Coffeehouses and the Rise of Science*

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Abstract

Can social spaces raise knowledge production by lowering the cost of learning from others? Historians have long credited coffeehouses, commercial venues where strangers met across social ranks, with fostering rational debate and seeding Enlightenment culture. We test this claim for science in seventeenth-century London. Using geocoded records and a staggered event study across parishes, we find a substantial and lasting increase in the number of mathematical practitioners and scientific instrument shops following a parish's first coffeehouse. Effects are concentrated among practitioners with weak ties to Oxford and Cambridge, connections between theory-oriented scientists and instrument makers multiply, and new shops turn toward experimental instruments. We argue coffeehouses fostered this growth by cheapening access to scientific knowledge for those outside academic networks and by making experimental science interactive and public.

Keywords: Coffeehouses, Science, Knowledge Diffusion, Social Networks

JEL Codes: N13, O31, O33, O43, Z13

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1. INTRODUCTION

Ideas are nonrival, but access to them is not. To pursue an idea, one needs reasons to believe in it, and those reasons are often formed with other people, through evidence, expertise, and criticism. This is especially true at the frontier, where much of what matters is hard to articulate: which problem is worth solving, what a tool is for, why a trial failed, who holds the missing skill. Face-to-face interaction transmits such knowledge, but venues determine who can take part, and access can be costly: universities, laboratories, and learned societies demand years of educational and social investment, and entry is shaped by geography, networks, social background, and wealth. What happens when these barriers fall? Can social spaces open to anyone complement established institutions and raise knowledge production by lowering the cost of learning from others?

We study the coffeehouse, a low-cost institution that turned geographic proximity into knowledge exchange in seventeenth-century London, the center of the Scientific Revolution in the British Isles. For the price of a dish of coffee, a penny or about one-tenth of a day's wage, strangers met and debated across social ranks; contemporaries dubbed coffeehouses "penny universities," and Habermas (1991, p. 33) singles out the coffeehouse, which "not merely made access to the relevant circles less formal and easier; it embraced the wider strata of the middle class, including craftsmen and shopkeepers." We test this claim for science. Coffeehouses spread parish by parish after 1652, and rich historical records track scientific activity over the subsequent decades. We focus on mathematical practitioners, the applied scientists of the period, recorded as teaching mathematics, writing on it, or making instruments, and on the shops that made, repaired, and sold those instruments. In a staggered event study design, the arrival of a parish's first coffeehouse roughly doubled the number of mathematical practitioners and raised the number of instrument shops nearly fivefold. The increase persisted for decades.

Technological change has repeatedly lowered the cost of accessing codified knowledge (e.g., Mokyr, 2002): the printing press (Dittmar, 2011), the postal networks of the Republic of Letters (Cervellati et al., 2026), the encyclopedias of arts and trades (Squicciarini and Voigtländer, 2015), the internet (Goldfarb and Tucker, 2019), and now frontier AI (Stanford Institute for Human-Centered Artificial Intelligence, 2026). These advances do less for what Polanyi (1966) calls "tacit knowledge," for which in-person contact remains valuable, especially when information changes quickly and resists codification (Storper and Venables, 2004). The transition from the Scientific Revolution to the Enlightenment brought a broader change: new public venues, the salon, the table society, and the coffeehouse, widened exchange across social groups in what Habermas (1991) called a structural transformation of the public sphere. Our results suggest that

such venues are an independent margin, not one that better information technology retires: seventeenth-century London had the printed book, yet the coffeehouse still changed who did science. If frontier AI further cheapens codified knowledge, venues for tacit exchange may matter more, not less.

London was not closed to useful knowledge before coffeehouses. Gresham College offered public lectures, St. Paul's Churchyard supported an open book trade, workshops transmitted craft skills, and universities and households connected established scholars. The closest precedent is the circle Robert Boyle (1627–1691) called the "invisible college" in the 1640s, a group of natural philosophers who met and corresponded in London. It was "invisible" because it had no building or charter, but it was not open: joining required correspondence, introduction, and standing among the learned. Private patronage worked similarly. Much seventeenth-century research depended on a wealthy sponsor, courtier, or a Fellow's own fortune, with support secured through social standing and personal ties rather than a fee. Coffeehouses added a different kind of access. One penny bought news and a seat in a shared room without a credential, charter, or patron. Natural philosophers, practitioners, instrument makers, artisans, merchants, and the middling sort could meet there repeatedly. Historical accounts place such institutions in the exchange of useful knowledge and Europe's transition to modern economic growth (Broman, 1998; Jacob, 1997; Mokyr, 2002, 2005, 2016; Stewart, 1992). Repeated contact built the reputation and trust that made exchange possible (Johns, 1999; Shapin, 1994; Sunderland, 2007).

The idea that London coffeehouses played a central role in the diffusion of knowledge can be traced to John Houghton (1645–1705), an English apothecary, writer on agriculture and trade, and Fellow of the Royal Society. In 1701, Houghton (1727, p. 132) observed:

> Coffee-houses make all sorts of people sociable, the rich and the poor meet together, as also do the learned and unlearned: It improves arts, merchandize, and all other knowledge; for here an inquisitive man, that aims at good learning, may get more in an evening than he shall by Books in a month [. . .]. I have heard a worthy friend of mine [. . .] say, that he did think, that coffeehouses had improved useful knowledge, as much as [the universities] have [. . .].

