original baronial map and the parish maps within that barony. Using this, we restrict our attention to the set of baronies in which any burn damage is reported for at least one parish map within that barony. This provides us with a sample of 64 baronies and excludes 110 baronies in the report for which no parish map was damaged in the fire. Within these 64 baronies, 390 parish-level maps are listed.

D.1 Parish data

From the titles of these 390 parish-level maps, 69% feature just one parish while the rest featured two or more. Particularly for smaller parishes, multiple adjoining parishes were often represented on the same physical maps (e.g. one map is called "The Parishes of Noghavall, Cullin and Drishane"). Overall, we extract 562 distinct parish names from the titles of the listed parish-level maps. This does not represent the *universe* of parishes in these baronies, however, to the extent that: (1) some parish maps were potentially entirely destroyed or otherwise missing by 1813; (2) parishes without any land eligible for expropriation and redistribution in the Cromwellian Settlement often went unmapped in the Down Survey (O Siochrú, Brown, and Bartlett, 2018).

Building on this analysis sample of baronies, along with the indicative set of parishes, we therefore reconstruct the full set of parishes in these parishes, along with shapefiles of their boundaries, leveraging four sources:

(A) **1841 parish boundaries.** Our starting point is a set of parish-level shapefiles pertaining to the 1841 census by Fernihough and O'Grada (2022). As noted above, the delineation of administrative units under Griffith—which the 1841 census used—closely hewed to boundaries as defined in the Down Survey two centuries prior, implying a substantial degree of persistence.

(B) **Down Survey baronial maps.** We initially manually adjust (A) using the Vallancey maps from the Down Survey, all of which survive, and which provide boundaries for each barony along with its constituent parishes. While low-quality tracings of the parish maps sometimes survive (see Appendix C), we generally find these too coarse to use.

(C) **Down Survey point data.** For more fine-grained adjustments, due to the limited granularity of the baronial maps, we leverage the geocoded work of Ó Siochrú, Brown, and Bailey (2013). For 85% of modern townlands in our analysis sample, this database links townlands back to their county, barony, and parish as defined in the Down Survey. We manually adjust the parish boundaries resulting from (A) and (B), where possible, to match their prior linkage work.

(D) **Books of Survey and Distribution.** Since the linkage of townlands to historical parishes in (C) is sometimes inconsistent or incomplete, we additionally adjudicate discrepancies by consulting the *Books of Survey and Distribution*, constructed contemporaneously with the *Down Survey*, and which lists each townland under its respective parish.

Altogether, we recover granular historical boundaries for 677 parishes across the 64 baronies, of which 562 are listed in Commissioners of Public Records (1813). Figure 3b plots their spatial distribution. We estimate the 64 baronies to comprise 22% of the land mass of Ireland, while the parishes listed in the report account for 19% of Ireland's land.

D.2 Townland data

The administrative units delineated for the enumeration of Griffith's Valuation have remained remarkably unchanged through time. Illustratively, we are able to confidently match over 99% of the townlands in our extracted *Valuation* data to spatial data reflecting modern townlands as defined by *Tailte Éireann* (for the Republic of Ireland) and the *Ordnance Survey of Northern Ireland*.

While this enables us to geolocate our various outcome data sources and assign townlands to treatment, using townlands as existing in the 1830s raises the possibility that the units themselves were endogenously affected by the destruction of the parish maps. As noted above, the boundary delimitation exercise accompanying the *Valuation* sought to *survey* townland boundaries as defined in the Down Survey. However, in cases of the destruction of these maps (or their non-existence to begin with), enumerators had more discretion over the delimitation and standardization of townlands. The *Boundary Survey (Ireland) Act* of 1825, illustratively, allowed enumerators to consult local informants to inform boundary delimitations or the splitting of existing townlands where they lacked more authoritative sources of information.

We therefore map all townlands as observed in our outcome dataset to townlands as existing *during* the enumeration of the Down Survey in the 1650s. We do this leveraging two sources: first,

the relatively comprehensive existing mapping work of (Ó Siochrú, Brown, and Bailey, 2013), which links nearly all modern townlands to their respective names in the *Down Survey* and *Books of Survey and Distribution*. However, this linkage is incomplete given that townlands ineligible for expropriation (for example, due to them only containing Protestant land, or containing only common land, mountains, or bogs) are not linked to specific locality names as existing in the 1650s. In such cases, we leverage the townland name histories of logainm.ie. These record the names by which (modern day) townlands were known at different points in time; we select the historical townland name closest to 1650. With this mapping exercise, we link 14,509 modern townlands in our baronial analysis sample to 12,234 townlands as existing during the time of the Down Survey.

E Extracting Data from Griffith's Valuation

Our primary outcome data comes from Griffith's Valuation (1847-64). This massive multi-year endeavor was, along with the Ordnance Survey, among the most ambitious enumeration exercises anywhere in the world in the 19th century (Smyth, 2008). Intended primarily to facilitate the collection of local taxes, a team of surveyors went county-by-county across the entirety of Ireland under strict instructions to enumerate all plots of land. Every plot was linked to its location along with the individual lessors of that plot, those responsible for administering the property, the occupiers leasing the plot, a description of the physical structures in the plot, and its area. Most importantly for our purposes, rateable estimates of the value of the plot's land and the buildings on it were computed for every plot (see Figure A2 for an example page and Section 4.1 for more detail on the interpretation of the rateable annual valuation numbers).

E.1 Data extraction pipeline

While Griffith's Valuation had previously been partially digitized to facilitate genealogical research, this comprised only the fields recording the names of individual occupiers and lessors (Ask About Ireland, 2025). None of the fields containing numeric data on area or valuations, nor the plot descriptions, had previously been digitized.

To enable our digitization, we obtained a comprehensive set of scans of the Griffith's Valuation volumes from Eneclann, the company originally responsible for scanning the entirety of the *Valuation*. Digitizing all 36,000 pages, with data on around 4 million plots, was impractical for our purposes and so we focused our efforts on only those townlands within the baronial analysis sample described in Appendix D.[53] This left us with a sample of 7,385 pages. Our Large Language Model (LLM) data extraction pipeline is comprised of three steps:

1. Refinement of prompts by training on a small initial sample of manually digitized pages.
2. Initial extraction of all pages using Anthropic's Claude Sonnet 4.0 which, at the time of data extraction, we found to offer the best balance of extraction quality and cost.
3. Assessment of data quality and re-extraction of flagged pages using either:

[53] See Appendix D.2 for details on the linkage of administrative units from Griffith's Valuation to the Down Survey.

PARISH OF BALSOON.

No. and Letters of Reference to Map.	Names. Townlands and Occupiers.	Names. Immediate Lessors.	Description of Tenement.	Area. A. R. P.	Rateable Annual Valuation. Land. £ s. d.	Rateable Annual Valuation. Buildings. £ s. d.	Total Annual Valuation of Rateable Property. £ s. d.
	BALLINA, or BECTIVE—*continued*.						
– *f*	James Clarke, . .	Thomas E. Taylor, .	House, . . .	—	—	0 5 0	0 5 0
			Waste, &c., . .	0 1 20	—	—	—
5	Henry Williams, .	Same, . .	Land (*fair-green*), .	9 3 35	6 10 0	—	6 10 0
	Henry Williams, .	Same, . .	Tolls of (*fair-green*), .	—	—	—	15 0 0
6	Thomas Vaughan, .	Same, . .	Land, . . .	3 3 16	3 0 0	—	3 0 0
– *a*	Martin Mooney, .	Thomas Vaughan, .	House and office, .	—	—	0 10 0	0 10 0
7 *a*	Lawrence M'Keever, .	Eliza M'Keever, .	House, offices, and land,	4 2 20	2 15 0	1 5 0	4 0 0
8 *a*	Eliza M'Keever, .	Thomas E. Taylor, .	House, offices, and land,	60 3 23	47 10 0	2 10 0	50 0 0
– *b*	John Rooney, . .	Eliza M'Keever, .	House, . . .	—	—	0 10 0	0 10 0
– *c*	Mary Carty, . .	Same, . .	House, . . .	—	—	0 5 0	0 5 0
– *d*	Catherine Sherlock, .	Thomas E. Taylor, .	House & small garden,	—	—	0 15 0	0 15 0
– *e*	James King, . .	Eliza M'Keever, .	House & small garden,	—	—	0 10 0	0 10 0
– *f*	James Byrne, . .	Same, . .	House & small garden,	—	—	0 10 0	0 10 0
– *g*	Patrick Mooney, .	Same, . .	House & small garden,	—	—	0 15 0	0 15 0
– *h*	Patrick Vaughan, .	Same, . .	House and garden, .	0 0 15	0 2 0	0 8 0	0 10 0
9	. . . . .	. . . . .	River Boyne (*part of*),	6 0 36	—	—	—
			Total, . .	170 1 34	131 4 0	18 3 0	164 7 0
	BALREASK. (*Ord. S.* 31 & 37.)						
1 *a*	Francis Loughran, .	Sir John Nugent, Bt.,	House, offices, and land,	93 2 7	57 0 0	3 0 0	60 0 0
2 *a*	Michael Shendin, .	Same, . .	House, offices, and land,	85 1 0	58 15 0	1 5 0	60 0 0
– *b*	Hugh Roe, . .	Michael Shendin, .	House, offices, & garden,	0 1 20	0 7 0	0 13 0	1 0 0
– *c*	Anne Weldon, . .	Same, . .	House, . . .	—	—	0 10 0	0 10 0
– *d*	Hugh Keeley, . .	Same, . .	House & small garden,	—	—	0 5 0	0 5 0
– *e*	James Carney, . .	Same, . .	House, . . .	—	—	0 5 0	0 5 0
3 *a*	Edward M'Keever, .	Sir John Nugent, Bt.,	House, offices, and land,	227 0 39	138 0 0	2 0 0	140 0 0
– *b*	Henry Canlin, . .	Edward M'Keever, .	House and garden, .	0 0 32	0 2 0	0 8 0	0 10 0
			Total, . .	406 2 18	254 4 0	8 6 0	262 10 0
	BALLYNAVADDOG. (*Ord. S.* 37 & 31.)						
1	Henry Williams, .	Thomas E. Taylor, .	Land, . . .	22 3 30	16 10 0	—	16 10 0
2	Richard Harvey, .	Same, . .	Land, . . .	46 2 4	38 0 0	—	38 0 0
3 *a*	Thomas Flynn, .	Same, . .	House, offices, and land,	30 3 2	20 0 0	3 0 0	23 0 0
– *b*	George Callaghan, .	Thomas Flynn, .	House and garden, .	0 0 20	0 2 0	0 13 0	0 15 0
4 A	Thomas Flynn, .	Thos. E. Taylor,	Land, . . .	23 1 17	14 0 0	—	18 10 0
– B *a*			Herd's house and land,	5 3 31	4 0 0	0 10 0	
5 *a*	Peter Swan, . .	Same, . .	House, offices, and land,	22 1 23	13 10 0	1 0 0	14 10 0
6 *a*	Michael Mullen, .	Same, . .	House, offices, and land,	28 2 18	17 10 0	1 10 0	19 0 0
– *b*	Mary Carroll, . .	Michael Mullen, .	House, . . .	—	—	0 5 0	0 5 0
– *c*	William Foley, . .	Same, . .	Ho., forge, office, & gar.,	0 0 25	0 2 0	0 13 0	0 15 0
			Total, . .	180 3 10	123 14 0	7 11 0	131 5 0
	BALSOON. (*Ord. S.* 31.)						
1 *a*	Thomas Vaughan, .	John J. Preston, .	Ho., offs., orchard, & ld.,	133 3 34	130 0 0	3 0 0	133 0 0
2	Thomas Vaughan, .	Same, . .	Land, . . .	57 3 25	50 0 0	—	50 0 0
– *a*	Vacant, . . .	Thomas Vaughan, .	House, . . .	—	—	15 0 0	15 0 0
– *b*	Patrick Roe, . .	Same, . .	House, . . .	—	—	3 0 0	3 0 0
– *c*	. . . . .	. . . . .	Grave-yard, . .	0 0 36	—	—	—
3 *a*	Patrick Marmion, .	John J. Preston, .	House, offices, & garden,	3 2 6	3 15 0	1 5 0	5 0 0
4	John J. Preston, .	In fee, . .	Land (*Islands*), . .	1 2 0	0 10 0	—	0 10 0
5	. . . . .	. . . . .	River Boyne (*part of*),	12 1 5	—	—	—
			Total, . .	209 1 26	184 5 0	22 5 0	206 10 0
			EXEMPTION: Grave-yard, . .	0 0 36	—	—	—
			Total, exclusive of Exemptions, .	209 0 30	184 5 0	22 5 0	206 10 0
	COOLJOHN. (*Ord. S.* 31 & 37.)						
1 *a*	David L. Clifford, .	In fee, . . .	Herd's ho., offs., & land,	166 2 14	115 0 0	1 0 0	116 0 0
– *b*	James Flynn, . .	Free, . . .	House and sm. garden,	—	—	0 10 0	0 10 0
2 *a*	Eliza Farrell, . .	Same, . .	House, office, & garden,	1 0 14	0 13 0	0 12 0	1 5 0
			Total, . .	167 2 28	115 13 0	2 2 0	117 15 0

Figure A2: Griffith's Valuation example page with townland total rows highlighted

(A) Manual digitization by a research assistant for the 408 relevant pages of the *Valuation* which were handwritten rather than typed.[54]

(B) Automated extraction of pages failing our quality tests using Anthropic's Claude Opus 4.5, a more advanced frontier model.

We found overall extraction quality from step 2 to be very high. To assess the quality of the extraction in step 2 and determine which pages to re-extract in step 3(B), we found the extraction quality of names and words to exceed the extraction of the numerical columns, which feature relatively challenging formats. To focus on improving the quality of these latter columns, we therefore leverage the fact that the *Valuation* includes plot-level valuation measures *and* the totals for each townland (see the gray boxes in Figure A2). Focusing on the total valuation column, and after unifying the extracted administrative units for every page, we then flagged pages containing any townland where the sum of the extracted individual plot valuations, for a given townland, diverged from the extracted "total" townland valuation by a factor of two or more. We consider this to represent a relatively challenging quality metric: given that townlands often covered multiple pages, a single sufficiently incorrectly extracted plot valuation measure would lead all pages pertaining to that townland to be re-extracted. This metric led us to re-extract, using Opus 4.5, 815 of the pages which had been initially extracted by Sonnet 4.0. After this process, indicative of high overall extracted data quality, we obtain a correlation of 0.95 between the sum of the plot valuations for a given townland and the total recorded valuation for that townland.

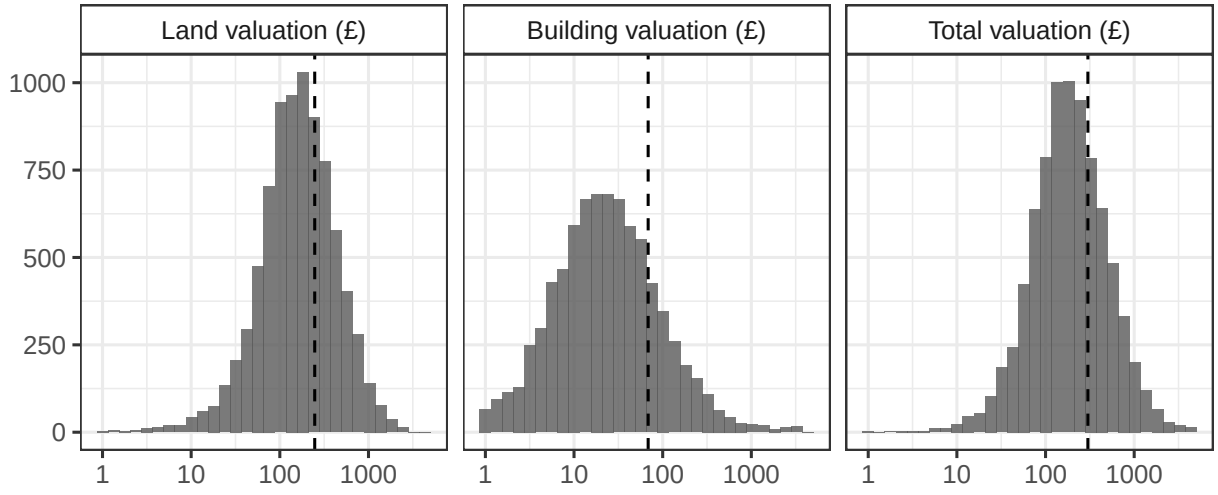


Figure A3: Distribution of Griffith's Valuation outcome measures

[54]These pages were all in baronies in Limerick corresponding to the historical barony of Connello: by the time of the *Valuation*, these comprised Connello Lower, Connello Upper, Shanid, and Glenquin.

E.2 Measurement concerns

As is noted in the manuscript, Griffith's Valuation encompassed the entirety of Ireland and took more than 20 years to complete. Given its scope, ambition, and that the instructions provided to all valuators run to nearly 70 pages, concerns about the integrity of the estimated valuations were raised by contemporary observers (House of Commons, 1869), and have been raised by numerous scholars since (Reilly, 2009; Smyth, 2008; Solow, 1971).

Three factors assuage concern that our results are driven by systematic measurement biases in Griffith's Valuation. First, Griffith and his technical team were well aware of the challenges inherent in creating such fine-grained measurements over time and space. Precisely because of concerns about maintaining consistency, the very first page of the instructions enumerate the principles guiding the valuation of land and physical infrastructure. Both are worth quoting in detail. For land, the instructions make clear that all valuations must be made on "a uniform principle and scale of prices for agricultural produce, so as to ensure that the relative value of the lands within any county, though ascertained at different periods, and also that the relative value of the lands of different and distant counties, though ascertained at different and distant periods, should be the same" (Smith, 1882, 7). The guidance for valuating buildings, while slightly more complex, is similarly direct. Building valuations were to be based on, "the rent for which, [from] one year with another the same [building] might, in its actual state, be reasonably expected to let from year to year, the probable average annual cost of repairs, insurance, and other expenses (if any), necessary to maintain the hereditament in its actual state, and all rates, taxes, and public charges, if any (except tithe rent-charge), being paid by the tenant" (Smith, 1882, 7-8). While different valuators surely interpreted this guidance in slightly different ways, there is little evidence to suggest that they were given fundamentally different guidance or protocols for their valuations that might systematically bias our results.

Second, given the technically demanding process that valuators were supposed to follow—including evaluating the physical integrity of the properties, but also characteristics like soil quality, proximity to roads, and productivity—we might be concerned that our results are driven by teams of valuators interpreting the same instructions differently. A survey of the academic literature on Griffith's Valuation, some of it quite critical (Solow, 1971, Chapter 3), is somewhat reassuring because this is *not* a concern raised by outside experts. The reason for this seems to be relatively straightforward: the publication dates of the 202 individual volumes makes it clear that valuations were conducted on a county-by-county basis. Because the *same* teams of valuators were responsible for all of the valuations in a given county, it was very unlikely that there would be inconsistencies in the way that instructions were interpreted *within* a single county. Technical innovations, specifically the use of "field-books" (Smyth, 2008, 120), which recorded independent provisional valuations by at least three different valuators (Smyth, 2008, 119), and "check evaluations" in which a senior valuator assessed the field books of multiple teams (Smyth, 2008, 121), seem to have greatly diminished the likelihood of huge disparities in valuations within the same county.[55]

Third, consistent with the previous point, scholars who raise concerns about the consistency of valuations are primarily concerned with *regional* differences in agricultural prices or rents that played a large role in determining the valuation of buildings and land (Solow, 1971, 60-66). Southern

[55]These techniques were pioneered by Griffith as part of an earlier valuation project, the "Townland Valuation" of 1826-1836.

counties were evaluated first, when agricultural commodities were at their lowest prices following the Great Famine, whereas northern counties were valuated almost a decade later. As a result, this critique implies important regional differences in measurement—biasing estimates in Ulster upwards relative to Leinster, Munster, or Connacht—although this concern has been contested in more recent analysis (Smyth, 2008, Chapter 6). While acknowledging this debate, it is important to emphasize that our digitization of townland-level data combined with map-level fixed effects, removes the possibility that our results are attributable to any systematic regional differences in the enumeration of the *Valuation*. Because our regressions only compare the valuations of townlands on the same map, any regional discrepancies, including the under- or over-valuation of agricultural commodities, are held constant.

F The Williamite Confiscations, Penal Laws, and the Protestant Ascendancy

The Restoration was initially a source of great hope for the Catholic nobility in Ireland, who hoped that the Stewarts might prove more amenable to their attempts to reclaim the properties expropriated under the Cromwellian Settlement. However, following a subsequent failed rebellion, the Williamite War of 1689-91, more land was expropriated from a group of Catholic landowners and sold mostly to Protestants (Simms, 1976). Following the Jacobites' defeat, Catholic landownership fell from 22% in 1688 to 14% in 1703 (Simms, 1976, 13). While a somewhat protracted process, these transfers involved the expropriation of land from Catholic landowners and their sale by trustee to overwhelmingly Protestant purchasers. The incidence of expropriation was substantially lower than under the Cromwellian settlement; this was due both to the narrower set of Catholic landowners directly involved in the Williamite conflict along with the provision of limited legal rights for them to retain some claims over land established by the Treaty of Limerick of 1691. This raises a measurement challenge for our specifications which examine the heterogeneous effects of the loss of the parish maps across Catholic and Protestant townlands, which otherwise rely on comprehensive data from 1670 (see Section 5.3). To address this issue we digitize archival records of the universe of resulting transfers from Catholics to Protestants which we located in the Appendix of a parliamentary inquiry of the *Irish Records Commission* published in 1825.

A series of laws passed following the Williamite Wars compounded the economic and political marginalization of Catholics, a status which was to endure for more than two centuries (O'Leary, 2019, Chapter 3). Politically, the failures of three successive rebellions (1641, 1691, and 1798), the subsequent expropriation of the Irish gentry, and the implementation of the Penal Laws, meant that Catholics, the overwhelmingly majority, were marginalized from all formal politics for more than a century (Cullen, 1986). This political marginalization exacerbated economic inequality which, especially outside of the northern province of Ulster, had a distinctly sectarian character.

The overwhelming majority of early British "Plantations" were concentrated in Ulster (see Figure A8). As a result, the Protestant portion of the population was always much larger in Ireland's northernmost province, which also led to large portions of the province being excluded from the Down Survey because there were effectively no Catholic gentry to expropriate. By 1778, Catholics comprised an estimated 80% of the population, but held only about 5% of the land, which remained the key asset in Ireland's overwhelmingly rural agrarian economy (O'Leary, 2019, 197).

These profoundly sectarian economic and political disparities did not begin to narrow until the

end of the 19th century. Despite the Acts of Union, which in 1800 legally made Ireland part of the United Kingdom, the Industrial Revolution which was transforming the British economy had only limited impact outside of Belfast and Dublin (Mokyr and O'Grada, 1988, 210). The rural economy and local administration in the countryside, in which Catholics were effectively prohibited from participating, were dominated by large landowners who derived their revenues from rents and had little incentive to invest in the industrializing forces that were gradually transforming the English countryside (Garnham, 1999). Catholics, by 1840 an estimated 85% of the population, lived in precarious circumstances, especially in the countryside (Fernihough and O'Grada, 2022). The extent of this precarity was fully exposed after an environmental catastrophe caused successive potato crops to fail starting in 1846 and continuing until 1851. The Great Famine exposed millions to economic devastation (Mokyr, 1983, 212), and emptied huge swathes of the Irish countryside as thousands died of hunger (Cousens, 1960) or migrated overseas (Ó Grada and O'Rourke, 1997; Ó Gráda, 2019). While the rural economy would gradually recover from the nadir of the famine years, Ireland's agrarian economy was characterized by profound inequalities until the very end of the century.

G Wills and Deeds

Our analysis of deeds uses the work of volunteers who have collectively coded more than 650,000 index records contained in more than 66,000 memorials of deeds, leases, and mortgages included in the Registry of Deeds (Registry of Deeds Index Project Ireland, 2026). While we briefly describe this data source in the paper, in this section we provide more detailed assessment of the data fields recorded in this database and how these fields map to the outcomes we use in our analysis. We conclude by considering issues of censoring and data quality.

For a subset of about 62,000 memorials we are able to consider a wider range of fields. To conduct this analysis we extract information from the "type" column: this distinguishes between 5 categories of legal document: Leases (the most common type overall), transfers, mortgages, settlements, and a residual "other" category. Previous studies of these documents indicate that while all are centered around property there are differences across these legal categories (Nugent, 2012; Walsh, 2022). Data on these legal categories of document help ensure that we are comparing similar types of legal instruments. After grouping documents across these legally distinct categories we consider two different dimensions: time horizon and complexity. Generally speaking we anticipate that stronger property rights should be associated with longer time horizons and greater complexity. For example, because wills only came into effect after a person had died we consider these to have a longer time horizon than most, but not all, deeds. In contrast, a so called "lease for lives," a relatively common subset of lease, was typically made for the lifetime of three named individuals. Less common was a so-called, "perpetuity" or "free farm lease" which granted a lease forever. While there are many potential ways to measure complexity, in our preferred specifications we simply focus on the number of parties named in an individual deed or will, which is reported for almost every entry. The simple intuition is that the more individuals that are party to a deed the more complex its administration, and that more complicated arrangements were only possible in conditions in which parties were more confident in the security of their property rights.

G.1 Data Concerns: Selection

The Registry of Deeds was established in 1708 during the early period of what would come to be known as the "Protestant Ascendancy," when economic and political life in Ireland became dominated by its Protestant minority (O'Leary, 2019, Chapter 3). The protection of Protestant interests during this period was greatly facilitated by the Penal Laws, a series of explicitly anti-Catholic laws that were designed to permanently marginalize Ireland's Catholic majority, and forestall any possibility of rebellions like those in 1641 and 1698 that had so threatened English interests across the island Ohlmeyer (2012). While scholars have long debated the actual enforcement of the Penal Laws (Cullen, 1986; McGrath, 1996), the language of the act Establishing the Registry of Deeds leaves little question that it was intended to further the economic marginalization of the Catholic majority: "[the Registry] secur[es] purchasers, preventing forgeries and fraudulent gifts and conveyances of land, tenements and hereditaments, which have been frequently practiced in this kingdom, especially by Papists, to the great prejudice of the Protestant interest" (O'Rourke and Polak, 1994, 58).

H The Down Survey and Tax Administration

While primarily connected to the protection of property rights in the extant historical literature, the Down Survey parish maps had relevance for the administration of various different forms of land-based taxation.