Why might coffeehouses have mattered? They did not necessarily create skill. They connected the people who held it. Thomas Tompion (1639–1713) was already a successful clockmaker when he discussed dividing compasses with Robert Hooke (1635–1703) at Child's Coffee House and a spring-watch mechanism at Garraway's. Hooke brought scientific problems and designs, Tompion built, tested, and revised them, and their work continued in the workshop before ending with a presentation to the king (Hooke, 1935; Iliffe, 1995). The record does not show that the coffeehouse

first brought the two men together. It shows how regular meetings could combine knowledge held by different people. The same exposure could draw in new entrants: craftsmen and scholars encountered scientific questions, potential collaborators, and demand for instruments, while theorists discovered what makers could build.

We take Houghton's hypothesis to the historical record. Did the arrival of coffeehouses increase applied scientific activity in seventeenth-century London? We hand-geocode every coffeehouse, mathematical practitioner workplace, and scientific instrument shop with a recorded address, including parishes, streets, alleys, and signboards, using digitized seventeenth-century maps and gazetteers. This places them within the 162 parishes of seventeenth-century London and yields a parish-by-decade panel from the 1600s through the 1690s. We also reconstruct the social connections among practitioners. Treatment and the two main outcomes come from separate compilations assembled from different historical records by different authors, so the results are not merely an internal artifact of a single work or author.

Figure 1 shows the citywide pattern. Coffeehouses appeared just as a sustained rise in practitioners and shops began. Titles in applied mathematics more than doubled in the 1650s, which Kelly and Gráda (2022) suggest reflects a sudden rise in demand. Progress-oriented language began rising around 1650 (Almelhem et al., 2026), and Britain's creative elite concentrated in London as coffeehouses spread (Cox and Figueroa, 2025). Historians treat coffeehouses as sites for circulating ideas (e.g., Ellis, 2006; Jacob, 1997), yet systematic quantitative evidence on these claims is scarce. The common timing is suggestive, but it does not establish that coffeehouses raised scientific activity.

We identify the effect of coffeehouses from variation within London. London parishes are small units, and 97 of the 162 lie inside the City walls alone, so a parish that received a coffeehouse and one that did not are often a few streets apart. Of 162 parishes, 101 never received a coffeehouse before 1700. We compare activity before and after the first recorded coffeehouse with contemporaneous changes in these never-treated parishes. The baseline uses the linear imputation estimator of Wooldridge (2023), allows effects to vary by cohort and decade, and clusters standard errors by parish.

We find large and persistent effects on both outcomes. Treated parishes averaged 0.62 mathematical practitioners in the decade before entry, and the number rises by 0.68 thereafter, roughly doubling. Scientific instrument shops rise from 0.33 to 1.57, a nearly fivefold increase. London gained 68 practitioners and 136 shops between the 1640s and the 1690s. Estimated effects in the 1690s account for 49 percent of the increase in practitioners and 63 percent of the increase in shops. On a second measure, entry accounts for 20 percent of practitioner-decades and 46 percent of instrument-shop-decades recorded between the 1650s and the 1690s. These shares are statistically attributable to entry under parallel trends. They sum effects within treated parishes and do not identify a London-wide equilibrium response.