The Down Survey was most directly relevant for the administration of quit rents. As described in Section 5.4.1, these were half-yearly payments owed by landowners to agents of the central Quit Rent Office. The amounts of the quit rents were set based on province-level land values determined in the Cromwellian Settlement in the 1650s and assigned to specific plots using the Down Survey and the Books of Survey and Distribution. The Down Survey parish maps then played an important role in enabling revenue collectors to adjudicate where exactly different land denominations fell. An excerpted interview with the Deputy Surveyor General in an 1806 parliamentary commission makes clear some of the dynamics:

> "*The Commissioners of Excise frequently apply to this Office for the purpose of ascertaining the situation of Lands, when the Quit and other Rents cannot be collected on account of the situation of the Lands being unknown to the Collectors. In such cases the Deputy Surveyor General gives Copies of the Maps from the Down Survey, which ascertains the Counties, Baronies, Parishes, Townlands, Quantity of Land, Situations and Boundaries, and the names of the adjoining Lands. And in cases where the Maps of the Down Survey have been burned by the fire in 1711, or otherwise destroyed or lost, in consequence of said fire, he gives Copies from the Barony Maps made by General Vallancey*" (Commissioners of Fees, 1806, 72).

As a result, the parish maps played an important role but—unlike for property disputes—either copies, or the baronial maps, were often considered sufficient to locate debtors. As highlighted in the manuscript, for some cases the Quit Rent Office had to write off unpaid arrears because no surviving source could pin down exactly which lands the arrears, ultimately defined in the 1650s, applied to.

Few other forms of centrally-imposed land taxation either existed for much of this period or had clear links to the Down Survey. Hearth and window taxes, for example, specifically taxed occupiers rather than landowners and were based on the number and characteristics of individual houses (Dickson, Grada, and Daultrey, 1982).

Local taxes were both far more substantial for much of this period and generally less directly linked to the Down Survey (Walsh, 2019). County cess taxes, as we note in the manuscript, were assigned flatly by townland (as defined in the Down Survey), which led to huge inequalities in their effective incidence over time (Andrews, 1985). However, their collection by country-level grand juries had little to do with access to the parish maps—indeed, Ó Cionnaith (2022) notes that grand juries often commissioned newer maps to replace the outdated Down Survey. Other local taxes were generally based on alternative informational sources, such as the poor rate (which followed the Ordnance Survey and the first townland valuation), or tithes (for which applotment was carried out between 1823 and 1837). Across these various local taxes there is scant evidence that the Down Survey played a meaningful role in administration, beyond defining the townlands themselves. As a result, the partial destruction of the parish maps would be unlikely to have much direct impact on the capacity to collect these taxes.

I Figures

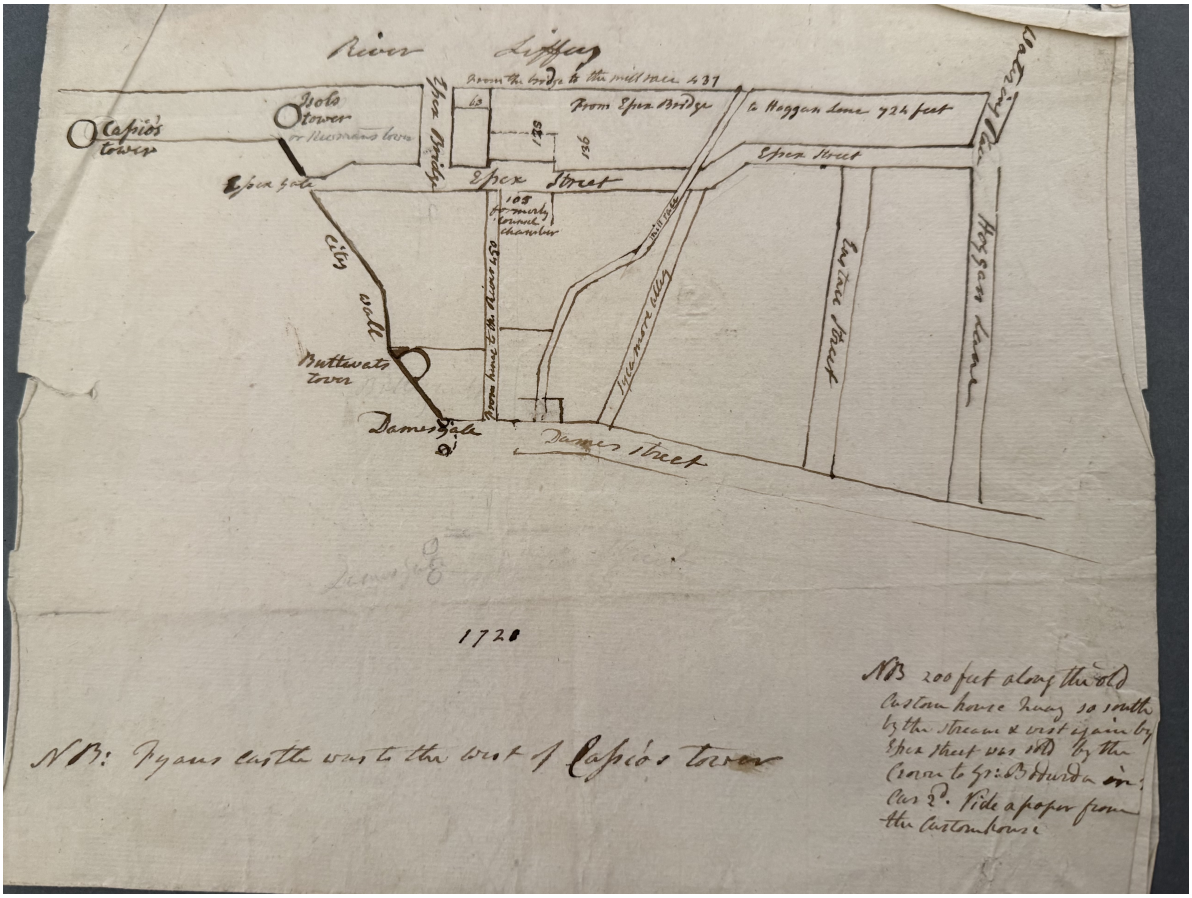


Figure A4: Map of Essex Street, 1720, O'Hara of Annaghmore Papers, National Library of Ireland.



Figure A5: Map of Essex Street, 1721, Wide Streets Commission, Dublin City Council, *Digital Repository of Ireland*, repository.dri.ie.

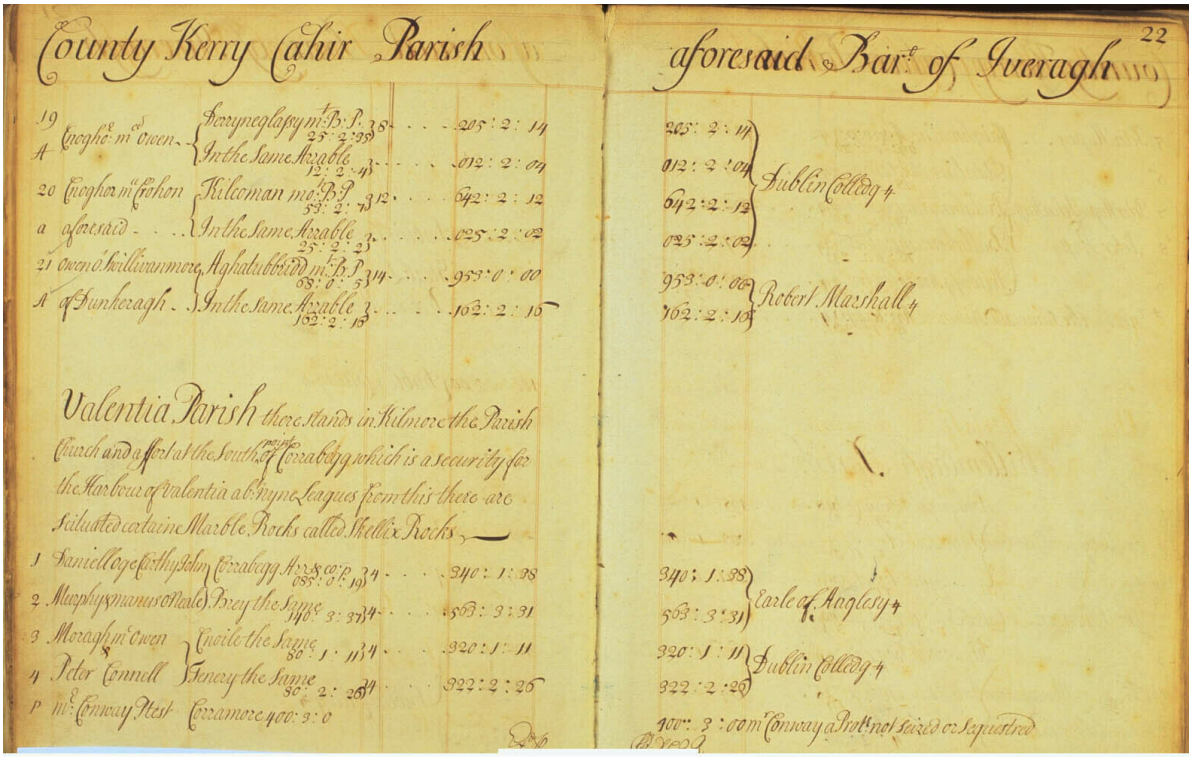


Figure A6: An Example of a page from the *Books of Survey and Distribution*. These *terriers* complemented the information recorded in the Down Survey Parish maps.

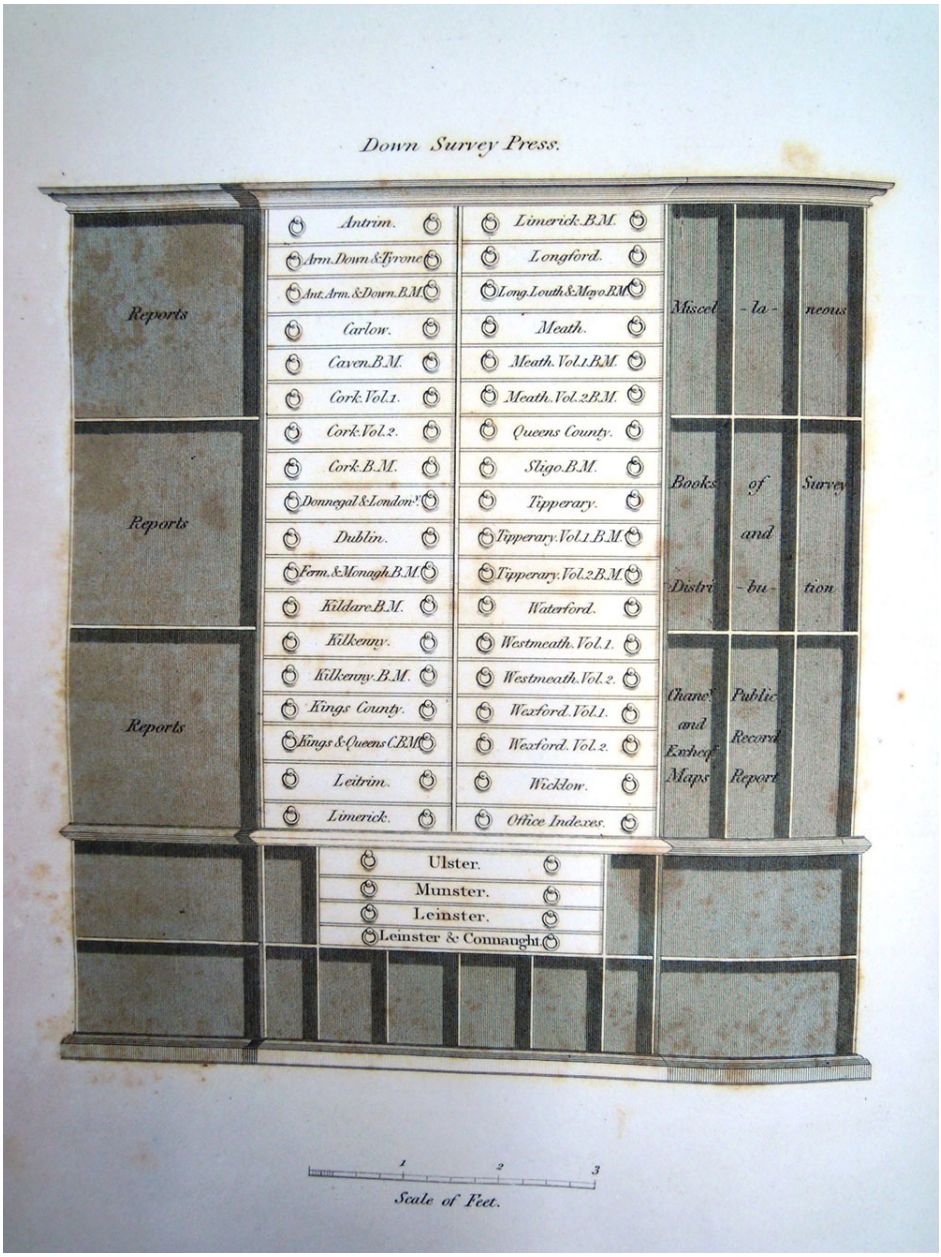


Figure A7: Storage of the Surviving Maps of the Down Survey in Record Tower, Dublin Castle, post-fire (Irish Record Commission, 1820, 247). The close correspondence between drawers labeled "B.M" and fire damage reported in Figure 3a suggest that these drawers held the Baronial Map series. These maps were made from a private copy of the Baronial maps commissioned by Sir William Petty that he intended to send to London for motives that were never entirely clear. On the way the ship carrying Petty's private copies of the Baronial maps were captured by French corsairs. As discussed in section C above they were subsequently located in the Royal Library in Paris and after substantial diplomatic negotiations copied by General Charles Vallancey in 1787 in Paris (Ó Cionnaith, 2024). Because these copies were only commissioned *after* the fire they would not have existed in the original storage of the parish maps in Essex Street.

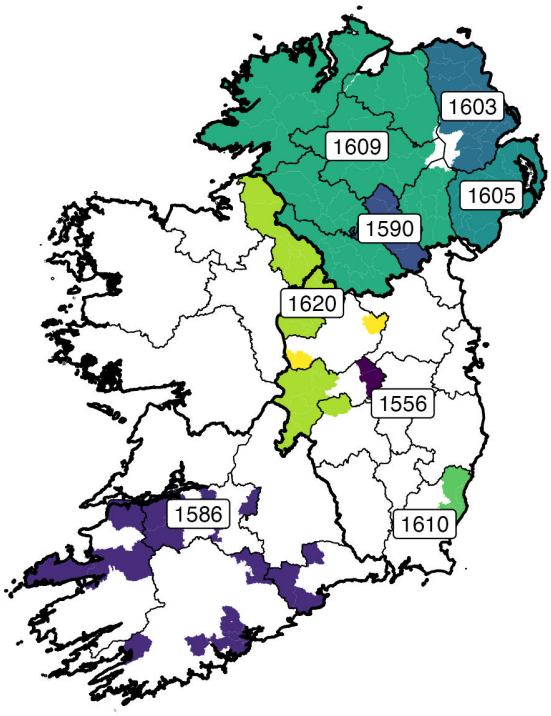


Figure A8: Early Plantations of Ireland

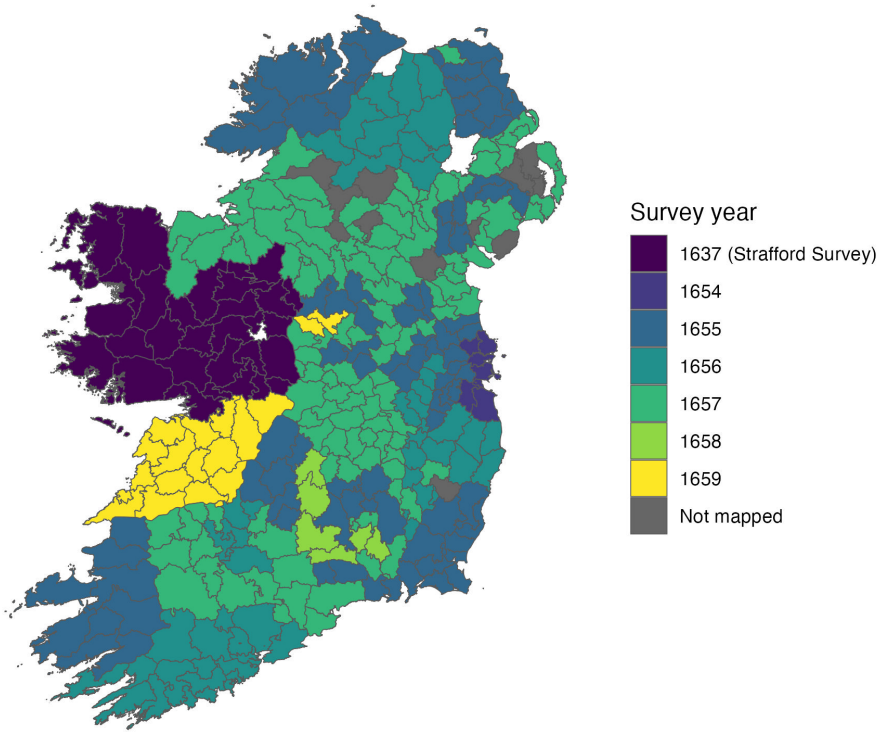


Figure A9: Baronial coverage of Down Survey maps by year (Hardinge, 1873)

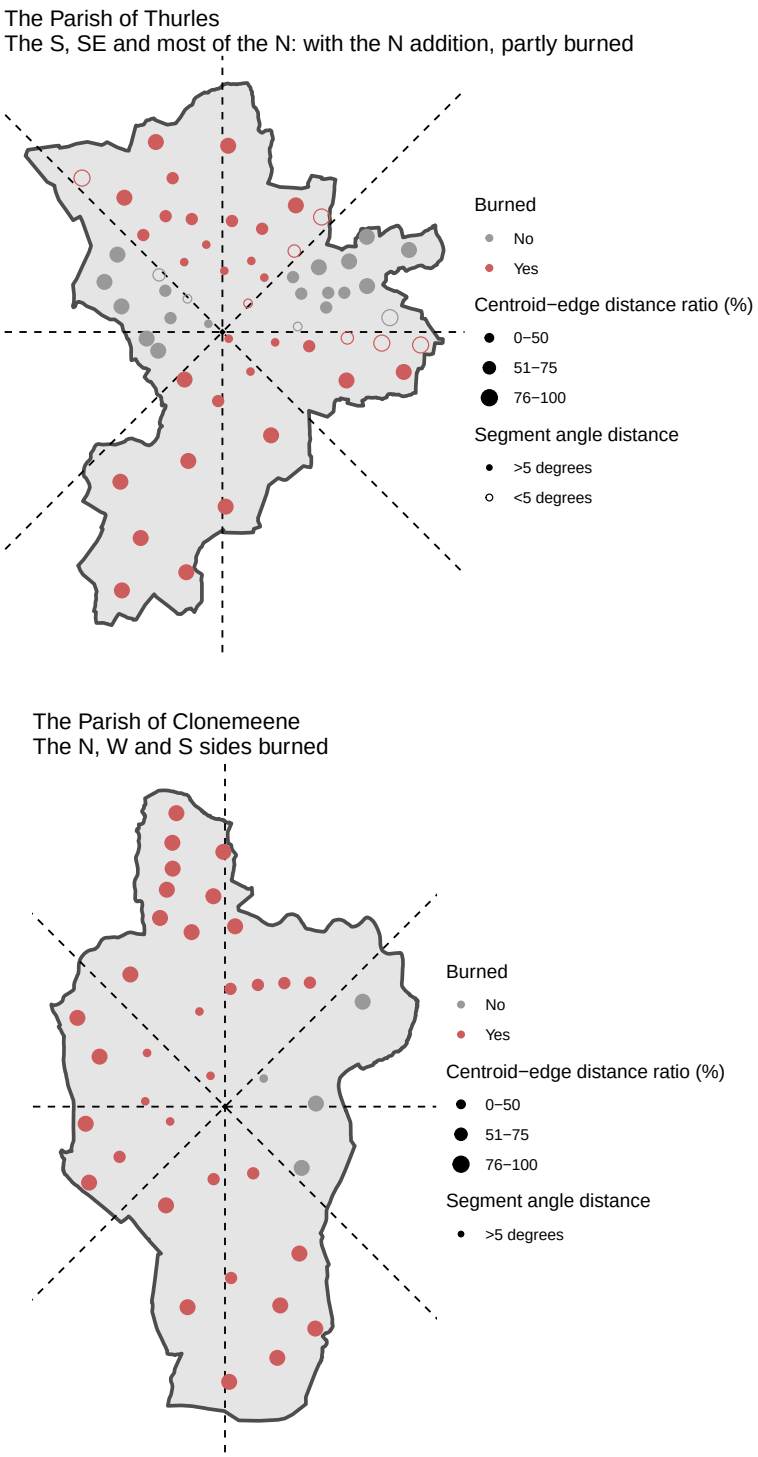


Figure A10: Visualization of treatment assignment of townlands in two parishes

Notes: Parish centroid marked in black with octants used to assign cardinal point of each townland. Red townlands indicate assignment to treatment. Description of fire damage to parish map from 2 printed at top of figures. Hollow points indicate exclusion of that townland from baseline estimating sample due to proximity to segment boundaries.

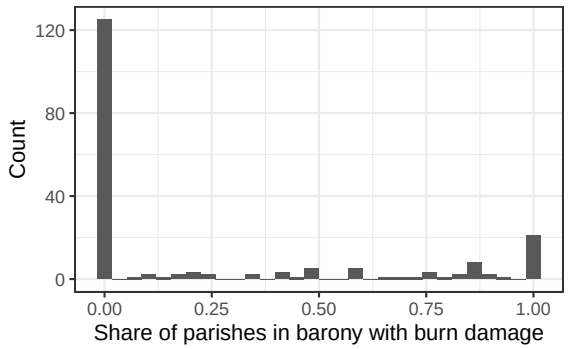


Figure A11: Barony-level variation in share of parish maps burned



Figure A12: Digitized Ordnance Survey Map: Coolroe, County Cork

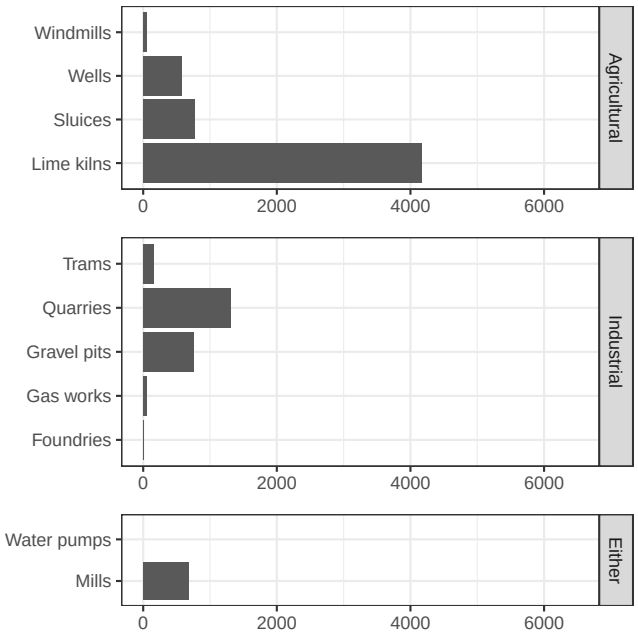


Figure A13: Ordnance Survey infrastructure

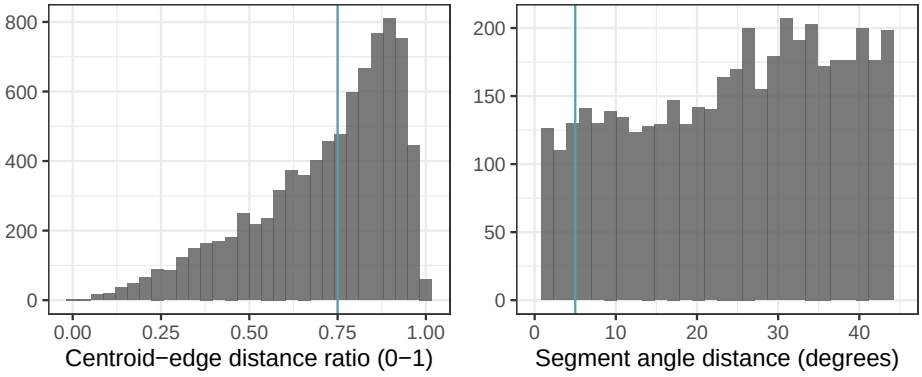


Figure A14: Distribution of sample inclusion thresholds (with baseline values)

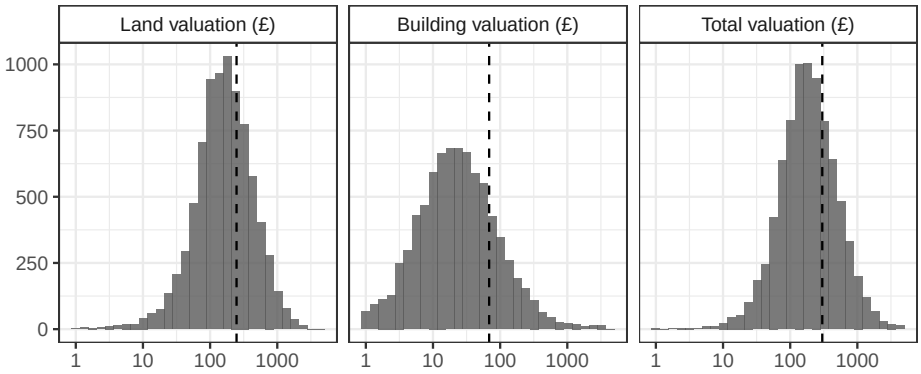
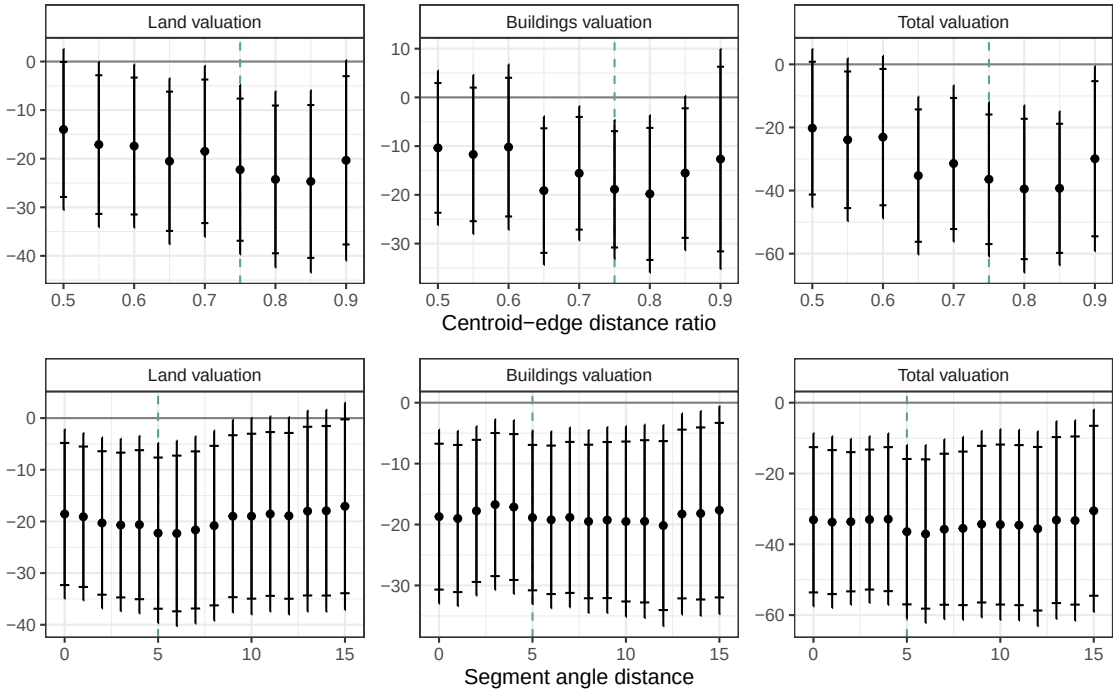


Figure A15: Distribution of main outcome measures

Figure A16: Effects on valuation across treatment assignment confidence criteria



Notes: Figure provides estimates based on Panel A of Table 1 while varying sample inclusion criteria: centroid-edge distance ratio (top panel); segment angle distance (bottom panel). All specifications include parish map fixed effects with standard errors clustered by parish map. Blue line indicates baseline specification used for the main analysis in the manuscript.