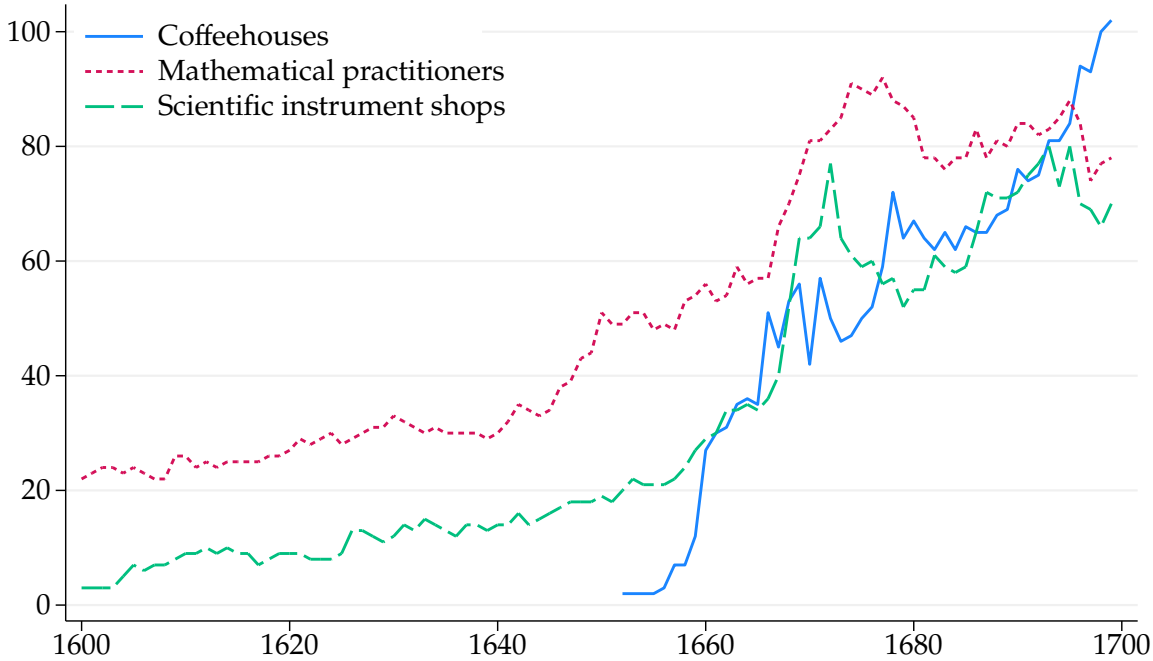


Figure 1. Coffeehouses and science in London over time

Notes: Figure plots the annual number of coffeehouses, mathematical practitioners, and scientific instrument shops in seventeenth-century London. Data from Clifton (1995); Hay et al. (2025); Lillywhite (1963, 1972); Taylor (1954). [Return to page 3]

The parish estimates do not by themselves show that London gained the same amount of activity. For shops, entry begins when a maker is first recorded, so moves among known London addresses cannot produce the result. Positive spillovers into neighboring parishes and scientific growth elsewhere in England also weigh against simple displacement within London. Moves from unrecorded locations or from outside London remain possible. Interpreting the aggregate shares as an enlargement of London's scientific sector requires assuming that such moves do not account for the response. The parish-level result does not require this additional assumption.

Coffeehouses did not open at random. Proprietors favored commercially active sites, and treated parishes began with more commerce and higher levels of both outcomes. The validity of the comparison is supported by flat pre-trends. Changes in both outcomes were similar before entry, and the pre-treatment coefficients are jointly indistinguishable from zero. The estimates also remain close after adjustment and reweighting for the observed predictors of entry. Population density, luxury shops, other commercial signs, and nonscientific correspondence do not rise with coffeehouse entry, which weighs against a coincident local boom. Cowan (2005) argues that the coffeehouse itself grew out of a national culture shaped by the virtuosi (natural philosophers and scholars). Such a change would affect London as a whole, while our design uses differences in when individual parishes received a coffeehouse. The

local concern is that houses opened where science was already gathering. Coffeehouse founders and natural philosophers came from distinct social worlds. Scientists shaped what coffeehouses became rather than where they opened: they were early users, and they helped turn the rooms into venues for empirical discussion.

Survival in the historical record raises a separate concern. Coffeehouses could make existing practitioners easier to observe through advertisements, imprints, correspondence, or contact addresses. Using separate compilations for treatment and outcomes does not rule this out. The largest response, however, appears among instrument shops, which are often recorded through signed objects, guild records, and trade cards. The estimates remain similar when we restrict the sample to guild-linked makers and when we omit coffeehouses recorded in different types of sources. Separate trends for areas affected by the Great Fire address rebuilding and differential record loss. Conley errors, leave-one-parish-out estimates, alternative geographic units, and alternative estimators yield similar conclusions.

Customer demand is the leading alternative to knowledge exchange. Merchants and navigators may have visited shops and teachers as customers, not collaborators. Null results for ordinary retail alone do not rule out demand for scientific goods. Effects are strongest among practitioners whose surnames were least represented at Oxford and Cambridge. Connections among makers, and between makers and theorists, rise when both were active in the same decade. Shops producing experimental instruments such as microscopes and air pumps rise too, though their gap over practical shops stays imprecise. Makers take more apprentices, and Fellows associated with treated parishes rise in later decades. Earlier pub openings show no matching rise, arguing against ordinary sociability alone. The patterns do not identify a single channel, but are consistent with coffeehouses making scientists and skilled entrants easier to reach.

Contribution to the Literature. These findings make three contributions. First, we provide, to our knowledge, the first causal evidence that the institutions contemporaries called "penny universities" increased applied scientific activity (Ellis, 1956). The evidence rests on a newly assembled geocoded parish-by-decade panel of coffeehouses, practitioners, and instrument shops. Historians often read the coffeehouse as a product of London science. Cowan (2005, p. 260) calls it "the product of the cultural world forged by the virtuosi," while Stewart (1999) describes particular houses as "other centres of calculation" alongside the Royal Society. We ask whether local coffeehouse entry also changed who took part in applied science. Activity rose where coffeehouses opened, when they opened, and not before. The evidence favors new activity over relocation.

Second, we contribute to research on institutions that widened access to useful knowledge and reduced the frictions in producing it (e.g., Dowey, 2017; Galofré-Vilà, 2023). Existing work studies two kinds. Some institutions codify knowledge and carry

it across distance: the printing press (Dittmar, 2019), the Republic of Letters and its correspondence networks (Cervellati et al., 2026; Melillo et al., 2026), and the Uniform Penny Post of 1840 (Hanlon et al., 2022). Others organize exchange within a bounded membership: universities and academies (de la Croix et al., 2025; Koschnick, 2025b), and economic societies (Cinnirella et al., 2025). Coffeehouses did neither. They lowered the cost of repeated face-to-face contact across communities that otherwise met in more specialized settings. Modern evidence finds high returns to contact of this kind (e.g., Andrews, 2023; Andrews and Lensing, 2024; Atkin et al., 2022; Boudreau et al., 2017; Catalini, 2018), and network evidence documents spillovers beyond the people directly exposed (Fluegge and Bailey, 2024). The rise in connections we document gives one way that urban density could raise knowledge production, at the scale of streets and parishes rather than cities (Cox and Figueroa, 2025); pub openings produce no comparable increase. The same results offer large-sample support for the view of Fleck (1979) and Mokyr (2016) that scientific knowledge is produced in interaction among people, not by individuals alone.

Third, the paper adds to research on the people who translated scientific knowledge into practice and on what enlarged their number. Zilsel (1942) attributed the rise of the early modern mathematical practitioner to a weakening separation between university scholars and artisans, Taylor (1954) to demand from navigation, warfare, and surveying, and Kelly and Gráda (2022) document how far practical mathematics spread. Related work traces tacit skill through apprenticeship (de la Croix et al., 2018), the skilled implementers behind industrial technological change (Meisenzahl and Mokyr, 2012), and the later emergence of professional engineers (Hanlon, 2025). Historical work already locates practical mathematics in the shops, lectures, and commercial communities of sixteenth-century London and treats the coffeehouse as another venue for a sociability that predated it (Cormack, 2017). We provide a causal test of this institutional margin: coffeehouse entry raised local entry and expansion. Coffeehouses connected established centers of knowledge to a wider body of skilled men, giving institutional content to accounts that link the associational world of Britain to the diffusion of useful knowledge (Clark, 2000; Habermas, 1991; Iliffe, 1995; Jacob, 1997; Mokyr, 2016; Squicciarini and Voigtländer, 2015). The practitioners and makers whose numbers rose are those that accounts of Britain's later technological change place at its center. Their price of entry was a penny rather than a university place.

Roadmap. The remainder of this paper is organized as follows: Section 2 provides historical background. Section 3 describes the data. Section 4 presents the main empirical analysis. Section 5 examines the mechanisms. Section 6 concludes.

2. BACKGROUND

London in the early 1600s was a rapidly growing commercial metropolis with dense trade networks, a thriving manufacturing sector of skilled artisans, and an established community of merchants, mathematical teachers, and instrument makers engaged in practical science (Harkness, 2007; Shaw-Taylor et al., 2024). Urbanization and the rise of wage labor increased disposable income, expanding demand for new consumer goods and exotic imports (Lake and Pincus, 2006). Coffee reached the city through contact with the Ottoman Empire, where a distinct coffee culture had flourished since the 1500s (Hattox, 2014); English travelers described the drink from 1600, and consumption in England is first recorded in the late 1630s, more than a decade before the first coffeehouse opened (Cowan, 2005, pp. 5, 25). Merchants who had encountered it abroad and natural philosophers seeking new forms of knowledge were the first to take it up (Cowan, 2005, pp. 14, 55–56). The philosopher and Lord Chancellor Francis Bacon (1561–1626) had helped shape this intellectual climate by encouraging systematic curiosity about the natural world, and coffee itself became an object of such curiosity (Cowan, 2005, p. 21).

2.1. Coffeehouses

Coffeehouses emerged in England in the 1650s as a novel kind of public house, similar to taverns, inns, and alehouses, where people could converse, exchange ideas, and build trust (Figure 2). Samuel Hartlib, a noted promoter of science, recorded in his *Ephemerides* (1654) the opening of "a cuphye-house or a Turkish, as it were ale-house" near the Old Exchange (quoted in Cowan, 2005, pp. 25–26). Bookshops, artisanal workshops, and literary circles already supported sociability of this kind, and the new houses took a familiar form. What set them apart at first was simply the drink they offered: coffee. Like beer, wine, and ale, coffee encouraged conviviality, yet spared customers the fog of intoxication. Physicians, writers, and politicians soon praised it as a sober stimulant that sharpened the mind and increased productivity, while alcohol was increasingly condemned as a threat to social order. Although the medical benefits of coffee remained uncertain, promotional tracts had promised mental clarity and self-control since well before the 1650s, and coffeehouses prospered on that promise.[1]

That appeal first took physical shape in 1652, when Pasqua Rosée, a Greek servant of the Levant Company merchant Daniel Edwards, opened the first coffeehouse in London.[2] To attract customers, he circulated a handbill advertising the virtues of coffee,

[1] In *Theatrum Botanicum*, the herbalist John Parkinson (1640) offered the first full English description of coffee, praising it for "strengthening a weake stomacke, helping digestion, and the tumours and obstructions of the liver and spleene, being drunke fasting for some time together."