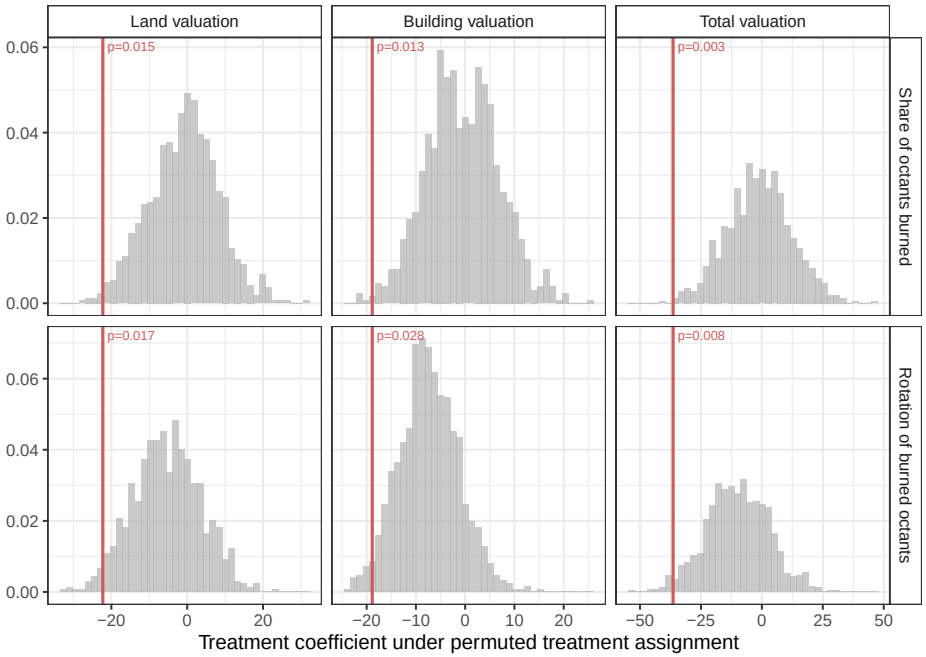


Figure A17: Randomization inference of treatment effects

Notes: Figure provides null distributions of treatment effects obtained through randomization inference. In top panel, we hold fixed the share of segments assigned to treatment but permute *which* are assigned to treatment; in bottom panel, we hold fixed the relative spatial distribution of treated segments but permute the *rotation* of these segments. Within each of 1,000 permutations, we estimate Equation (1) with relevant sample inclusion criteria. Observed treatment effects provided by red lines.

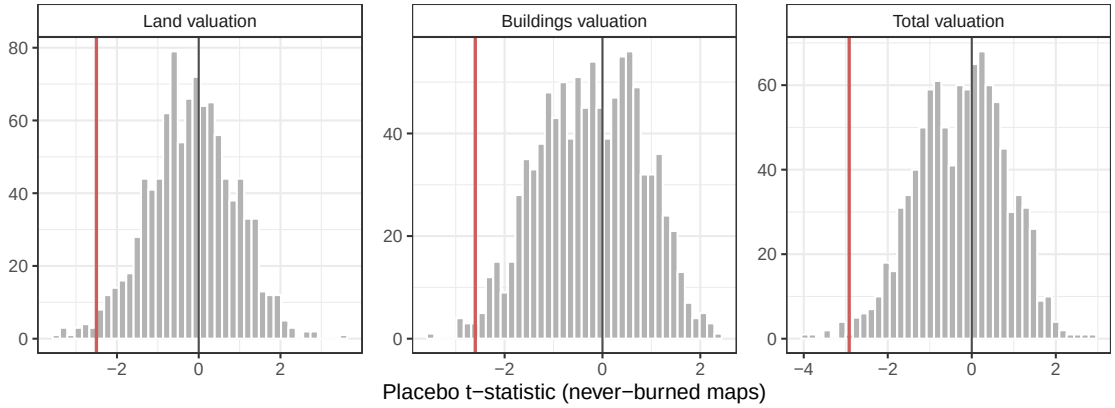
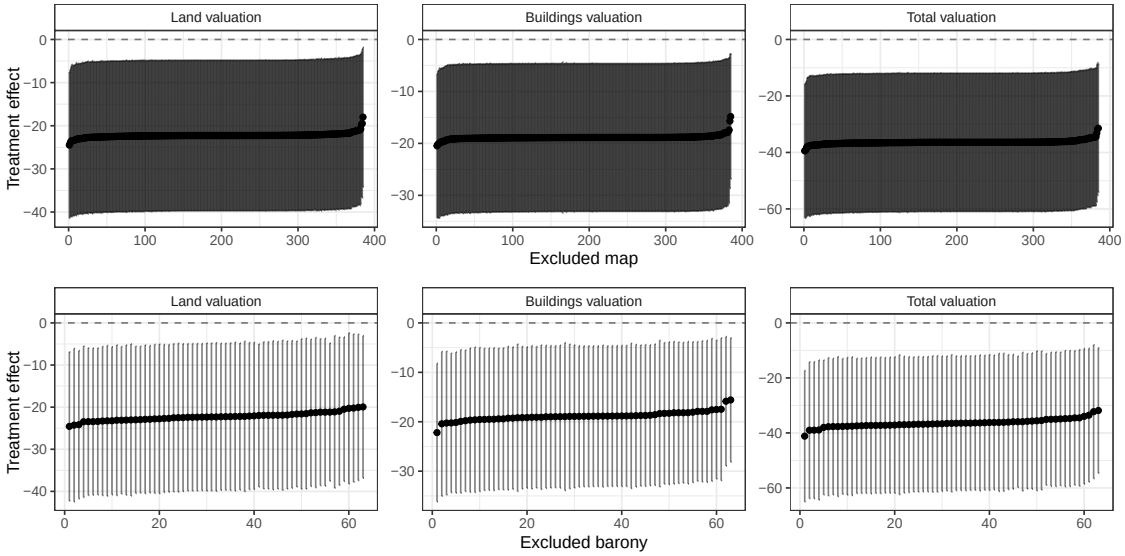


Figure A18: Randomization inference of placebo treatment effects

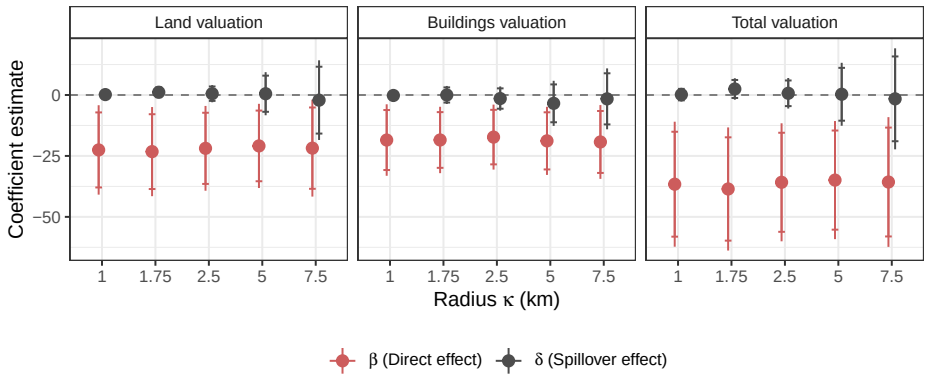
Notes: Figure provides null distributions of t-statistics obtained through permuting observed distribution of treated octants across parishes *without* any fire damage in the baronial sample. Within each of 1,000 permutations, we estimate Equation (1) with relevant sample inclusion criteria. Observed t-statistics shown with red line.

Figure A19: Effects on valuation excluding maps or baronies

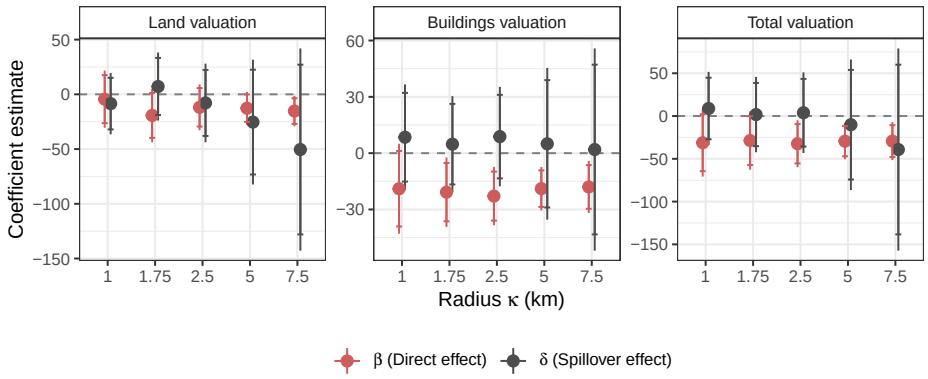


Notes: Figure provides estimates based on Panel A of Table 1 while varying the sample exclusion of parish maps (top panel) or baronies (bottom panel). Coefficients ordered by magnitude. All specifications include parish map fixed effects with standard errors clustered by parish map.

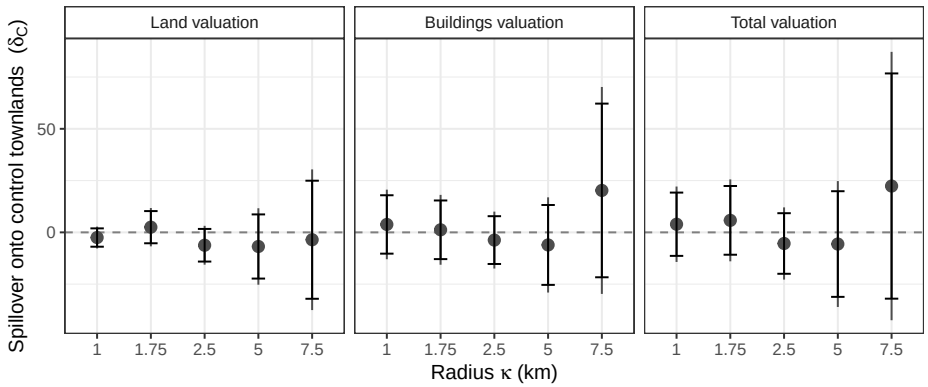
Figure A20: Estimates of direct and spillover effects on valuation outcomes



(a) Excluding townlands in same segment



(b) Using share of nearby treated townlands



(c) Estimation of spillover effect in control townlands

Notes: Estimates of β and δ from Equation (2) across different distance thresholds (κ) for outcomes described in Table 1. Direct effect measures townland's own treatment status. Spillover effect measures the number of treated other townlands within a given κ. Specification controls for total density of *all* other townlands within a given κ. 90% and 95% confidence intervals plotted. Figure A20a excludes townlands in the same segment as the townland (e.g. see the illustration in Figure 4); Figure A20b replaces *number* of nearby treated townlands with *share* of nearby townlands which are treated; Figure A20c estimates spillover effect restricting sample to control townlands.

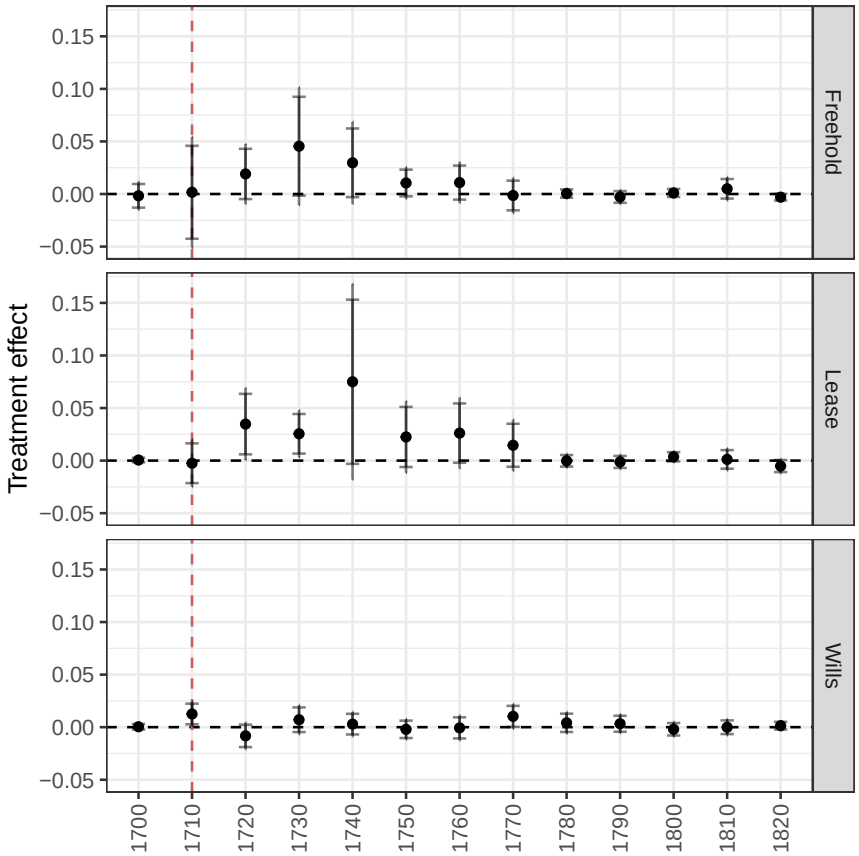


Figure A21: Event study estimation of deed registration (disaggregated)

Notes: Figure presents estimates of Equation (3), disaggregated by deed types, where we interact the treatment indicator with decade indicators. 90% and 95% confidence intervals plotted.