[2] Pasqua Rosée's Coffee House is often described as the first coffeehouse in London, and sometimes as the first coffeehouse in Christian Europe. The latter claim is contested. Some sources credit an Oxford

Figure 2. A seventeenth-century London coffeehouse

Notes: Drawing by an unknown artist, circa 1690–1700, showing the interior of a London coffeehouse. Among the earliest visual records of a coffeehouse, it depicts a maid behind a canopied bar, coffee boys preparing coffee and taking clay pipes from a chest, and patrons reading newspapers and drinking by the fire. British Museum, London, museum no. 1931,0613.2. [Return to page 7]

claiming the beverage "quickens the Spirits, and makes the Heart lightsome" and "is excellent to prevent and cure the Dropsy, Gout, and Scurvy." The idea spread quickly. By 1663, the City of London already counted 82 coffeehouses (City of London Magistrates, 1663). A penny, about £1.10 or $1.45 in 2025 prices, bought a dish of coffee; two pence could cover a longer visit (Peacham, 1667).[3] These low prices opened coffeehouses to men below the elite, turning them into public rooms for sober news, argument, and exchange (Cowan, 2005, p. 52). Throughout the 1660s, coffeehouses became fixtures of urban life: Fellows of the Royal Society gathered at Garraway's, merchants met near

establishment with priority, based on Anthony Wood's diary entries from 1654–55, which report that a Jewish man named Jacob sold coffee near the Angel in Oxford in 1650. Ellis (2004, p. 38), a historian of the English coffeehouse, disputes this attribution. He argues that Wood's entries show that coffee was sold in Oxford, but do not establish the existence of a true public coffeehouse. The European priority claim is also complicated by popular accounts that identify Venice as the site of Europe's first coffeehouse in 1645. However, Ellis (2004, p. 85) dates the first Venetian coffeehouse to 1683.

[3]Price conversion uses the retail-price series from Clark (2026). The average-earnings series from the same source implies that, assuming 300 paid workdays per year, one penny was roughly 10 percent of a day's earnings. This was a meaningful unit of everyday spending: Peacham (1667) notes that a penny could buy a dish of coffee, a small loaf, a candle, or seasonal fruit.

the Royal Exchange, and their growing influence so alarmed Charles II that in 1666 he even considered banning them. Their blend of low cost and lively discussion earned them the contemporary nickname "penny universities," a phrase that underscored their reputation as informal centers of learning. In the London broadside *The Triumphs of London*, the poet Thomas Jordan (1675) vividly echoes this sentiment:

> So great an university,
>
> I think there ne'er was any;
>
> In which you may a scholar be,
>
> For spending of a penny.

Habermas (1991 [1962]) expands on this view by presenting English coffeehouses as the embodiment of the emerging "public sphere" in early modern Europe: bourgeois, urban spaces open to all, where rational, egalitarian debates on topics from literature to politics flourished, reason rather than social rank or political power settled matters, and philosophical discourse escaped rigid hierarchies. The coffeehouse, in this account, became a seedbed of Enlightenment ideals. Mokyr (2005, p. 312) strikes a similar note, portraying the coffeehouse as a natural gathering point for polymaths and practical men alike, a locus where disciplines intertwined and a culture of improvement and empiricism took hold. "Much of the improved access to useful knowledge," he writes, "took place through informal meetings [. . .], in coffeehouses and pubs, improvised lectures, and private salons."

Understanding the social impact of coffeehouse culture requires comparison with earlier norms. As Cowan (2005) explains, coffeehouses replaced alcohol-centered public houses as key venues for elite exchange. In early seventeenth-century England, the virtuosi (natural philosophers and scholars) had gathered in aristocratic great houses, where interactions were formal and exclusive. Coffeehouses, by contrast, encouraged informal, cross-class dialogue. While they did not replace great houses as centers of virtuosi activity, they challenged traditional pathways to intellectual recognition. For less wealthy aspiring virtuosi, coffeehouses provided unprecedented access to information and social networks.

The promise mattered more than the drink. Coffee was consumed mainly in coffeehouses rather than at home, since London household inventories before 1700 rarely listed utensils for hot drinks, and Robert Hooke, a frequent visitor, seldom recorded drinking it, perhaps because it was too routine to note (Withington, 2020, pp. 54, 59). Quantities were in any case small. At the height of the trade in the mid-1680s, English imports could have supplied at most about 50,000 people with half a liter a day, some 1.5 percent of the population aged fifteen or over (Smith, 2001, pp. 252–3), too little for caffeine to explain a substantial change in productivity. What the

houses supplied was the setting rather than the stimulant: accessible and predictable venues that lowered the cost of communication between theorists, craftsmen, and entrepreneurs from different social backgrounds, and that diffused new norms of civility and intellectual openness (Klein, 1996). Their contribution was institutional and cultural rather than physiological.

2.2. Diffusion, Reception, and Clientele

The spatial diffusion of coffeehouses within London followed the city's commercial and institutional geography (Cowan, 2005, pp. 152–192). Early establishments clustered near the Royal Exchange, Fleet Street, and the Inns of Court, just beyond the western wall of the City, where merchants, lawyers, and printers intersected. From these nodes, coffeehouses expanded into nearby neighborhoods as proprietors captured foot traffic and repeat customers. By the early 1660s, coffeehouses were a stable feature of the metropolitan landscape, often differentiated by clientele, profession, or politics. Diffusion reflected integration into existing circuits of movement, credit, and information.

Public reception reflected both the coffeehouse's role as a site of collective discussion and its positioning as a sober alternative to traditional public houses (Cowan, 2005, pp. 45–46). Whether coffeehouses were uniformly sober in practice is secondary. What mattered was that they were marketed and widely understood as spaces of sobriety, in contrast to taverns, inns, and alehouses. This framing shaped patron expectations and official scrutiny. The concentration of news, opinion, and rumor drew attention from authorities during periods of political instability in the late seventeenth century. Regulatory efforts focused on publicity rather than consumption (Cowan, 2005, pp. 193–224). Satire and polemic framed coffeehouses as idle or pretentious, but such criticism did not slow their expansion.

Coffeehouse clientele was broad but bounded (Cowan, 2005, pp. 1–15). Early frequenters included natural philosophers and merchants familiar with coffee through contact with the Ottoman Empire, but coffeehouses quickly expanded to serve a wider urban audience. Participation required modest means, literacy, and conversational competence, excluding much of the urban poor. Women were largely absent as customers, though present as proprietors or workers (Cowan, 2001). Before the 1650s, scientists had limited ties to merchants, and historical evidence suggests that the emergence of coffeehouses was not driven by changes in scientific or intellectual life.[4] Coffeehouses thus connected commercial, intellectual, and technical communities,

[4]Among 30 so-called mathematical practitioners described in Section 3 for whom detailed network data are available in the *Oxford Dictionary of National Biography* (Oxford Dictionary of National Biography, 2004), only 9 of 348 recorded connections are to merchants, and only 6 practitioners had any such connection. By contrast, early coffeehouse proprietors were embedded in mercantile networks from the

explaining why merchant-run venues became spaces where scientific problems, methods, and reputations could circulate beyond formal institutions.

2.3. Relation to Science

In January 1684, at Garraway's Coffee House in London, Robert Hooke (1635–1703), Christopher Wren (1632–1723), and Edmond Halley (1656–1742) met to discuss the problem of planetary motion, specifically the nature of the force that keeps planets in orbit (Mount, 2021, pp. 145–146). Hooke claimed to have discovered the inverse-square law but did not provide a demonstration. Wren offered a prize for a proof, which Hooke failed to deliver. Halley, seeking a resolution, visited Isaac Newton (1643–1727) in Cambridge later that year. Newton replied he had already solved the problem and subsequently sent Halley a manuscript, *De motu corporum in gyrum*. This work became the foundation for his *Philosophiæ Naturalis Principia Mathematica*, one of the most influential books in the history of science.

This episode illustrates how coffeehouses supported scientific dialogue by providing a comparatively accessible setting alongside the Royal Society, private households, workshops, and instrument shops. Access was neither universal nor entirely egalitarian, but coffeehouses widened the range of settings in which natural philosophers and skilled practitioners could meet. Hooke's diary is filled with references to London coffeehouses, which he frequented almost daily. As Iliffe (1995) demonstrates, Hooke used these spaces to build networks, exchange technical information, examine machines and instruments, and conduct business. After one such meeting with Wren at Man's Coffee House, on August 21, 1678, Hooke sketched in his diary the four devices the two had described to each other, among them a "poysd weather glasse" and his own "philosophicall spring scales" (Hooke, 1935, pp. 372–373). Two of the four were Wren's.

Coffeehouses complemented print: pamphlets and periodicals supplied material for reading and conversation, while face-to-face exchange allowed claims to be discussed, demonstrated, and combined with hands-on expertise (Higgitt et al., 2024; Johns, 2006). More broadly, scientific practice in early modern London developed through overlapping networks of natural philosophers, mathematical practitioners, and artisans operating across coffeehouses, workshops, shops, and institutions (Higgitt et al., 2024, pp. 8–9, 19–20).

Instrument production remained largely commission based: guild apprenticeships transmitted craft and commercial knowledge, while advertising connected makers

outset. Thomas Garraway and Edward Lloyd established coffeehouses near the Royal Exchange and transformed them into centers for auctions, shipping intelligence, and financial exchange, while Pasqua Rosée's first coffeehouse emerged directly from Levant Company connections. This contrast suggests that commercial and technical communities initially belonged to distinct social cultures, and that coffeehouses helped bridge, rather than reflect, an existing integration between them.

with professional users (Bryden, 1992; Crawforth, 1987; Stewart, 2005). One especially concrete sequence connects coffeehouse exchange to instrument production. The clockmaker Thomas Tompion (1639–1713) already possessed substantial practical skill when he began working with Hooke. At Child's Coffee House on June 27, 1674, Hooke described new dividing compasses and other mechanisms to him. At Garraway's Coffee House on March 8, 1675, Hooke showed Tompion how to fix double springs inside a balance wheel. Tompion brought clockwork to Hooke six days later, and on April 7 they showed Hooke's new spring watch to Charles II, who praised it and encouraged its further development (Hooke, 1935, pp. 109, 151–157). Their work continued through testing and revision. Iliffe (1995, p. 311) emphasizes that the collaboration became a mutual exchange of techniques and skills. The episode shows how coffeehouses could make existing skills more productive by connecting designs, practical knowledge, collaborators, patrons, and buyers.