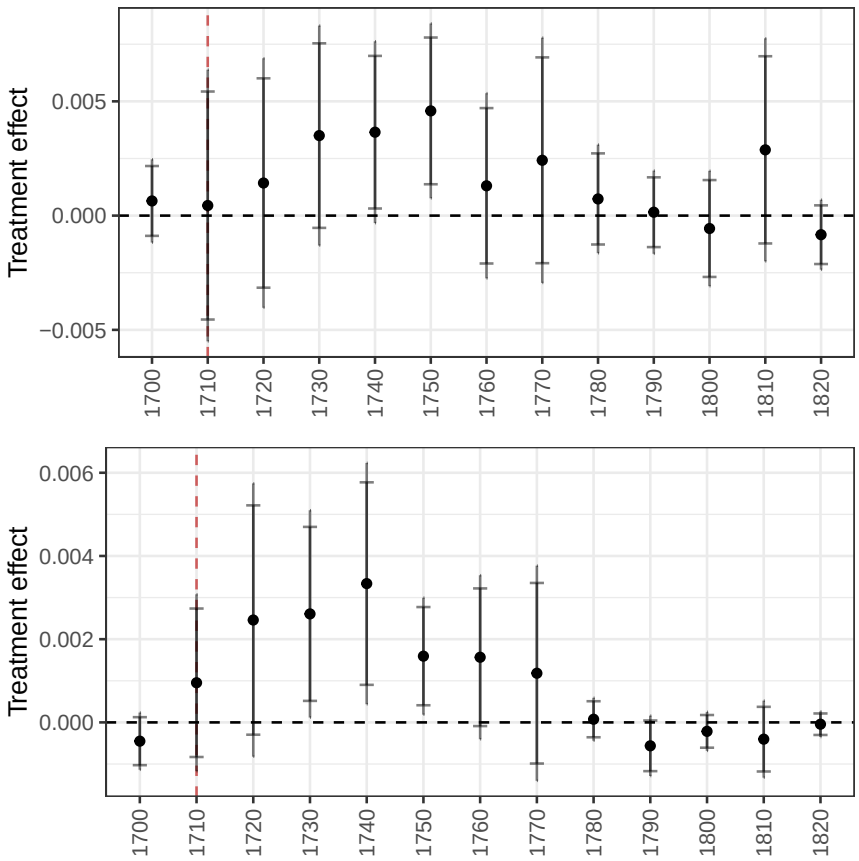


Figure A22: Event study estimation of deed registration (margins)

Notes: Figure presents estimates of Equation (3) where treatment is interacted with decade indicators. For outcome variables, top panel uses binary indicator for any deeds of a given type in a given decade; bottom panel uses an indicator for more than one such deed. 90% and 95% confidence intervals plotted.

J Tables

Table A2: Parish-level correlates of burn damage

			County folio fixed effects		Barony fixed effects	
	μ	σ	β^c_{any} [p]	β^c_{share} [p]	β^b_{any} [p]	β^b_{share} [p]
	(1)	(2)	(3)	(4)	(5)	(6)
A. Organization of maps						
Original order in map folio	19.70	13.95	-3.41 [0.02]	-3.35 [0.21]	0.24 [0.37]	-0.16 [0.79]
Office mark	15.25	10.86	0.53 [0.63]	-1.36 [0.38]	0.71 [0.47]	-1.48 [0.35]
B. Geography						
Longitude	-7.53	0.91	-0.04 [0.07]	-0.08 [0.07]	-0.01 [0.31]	0.05 [0.48]
Latitude	53.22	0.77	0.00 [0.77]	0.00 [0.97]	0.00 [0.75]	-0.05 [0.23]
Total area (acres)	6880.65	7631.87	2893.86 [0.01]	4188.83 [0.01]	2735.56 [0.01]	3569.87 [0.02]
Average elevation (m)	84.03	39.06	-1.48 [0.66]	0.06 [0.99]	-3.18 [0.27]	-0.17 [0.98]
Average distance to coast (km)	33.26	19.95	-0.02 [0.98]	1.14 [0.44]	0.30 [0.63]	3.71 [0.08]
Average distance to Dublin (km)	169.16	92.69	2.49 [0.26]	6.72 [0.12]	1.81 [0.15]	-5.77 [0.51]
C. Historical characteristics						
Share owner Catholic (1641)	0.48	0.33	0.02 [0.67]	0.06 [0.36]	0.03 [0.39]	0.04 [0.54]
Share owner Catholic (1670)	0.15	0.25	-0.04 [0.13]	-0.02 [0.60]	-0.02 [0.53]	0.00 [0.90]
Share landowner in other counties (1670)	0.43	0.31	-0.03 [0.39]	-0.07 [0.16]	-0.03 [0.43]	-0.07 [0.16]
Average forfeited land share (1655)	0.67	0.32	0.04 [0.32]	0.05 [0.35]	0.03 [0.45]	0.01 [0.84]
Any 17th century mills	0.21	0.41	0.06 [0.16]	0.04 [0.54]	0.03 [0.37]	0.08 [0.18]
Total households (1659)	110.34	150.21	23.99 [0.20]	38.67 [0.08]	22.72 [0.27]	24.80 [0.30]
Average Irish share of households (1659)	0.90	0.13	0.02 [0.18]	0.03 [0.25]	0.02 [0.20]	0.03 [0.12]
D. Natural resources						
Average caloric suitability: Post-1500	9.37	0.12	-0.01 [0.25]	-0.02 [0.05]	-0.01 [0.13]	-0.01 [0.47]
Average caloric suitability: Potato	8.84	0.12	-0.01 [0.03]	-0.03 [0.03]	-0.01 [0.19]	-0.01 [0.53]
Average caloric suitability: Wheat	10.16	0.13	-0.01 [0.13]	-0.02 [0.05]	-0.01 [0.07]	-0.01 [0.38]
Average caloric suitability: Oats	9.30	0.10	-0.01 [0.06]	-0.02 [0.11]	-0.01 [0.06]	-0.01 [0.27]
Average caloric suitability: Barley	10.18	0.15	-0.01 [0.06]	-0.03 [0.05]	-0.01 [0.04]	-0.02 [0.30]
Share townland stem: Derry	0.01	0.02	0.00 [0.96]	-0.01 [0.06]	0.00 [0.48]	-0.01 [0.09]
Share townland stem: Ard	0.03	0.09	0.00 [0.51]	0.01 [0.72]	0.01 [0.27]	0.01 [0.62]
Share townland stem: Carrick	0.01	0.05	0.00 [0.36]	-0.01 [0.28]	0.00 [0.49]	-0.01 [0.40]
Share townland stem: Down	0.03	0.11	-0.02 [0.14]	-0.04 [0.21]	-0.02 [0.22]	-0.03 [0.24]
Share townland stem: Knock	0.03	0.09	-0.01 [0.44]	-0.05 [0.07]	-0.01 [0.45]	-0.05 [0.06]
Share townland stem: Kil	0.09	0.15	0.03 [0.03]	0.06 [0.08]	0.03 [0.03]	0.05 [0.10]

Notes: Variables are aggregated to the parish level as parish means, except total area and total households, which are parish sums. μ (σ) provides mean (standard deviation) of each variable across parishes. Each $\beta.[p]$ column reports the coefficient and p-value from a separate OLS regression of the row variable onto a parish-level measure of fire damage and county folio/barony fixed effects, with standard errors clustered by barony. β^c_{any} uses an indicator for any burn damage to the parish's map with county folio fixed effects, β^c_{share} uses the share of cardinal points reported as burned with county folio fixed effects, β^b_{any} uses an indicator for any burn damage to the parish's map with barony fixed effects, and β^b_{share} uses the share of cardinal points reported as burned with barony fixed effects.

Table A3: Balance on pre-fire townland characteristics

	μ	σ	β [p]
	(1)	(2)	(3)
A. Geography			
Longitude	-7.65	0.79	0.00 [0.90]
Latitude	53.52	0.73	-0.01 [0.05]
Townland total area (acres)	380.51	426.36	22.26 [0.36]
Elevation (m)	89.04	51.49	-0.60 [0.89]
Distance to coast (km)	42.63	23.50	0.20 [0.55]
Distance to Dublin (km)	175.11	78.94	0.02 [0.98]
B. Historical characteristics			
Owner Catholic (1641)	0.43	0.49	-0.01 [0.59]
Owner Catholic (1670)	0.12	0.33	0.00 [0.87]
Landowner in other counties (1670)	0.38	0.48	0.02 [0.40]
Forfeited land share (1655)	0.59	0.46	-0.05 [0.09]
Any 17th century mills	0.01	0.12	0.00 [0.87]
Total households (1659)	5.68	19.24	-0.35 [0.59]
Irish share of households (1659)	0.89	0.20	0.02 [0.13]
C. Natural resources			
Caloric suitability: Post-1500	9.39	0.13	-0.01 [0.16]
Caloric suitability: Potato	8.84	0.22	-0.03 [0.12]
Caloric suitability: Wheat	10.19	0.13	-0.01 [0.14]
Caloric suitability: Oats	9.33	0.09	-0.01 [0.16]
Caloric suitability: Barley	10.22	0.14	-0.01 [0.11]
Townland stem: Derry	0.01	0.09	0.00 [0.44]
Townland stem: Ard	0.02	0.14	0.00 [0.91]
Townland stem: Carrick	0.01	0.09	0.00 [0.84]
Townland stem: Down	0.02	0.14	0.00 [0.79]
Townland stem: Knock	0.03	0.16	-0.01 [0.15]
Townland stem: Kil	0.07	0.26	0.01 [0.54]
D. Research design			
Centroid-edge distance ratio	0.87	0.06	0.00 [0.15]
Linked to Griffith's Valuation extraction	0.98	0.13	0.00 [0.70]

Notes: μ (σ) provides mean (standard deviation) of pre-treatment variable in townlands not assigned to Burned; $\beta[p]$ provides coefficient and p-values from an OLS regression of each variable onto Burned and parish map fixed effects, with standard errors clustered by parish map.

Table A4: Correlation between spatial coordinates and main outcomes

	Land valuation	**Buildings valuation**	**Total valuation**
	(1)	(2)	(3)
Latitude	180.26	42.22	174.85
	(147.95)	(97.21)	(190.59)
Longitude	303.44**	-36.87	222.87
	(128.46)	(83.92)	(162.50)
Outcome mean	221.27	55.05	262.22
Outcome std. dev.	226.76	167.64	314.07
Observations	4,159	4,159	4,159
Clusters	349	349	349

Notes: Outcomes are townland-level land valuation; buildings valuation; and total valuation. Outcomes are IHS-transformed with estimation using OLS. All specifications include parish map fixed effects and cluster standard errors by parish map. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Effects on townland valuation (Varying specification)

	Land valuation		Buildings valuation		Total valuation	
A. IHS-transformed outcome	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-0.06	-0.07***	-0.17***	-0.18***	-0.10**	-0.11***
	(0.04)	(0.02)	(0.06)	(0.05)	(0.04)	(0.03)
Control townland mean	5.63	5.63	3.65	3.65	5.76	5.76
Control townland std. dev.	0.99	0.99	1.42	1.42	1.05	1.05
Observations	4,159	4,159	4,159	4,159	4,159	4,159
Clusters	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓
B. Parish fixed effects						
Burned	-20.42**	-22.62***	-10.35*	-18.92***	-28.27**	-35.29***
	(8.67)	(6.17)	(5.42)	(6.94)	(11.82)	(9.54)
Control townland mean	207.47	207.47	58.80	58.80	250.96	250.96
Control townland std. dev.	213.69	213.69	195.22	195.22	311.44	311.44
Observations	4,112	4,112	4,112	4,112	4,112	4,112
Clusters	342	342	342	342	342	342
LASSO-selected covariates		✓		✓		✓
C. Adding 1670 landowner fixed effects						
Burned	-38.54***	-33.21***	-42.20**	-33.87***	-62.83***	-57.54***
	(12.39)	(8.35)	(16.92)	(10.95)	(19.69)	(13.67)
Control townland mean	211.61	211.61	62.21	62.21	258.25	258.25
Control townland std. dev.	227.21	227.21	199.58	199.58	321.46	321.46
Observations	2,398	2,398	2,398	2,398	2,398	2,398
Clusters	294	294	294	294	294	294
LASSO-selected covariates		✓		✓		✓
D. No X control vector						
Burned	-13.16	-23.92***	-16.84**	-19.35***	-25.60*	-38.40***
	(10.23)	(6.29)	(7.09)	(7.00)	(13.46)	(9.79)
Control townland mean	213.12	213.12	59.75	59.75	258.01	258.01
Control townland std. dev.	226.61	226.61	197.03	197.03	328.96	328.96
Observations	4,159	4,159	4,159	4,159	4,159	4,159
Clusters	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓

Notes: Specification modifications of Panel A of Table 1. Panel A uses level of outcome and estimates with OLS using parish map fixed effects, also clustering by parish map. Panel B uses parish, rather than parish map, fixed effects and clusters by parish. Even-indexed columns add LASSO double-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: Effects on townland valuation (Weighted estimation)

	Land valuation		Buildings valuation		Total valuation	
A. Weighting by centroid-edge distance	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-14.47*	-16.56**	-10.31	-11.08	-20.56*	-23.30**
	(8.01)	(6.61)	(7.05)	(6.85)	(11.72)	(10.12)
Control townland mean	242.56	242.56	67.89	67.89	292.78	292.78
Control townland std. dev.	267.01	267.01	205.26	205.26	363.01	363.01
Observations	7,820	7,820	7,820	7,820	7,820	7,820
Clusters	380	380	380	380	380	380
LASSO-selected covariates		✓		✓		✓
B. Weighting by segment angle distance						
Burned	-20.08*	-24.05**	-22.31**	-23.85**	-34.90**	-40.26***
	(10.96)	(9.55)	(11.11)	(11.17)	(16.90)	(15.51)
Control townland mean	212.27	212.27	60.62	60.62	258.31	258.31
Control townland std. dev.	225.20	225.20	203.62	203.62	333.44	333.44
Observations	4,375	4,375	4,375	4,375	4,375	4,375
Clusters	351	351	351	351	351	351
LASSO-selected covariates		✓		✓		✓

Notes: Specification modifications of Panel A of Table 1. Panel A weights using centroid-edge distance ratio; Panel B weights using segment angle distance. Even-indexed columns add LASSO double-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Effects on townland valuation (Varying sample)

	Land valuation		Buildings valuation		Total valuation	
A. Excluding small parishes	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-16.89**	-19.12***	-18.75**	-19.53***	-29.78**	-32.67***
	(8.50)	(6.31)	(7.93)	(7.54)	(11.97)	(9.60)
Control townland mean	187.30	187.30	58.02	58.02	231.84	231.84
Control townland std. dev.	188.69	188.69	204.65	204.65	299.21	299.21
Observations	3,509	3,509	3,509	3,509	3,509	3,509
Clusters	245	245	245	245	245	245
LASSO-selected covariates		✓		✓		✓
B. Excluding partial cardinal points parishes						
Burned	-18.59**	-21.16***	-17.33**	-18.25**	-31.46***	-34.75***
	(8.49)	(6.24)	(7.74)	(7.37)	(11.79)	(9.48)
Control townland mean	192.45	192.45	57.08	57.08	236.00	236.00
Control townland std. dev.	195.04	195.04	203.10	203.10	302.56	302.56
Observations	3,628	3,628	3,628	3,628	3,628	3,628
Clusters	287	287	287	287	287	287
LASSO-selected covariates		✓		✓		✓
C. Excluding townlands with lower data extraction quality						
Burned	-15.12	-16.34**	-7.28**	-7.53**	-23.23**	-24.67***
	(9.37)	(6.89)	(3.58)	(3.71)	(10.78)	(8.28)
Control townland mean	196.91	196.91	43.06	43.06	234.78	234.78
Control townland std. dev.	204.70	204.70	113.43	113.43	254.93	254.93
Observations	2,749	2,749	2,749	2,749	2,749	2,749
Clusters	308	308	308	308	308	308
LASSO-selected covariates		✓		✓		✓

Notes: Sample modifications of Panel A of Table 1. Panel A excludes parishes with fewer than 10 townlands; Panel B excludes parishes which lack townlands assigned to every cardinal direction; Panel C excludes townlands where the sum of plot-level total valuations varies from the townland aggregate by 10% or more. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A8: Balance on pre-fire townland characteristics: direct and spillover effects

	μ	σ	β [p]	δ [p]
	(1)	(2)	(3)	(4)
A. Geography				
Longitude	-7.65	0.79	0.00 [0.52]	0.00 [0.39]
Latitude	53.52	0.73	-0.01 [0.05]	0.00 [0.56]
Townland total area (acres)	380.51	426.36	2.08 [0.95]	0.39 [0.97]
Elevation (m)	89.04	51.49	1.81 [0.67]	-2.56 [0.12]
Distance to coast (km)	42.63	23.50	-0.32 [0.32]	0.34 [0.11]
Distance to Dublin (km)	175.11	78.94	0.21 [0.74]	-0.14 [0.71]
B. Historical characteristics				
Owner Catholic (1641)	0.43	0.49	-0.01 [0.83]	-0.01 [0.64]
Owner Catholic (1670)	0.12	0.33	0.02 [0.46]	-0.01 [0.35]
Landowner in other counties (1670)	0.38	0.48	0.01 [0.54]	0.00 [0.84]
Forfeited land share (1655)	0.59	0.46	-0.03 [0.21]	-0.01 [0.61]
Any 17th century mills	0.01	0.12	0.00 [0.81]	0.00 [0.87]
Total households (1659)	5.68	19.24	-0.26 [0.77]	-0.09 [0.79]
Irish share of households (1659)	0.89	0.20	0.01 [0.44]	0.01 [0.50]
C. Natural resources				
Caloric suitability: Post-1500	9.39	0.13	-0.01 [0.14]	0.00 [0.77]
Caloric suitability: Potato	8.84	0.22	-0.01 [0.21]	-0.01 [0.38]
Caloric suitability: Wheat	10.19	0.13	-0.01 [0.14]	0.00 [0.91]
Caloric suitability: Oats	9.33	0.09	0.00 [0.73]	0.00 [0.21]
Caloric suitability: Barley	10.22	0.14	-0.01 [0.16]	0.00 [0.88]
Townland stem: Derry	0.01	0.09	0.00 [0.46]	0.00 [0.07]
Townland stem: Ard	0.02	0.14	0.01 [0.38]	0.00 [0.16]
Townland stem: Carrick	0.01	0.09	0.00 [0.26]	0.00 [0.18]
Townland stem: Down	0.02	0.14	0.01 [0.54]	-0.01 [0.42]
Townland stem: Knock	0.03	0.16	-0.01 [0.34]	0.00 [0.43]
Townland stem: Kil	0.07	0.26	0.01 [0.37]	0.00 [0.56]
D. Research design				
Centroid-edge distance ratio	0.87	0.06	0.00 [0.66]	0.00 [0.14]
Linked to Griffith's Valuation extraction	0.98	0.13	0.00 [0.74]	0.00 [0.87]

Each row regresses a pre-fire townland characteristic on an indicator for own-townland burn (*burn*) and the normalised count of burned townlands within 2500m on the same parish map (*nbr*), controlling for the total number of neighbouring townlands within that radius (local density), with parish-map fixed effects and standard errors clustered by map. μ and σ are the mean and standard deviation among control (unburned) townlands. Cells report the coefficient and, in brackets, the p-value. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A9: Effects on distribution of plot valuations (Poisson)

	10^{th}		25^{th}		50^{th}		75^{th}		90^{th}	
A. Land valuation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Burned	-0.10	-0.10	-0.13	-0.13	-0.12	-0.12	-0.12*	-0.12*	-0.06	-0.07
	(0.18)	(0.18)	(0.15)	(0.15)	(0.10)	(0.10)	(0.07)	(0.07)	(0.05)	(0.05)
Control townland mean	4.90	4.90	6.51	6.51	10.85	10.85	19.88	19.88	33.16	33.16
Control townland std. dev.	22.49	22.49	23.19	23.19	26.13	26.13	33.04	33.04	44.66	44.66
B. Buildings valuation										
Burned	-0.49**	-0.49**	-0.36**	-0.36**	-0.22	-0.22	-0.17	-0.17	-0.13	-0.13
	(0.23)	(0.23)	(0.18)	(0.18)	(0.14)	(0.14)	(0.12)	(0.12)	(0.10)	(0.10)
Control townland mean	0.76	0.76	1.05	1.05	1.64	1.64	2.89	2.89	5.32	5.32
Control townland std. dev.	4.75	4.75	5.04	5.04	5.96	5.96	8.32	8.32	12.29	12.29
C. Total valuation										
Burned	-0.19	-0.19	-0.17	-0.17	-0.13	-0.13	-0.14**	-0.15**	-0.09*	-0.10**
	(0.15)	(0.15)	(0.13)	(0.13)	(0.09)	(0.09)	(0.07)	(0.07)	(0.05)	(0.05)
Control townland mean	6.70	6.70	8.78	8.78	13.93	13.93	24.46	24.46	39.71	39.71
Control townland std. dev.	25.93	25.93	27.05	27.05	31.19	31.19	39.97	39.97	54.43	54.43
Observations	4,112	4,112	4,112	4,112	4,112	4,112	4,112	4,112	4,112	4,112
Clusters	347	347	347	347	347	347	347	347	347	347
LASSO-selected covariates		✓		✓		✓		✓		✓

Notes: Outcomes defined at the plot level as the valuation corresponding to a given quantile of the valuation distribution within a townland, from 10^{th} percentile (columns 1-2) to 90^{th} percentile (columns 9-10). Panel A uses land annual valuation, panel B uses buildings annual valuation, panel C uses total annual valuation. Treatment effects estimated using Poisson regression. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A10: Treatment effects on deed registration

	Stacked		Pooled		Deed type: Leasehold transfers		Freehold transfers		Wills		Assignments		Mortgages		Settlements		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
A. Post-fire cross-sectional																		
Burned	0.009**	0.009**	0.030*	0.022	0.016*	0.011	0.009	0.007	0.003	0.003	0.001	0.001	0.003*	0.002	0.002	0.001	0.000	0.001
	(0.004)	(0.004)	(0.016)	(0.016)	(0.009)	(0.008)	(0.006)	(0.005)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
Control mean	0.020	0.020	0.086	0.068	0.017	0.012	0.032	0.025	0.012	0.010	0.003	0.002	0.004	0.003	0.007	0.005	0.015	0.011
Control std. dev.	0.219	0.220	0.575	0.483	0.241	0.196	0.274	0.235	0.129	0.121	0.056	0.049	0.066	0.058	0.092	0.082	0.145	0.123
B. Difference-in-differences																		
Burned × Post	0.011**	0.011**	0.036*	0.036*	0.018**	0.018**	0.013	0.013	0.002	0.002	0.002	0.002	0.003	0.003	0.002	0.002	0.000	0.000
	(0.005)	(0.005)	(0.019)	(0.019)	(0.009)	(0.009)	(0.010)	(0.010)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.004)	(0.004)
Control mean	0.019	0.019	0.082	0.082	0.015	0.015	0.031	0.031	0.012	0.012	0.003	0.003	0.004	0.004	0.006	0.006	0.014	0.014
Control std. dev.	0.216	0.216	0.556	0.556	0.231	0.231	0.269	0.269	0.124	0.124	0.057	0.057	0.064	0.064	0.088	0.088	0.140	0.140
Observations	152,892	152,892	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676	50,676
Clusters	374	374	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350
LASSO-selected covariates		✓		✓		✓		✓		✓		✓		✓		✓		✓

Notes: Outcomes defined at the townland by deed type by decade level. Panel A restricts sample to post-fire period and reports cross-sectional treatment coefficient; panel B includes pre-fire period and reports difference-in-differences treatment coefficient. All specifications include parish map by decade fixed effects and geographical controls. Stacked estimates include deed type fixed effects. Panel B adds townland fixed effects. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A11: Treatment effects on margins of deed registration

	Pooled		Deed type: Leasehold transfers		Freehold transfers		Wills	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Any deed (y > 0)								
Burned	0.002*	0.002*	0.004*	0.002	0.001	0.000	0.003	0.003
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Control mean	0.014	0.014	0.010	0.008	0.021	0.018	0.011	0.010
Control std. dev.	0.116	0.116	0.098	0.087	0.144	0.132	0.106	0.098
B. Multiple deeds (y > 1)								
Burned	0.002**	0.002**	0.002*	0.001	0.003**	0.002*	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Control mean	0.003	0.003	0.003	0.002	0.006	0.004	0.001	0.000
Control std. dev.	0.055	0.055	0.052	0.044	0.078	0.067	0.023	0.018
Observations	148,645	148,645	46,453	38,918	46,453	39,391	46,453	39,391
Clusters	374	374	350	334	350	335	350	335
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes defined at the townland by deed type by decade level. Panel A uses indicator for *any* deeds of a given type in a townland and decade; panel B uses indicator for *multiple* deeds. Columns 1-2 stack across deed types, columns 3-4: number of leasehold transfers; columns 5-6: number of freehold transfers; 7-8: number of wills. All specifications include parish map by decade fixed effects and geographical controls. Stacked estimates include deed type fixed effects. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A12: Treatment effects on distinct parties registering deeds