Coffeehouses also hosted disputes over experimental philosophy. Shapin and Schaffer (1985, pp. 292–293) document that Tillyard's Coffee-House in Oxford served as a venue for an experimental group and chemistry lectures, and that a London coffeehouse dispute over barometric phenomena was discussed in a 1662 pamphlet. These episodes fit their broader account of experimental knowledge as a product of material instruments, credible witnessing, and communication. Coffeehouses did not replace laboratories or the Royal Society; they extended the social settings around this experimental system.

This exchange rested on a broader metropolitan knowledge economy. Beeley (2019) describes London's practical mathematicians as an interdependent community spanning teachers, instrument makers, printers, booksellers, merchants, and mathematical clubs. The mathematician and scientific administrator John Collins (1625–1683) exemplifies the brokers within this community: he circulated manuscripts, arranged publication, identified relevant expertise, and connected practical problems with mathematicians and instrument makers (Beeley, 2017). Coffeehouses expanded the decentralized, face-to-face infrastructure through which such matching could occur. This interaction was intellectually productive because practical mathematics and instrument making helped constitute experimental natural philosophy rather than merely applying finished theory (Bennett, 1986).

Stewart (1999) more broadly documents that coffeehouses set aside rooms for meetings, lectures, and discussions, serving as important sites for exchanging knowledge and print materials. They hosted lectures and demonstrations in natural philosophy, sometimes with a formality comparable to that of formal schools, the Royal Society, or Gresham College. Stewart characterizes coffeehouses as "other centres of calculation," frequently attended by key figures of the Royal Society, underscoring their role in knowledge production and circulation.

3. DATA

We assemble records of coffeehouses, mathematical practitioners, and scientific instrument shops, each with an address and dates. We geocode every address and assign it to one of the 162 jurisdictions into which London was divided in 1660: 113 City of London parishes, 97 within the walls; 9 Westminster parishes; 20 parishes in Middlesex and Surrey; and 20 liberties or extra-parochial areas, including the Inns of Court and the Tower. We refer to all 162 as parishes, and we count records by parish and decade from the 1600s through the 1690s.

Coffeehouses. To determine where and when coffeehouses opened in London, we compile data from *London Signs* (Lillywhite, 1972). The work draws on primary and secondary sources at the Guildhall Library in London, covering coffeehouses and other establishments from the seventeenth through the nineteenth centuries. These include tokens, records of house signs, lost-and-reward notices, business directories, newspapers, advertisements, letters, reference works, and diaries.[5] Lillywhite (1972) consistently reports the names and years of mention of each coffeehouse and provides addresses for 2,124 of the 2,254 coffeehouses.

To our knowledge, Lillywhite (1972) remains the most comprehensive source on early modern London coffeehouses, documenting far more than the prominent ones. Its more widely cited predecessor, Lillywhite (1963), accounts for 2,034 of the 2,254 coffeehouses listed in Lillywhite (1972).[6] Ellis (2006) treats Lillywhite (1963) as *the* major reference work, Pincus (1995, p. 809) describes it as an "encyclopedic list of coffeehouses," and Cowan (2007, p. 1197) characterizes it as an "enormously valuable catalogue of references to London coffeehouses."[7]

In constructing the dataset, we address two sources of potential measurement error. First, we consolidate duplicate entries. When the same coffeehouse appears under

[5]Before the London Streets Act of 1762, buildings were identified by house signs rather than street numbers. These signs often indicated the type of social institution on the premises, and historical records of them form the basis of Lillywhite (1972).

[6]Appendix Figure B.1 shows an excerpt from Lillywhite (1963). Entry 656 details "Jonathan's Coffee House," located at "Exchange Alley, Cornhill, No. 20," first mentioned in "1680–1684," along with its background. Appendix Figure B.2 shows an excerpt from Lillywhite (1972). Entry 13056 refers to the "Sandford Coffee House" on Lawrence Lane in Cheapside ward, a seventeenth-century coffeehouse not listed in Lillywhite (1963). Entry 1163 corresponds to a coffeehouse already documented in Lillywhite (1963).

[7]Lillywhite worked from London house signs, the addresses in use before the London Streets Act of 1762, and came to coffeehouses as one class of sign-bearing house (Lillywhite, 1972, p. xv). Much of his material reached him as postal history, letters addressed to those signs (Lillywhite, 1963, p. 10). He enters a house when a document fixes its sign, its address, and a year, and reports whatever else his sources give. What he found about the clientele fills out an entry; it does not create one.

multiple names, Lillywhite (1963, 1972) lists each separately and notes overlaps, which we use to merge records into a single entry.[8] Second, we identify and remove a small number of non-coffeehouse public houses, primarily taverns and inns, that Lillywhite (1963) includes for contextual completeness rather than as coffeehouses.[9] Appendix Section B.7 then evaluates the completeness of the resulting dataset by benchmarking it against contemporaneous administrative records and independent archival searches. We find that coverage is strong for the late seventeenth century but more limited in the 1650s and 1660s, consistent with the broader loss of historical records in the Great Fire of 1666.