	Pooled		Deed type: Leasehold transfers		Freehold transfers		Wills	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Number of distinct parties								
Burned	0.005**	0.005**	0.007*	0.004	0.006	0.004	0.003	0.003
	(0.002)	(0.002)	(0.004)	(0.003)	(0.004)	(0.004)	(0.002)	(0.002)
Control mean	0.017	0.017	0.013	0.009	0.029	0.023	0.012	0.010
Control std. dev.	0.164	0.165	0.145	0.121	0.224	0.191	0.115	0.105
B. Multiple distinct parties								
Burned	0.002*	0.002*	0.001	0.001	0.003***	0.002*	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Control mean	0.014	0.014	0.002	0.001	0.005	0.004	0.000	0.000
Control std. dev.	0.116	0.116	0.045	0.037	0.071	0.061	0.018	0.013
C. Any multi-party years								
Burned	0.001**	0.001**	0.001**	0.001*	0.001	0.001	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Control mean	0.001	0.001	0.001	0.000	0.002	0.001	0.000	0.000
Control std. dev.	0.027	0.027	0.024	0.021	0.039	0.035	0.010	0.009
Observations	148,645	147,140	46,453	39,391	46,453	38,918	46,453	39,391
Clusters	374	374	350	335	350	334	350	335
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes defined at the townland by deed type by decade level. Panel A uses count of distinct parties registering a given deed type in a townland and decade; panel B uses an indicator for at least two different parties; panel C uses an indicator for whether multiple parties are observed registering the same deed type in the same year. Columns 1-2 stack across deed types, columns 3-4: number of leasehold transfers; columns 5-6: number of freehold transfers; 7-8: number of wills. All specifications include parish map by decade fixed effects and geographical controls. Stacked estimates include deed type fixed effects. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A13: Effects on presence of unproductive land plots

	Any unproductive plots		Mountains		Bogs		Waste land	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Burned	0.04**	0.04***	0.01	0.01	0.03*	0.03**	0.00	0.00
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Control townland mean	0.17	0.17	0.02	0.02	0.22	0.22	0.04	0.04
Control townland std. dev.	0.38	0.38	0.14	0.14	0.42	0.42	0.19	0.19
Observations	4,156	4,156	4,156	4,156	4,156	4,156	4,156	4,156
Clusters	349	349	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes defined at the townland level. Columns 1-2: Townland contains any plots of unproductive land; 3-4: Any mountains; 5-6: Any bogs; 7-8: Any waste land. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A14: Effects on absence of buildings

	No buildings		Houses		Offices	
	(1)	(2)	(3)	(4)	(5)	(6)
Burned	0.01*	0.01**	-0.01	-0.01*	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Control townland mean	0.03	0.03	0.96	0.96	0.91	0.91
Control townland std. dev.	0.18	0.18	0.19	0.19	0.28	0.28
Observations	4,156	4,156	4,156	4,156	4,156	4,156
Clusters	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓

Notes: Outcomes defined at the townland level. Columns 1-2: Townland contains no valuation-relevant buildings; 3-4: Townland contains any houses; 5-6: Townland contains any office. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A15: Effects on presence of derelict structures

	Any derelict plots		Ruins		Dilapidated		Unfinished	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Burned	-0.00	-0.00	0.00	0.00	-0.00	-0.00	-0.01	-0.01*
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Control townland mean	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
Control townland std. dev.	0.11	0.11	0.09	0.09	0.04	0.04	0.07	0.07
Observations	4,156	4,156	4,156	4,156	4,156	4,156	4,156	4,156
Clusters	349	349	349	349	349	349	349	349
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes defined at the townland level. Columns 1-2: Townland contains any derelict plots; 3-4: Any plots only with ruins; 5-6: Any plots only with dilapidated structures; 7-8: Any plots only with unfinished structures. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A16: Effects on presence of agricultural infrastructure

	Agricultural infrastructure		Lime kilns		Sluices		Wells		Windmills	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Burned	-0.061	-0.067*	-0.016	-0.016	-0.022	-0.022	-0.014	-0.014	-0.001	-0.001
	(0.052)	(0.035)	(0.179)	(0.085)	(0.017)	(0.017)	(0.012)	(0.012)	(0.001)	(0.001)
Control townland mean	0.00	0.00	0.29	0.29	0.10	0.10	0.04	0.04	0.00	0.00
Control townland std. dev.	1.00	1.00	1.60	1.60	0.54	0.54	0.31	0.31	0.06	0.06
Observations	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223
Clusters	350	350	350	350	350	350	350	350	350	350
LASSO-selected covariates		✓		✓		✓		✓		✓

Notes: Outcomes defined at the townland level. Columns 1-2: Standardized index of individual facility types; other columns indicated by panel names. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A17: Effects on presence of industrial infrastructure

	Industrial infrastructure		Quarries		Trams		Gravel pits		Gas works		Foundries	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Burned	-0.042	-0.046	-0.032	-0.032	0.003	0.003	-0.041*	-0.041*	0.001	0.001	0.001	0.001
	(0.044)	(0.038)	(0.024)	(0.021)	(0.006)	(0.005)	(0.023)	(0.022)	(0.002)	(0.002)	(0.001)	(0.001)
Control townland mean	-0.00	-0.00	0.10	0.10	0.01	0.01	0.07	0.07	0.00	0.00	0.00	0.00
Control townland std. dev.	1.00	1.00	0.54	0.54	0.19	0.19	0.49	0.49	0.06	0.06	0.02	0.02
Observations	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223	4,223
Clusters	350	350	350	350	350	350	350	350	350	350	350	350
LASSO-selected covariates		✓		✓		✓		✓		✓		✓

Notes: Outcomes defined at the townland level. Columns 1-2: Standardized index of individual facility types; other columns indicated by panel names. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A18: Heterogeneous effects on composition of lessors and occupiers

	Imputed Catholic share				Land concentration			
	Lessors		Occupiers		Lessors		Occupiers	
A. Variation in bordering townlands	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Burned	-0.01	-0.01	0.01	0.01	-0.01	-0.01	0.01	0.01
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Burned × Bordering Catholic	0.10**	0.10**	0.07*	0.07*	0.04	0.04	0.02	0.02
	(0.05)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Burned + Burned × Bordering Catholic	0.09**	0.09**	0.07**	0.07**	0.03	0.03	0.04	0.04
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Control townland mean	0.39	0.39	0.70	0.70	0.80	0.80	0.32	0.32
Control townland std. dev.	0.33	0.33	0.26	0.26	0.24	0.24	0.28	0.28
Observations	2,494	2,494	2,494	2,494	2,480	2,480	2,480	2,480
Clusters	288	288	288	288	288	288	288	288
LASSO-selected covariates		✓		✓		✓		✓
B. Variation in dispersion of landholdings								
Burned	0.06*	0.06*	0.02	0.02	0.02	0.02	0.02	0.02
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Burned × Dispersed across counties	-0.07	-0.07	-0.01	-0.01	-0.05*	-0.05*	0.01	0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Burned + Burned × Dispersed across counties	-0.02	-0.02	0.02	0.02	-0.03	-0.03	0.03	0.03
	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Control townland mean	0.39	0.39	0.70	0.70	0.80	0.80	0.32	0.32
Control townland std. dev.	0.33	0.33	0.26	0.26	0.24	0.24	0.28	0.28
Observations	2,494	2,494	2,494	2,494	2,480	2,480	2,480	2,480
Clusters	288	288	288	288	288	288	288	288
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes: Columns 1-2: Share of area with Catholic-imputed lessors; 3-4: share of area with Catholic-imputed occupiers; 5-6: Herfindahl-Hirschman index of area held by lessors in townland; 7-8: Herfindahl-Hirschman index of area held by occupiers in townland. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. Interacted covariate is fully interacted with all fixed effects and covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A19: Effects on imputed Catholic proportion of lessors and occupiers

	Lessors		Occupiers	
	(1)	(2)	(3)	(4)
Burned	-0.00	-0.00	0.00	0.00
	(0.02)	(0.01)	(0.01)	(0.01)
Control townland mean	0.39	0.39	0.70	0.70
Control townland std. dev.	0.32	0.32	0.27	0.27
Observations	4,156	4,156	4,156	4,156
Clusters	349	349	349	349
LASSO-selected covariates		✓		✓

Notes: Outcomes constructed as the imputed share of Catholic lessors in townland (columns 1-2) or Catholic occupiers (columns 3-4). All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A20: Effects on Herfindahl index of lessors and occupiers

	Area		Land valuation		Buildings valuation		Total valuation	
A. Lessors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Burned	0.013	0.014	0.011	0.008	-0.006	-0.006	0.005	0.002
	(0.012)	(0.010)	(0.012)	(0.010)	(0.013)	(0.011)	(0.013)	(0.011)
Control townland mean	0.76	0.76	0.76	0.76	0.69	0.69	0.75	0.75
Control townland std. dev.	0.26	0.26	0.26	0.26	0.28	0.28	0.27	0.27
B. Occupiers								
Burned	0.025*	0.025**	0.022*	0.022**	-0.002	-0.002	0.017	0.017
	(0.014)	(0.011)	(0.013)	(0.011)	(0.012)	(0.010)	(0.013)	(0.011)
Control townland mean	0.31	0.31	0.30	0.30	0.30	0.30	0.31	0.31
Control townland std. dev.	0.28	0.28	0.28	0.28	0.26	0.26	0.28	0.28
Observations	4,135	4,135	4,134	4,134	4,061	4,061	4,112	4,112
Clusters	347	347	347	347	346	346	347	347
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes constructed as the Herfindahl index of concentration across distinct lessors (panel A) or occupiers (panel B) in a given townland. Columns 1-2: concentration of land area; 3-4: concentration of land valuation; 5-6: concentration of building valuation; 7-8: concentration of total valuation. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A21: Effects on maximal townland share of lessors and occupiers

	Area		Land valuation		Buildings valuation		Total valuation	
A. Lessors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Burned	0.012	0.013	0.011	0.009	0.006	0.006	0.010	0.008
	(0.010)	(0.009)	(0.010)	(0.008)	(0.010)	(0.009)	(0.011)	(0.009)
Control townland mean	0.82	0.82	0.82	0.82	0.78	0.78	0.82	0.82
Control townland std. dev.	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22
B. Occupiers								
Burned	0.023*	0.023**	0.021*	0.021**	-0.003	-0.003	0.016	0.016
	(0.013)	(0.011)	(0.012)	(0.011)	(0.012)	(0.010)	(0.013)	(0.011)
Control townland mean	0.41	0.41	0.40	0.40	0.41	0.41	0.40	0.40
Control townland std. dev.	0.27	0.27	0.27	0.27	0.26	0.26	0.27	0.27
Observations	4,135	4,135	4,134	4,134	4,061	4,061	4,112	4,112
Clusters	347	347	347	347	346	346	347	347
LASSO-selected covariates		✓		✓		✓		✓

Notes: Outcomes constructed as the maximal share of the total townland outcome assigned to a given lessor (panel A) or tenant (panel B) in that townland. Columns 1-2: concentration of land area; 3-4: concentration of land valuation; 5-6: concentration of building valuation; 7-8: concentration of total valuation. All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A22: Effects on fiscal capacity

	Any		Amount	
A. Quit rent arrears	(1)	(2)	(3)	(4)
Burned	0.011**	0.011**	0.021	0.021
	(0.005)	(0.005)	(0.017)	(0.017)
Control townland mean	0.01	0.01	0.01	0.01
Control townland std. dev.	0.08	0.08	0.26	0.26
B. Stills fines				
Burned	-0.008	-0.008*	-0.009*	-0.009*
	(0.005)	(0.005)	(0.005)	(0.005)
Control townland mean	0.01	0.01	0.01	0.01
Control townland std. dev.	0.12	0.12	0.13	0.13
Observations	4,223	4,223	4,223	4,223
Clusters	350	350	350	350
LASSO-selected covariates		✓		✓

Notes: Outcomes: Panel A: Townland associated with any quit rent arrear (1809-23) (columns 1-2), amount of arrears (3-4); Panel B: Townland associated with any stills fine (1-2), number of stills fines (3-4). All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p <$ 0.1, ** $p < 0.05$, *** $p < 0.01$.

Table A23: Effects on population and valuation in 1841-51 census

	1841		1851		Change	
A. Population	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-12.07	-13.11*	-8.52	-8.52	0.01	0.01
	(8.98)	(7.45)	(7.13)	(6.31)	(0.02)	(0.02)
Control townland mean	136.92	136.92	95.01	95.01	-0.26	-0.26
Control townland std. dev.	196.21	196.21	147.57	147.57	0.48	0.48
	1841		**1851**		**Change**	
B. Houses	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-1.86	-1.86	-1.85	-1.85	0.06	0.06
	(1.66)	(1.38)	(1.40)	(1.28)	(0.08)	(0.09)
Control townland mean	23.23	23.23	17.40	17.40	-0.18	-0.18
Control townland std. dev.	34.66	34.66	29.08	29.08	0.64	0.64
	Area		**Valuation**		**Valuation (non-GV)**	
C. Valuation	(1)	(2)	(3)	(4)	(5)	(6)
Burned	-2.10	-2.10	-25.23***	-27.07***	-23.74**	-24.54***
	(9.43)	(10.10)	(9.51)	(8.62)	(9.88)	(8.44)
Control townland mean	375.07	375.07	217.70	217.70	198.23	198.23
Control townland std. dev.	475.02	475.02	301.94	301.94	271.86	271.86
Observations	4,223	4,223	4,223	4,223	3,544	3,544
Clusters	350	350	350	350	280	280
LASSO-selected covariates		✓		✓		✓

Notes: Outcomes: Panel A: Total townland population in 1841 census (columns 1-2), 1851 census (3-4), share change 1841-51 (5-6); Panel B: Total number of houses in 1841 census (1-2), 1851 census (3-4), share change 1841-51 (5-6); Panel C: Total area in 1851 census (1-2), Total townland poor law valuation in 1851 (3-4), Total townland poor law valuation excluding localities already covered by *Griffith's Valuation* (5-6). All specifications include parish map fixed effects, control for latitude, longitude, and townland area, and cluster standard errors by parish map. Even-indexed columns add LASSO doubly-selected predetermined covariates. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.