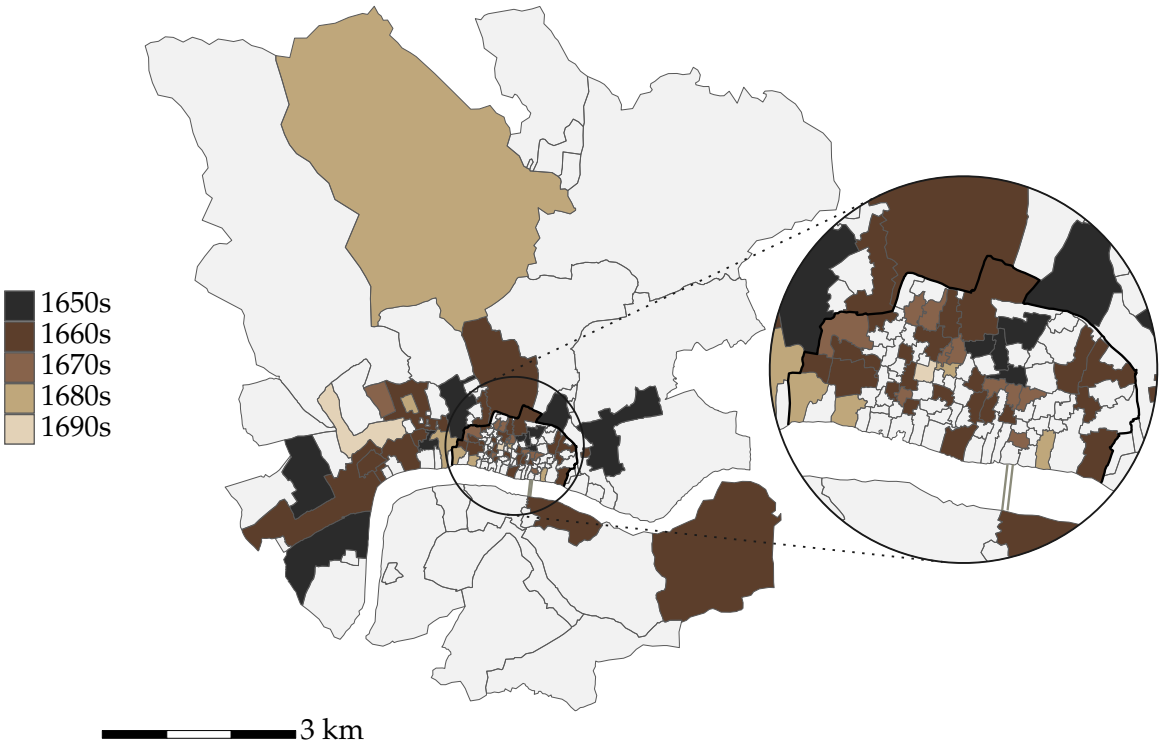


Figure 3. Mapping the first coffeehouses in London

Notes: Map of London showing the decade of first recorded coffeehouse by parish, with an inset of the area inside the wall. Gray parishes indicate no recorded coffeehouses in the 1600s. [Return to page 14]

In total, the panel contains 286 coffeehouses across 61 parishes in seventeenth-century London.[10] Figure 3 maps the decade of first coffeehouse entry in each parish. Of

[8]For example, "The New Bagnio" (entry 1845) also appears as "Turk's Head Bagnio" (entry 1957). In general, coffeehouses were known by various names based on location (e.g., "St. Dunstan"), sign (e.g., "Turk's Head"), or proprietor (e.g., "Bowman"), and Lillywhite (1963) cross-references these variants.

[9]For example, "Pope's Head Tavern" (entry 1870) is "included by reason of its site and close connexion with coffee-houses" (Lillywhite, 1963, p. 724).

[10]The source data contain 287 coffeehouses first recorded before 1700. Don Saltero's coffeehouse in Chelsea, first recorded in 1695, lies outside the 162-parish study area and is therefore excluded. Appendix Table B.2 summarizes the historical sources for the 286 included coffeehouses.

the 61 treated parishes, 49 lie in the City of London and 12 outside it. Openings in the 1650s cluster around the Royal Exchange and Gresham College, the financial and intellectual centers of the period, with a second cluster in Westminster. Entry then spreads decade by decade across the walled city and surrounding suburbs, without persistent concentration in a small set of parishes.

Mathematical Practitioners. We measure applied scientists by counting mathematical practitioners, the closest historical analogue: individuals who applied mathematics in teaching, writing, instrument making, and related technical occupations. The data draw on Taylor (1954), which pioneered the study of early English applied mathematicians and instrument makers and introduced the concept of the mathematical practitioner.[11] Taylor (1954) compiled a collective biography of 584 mathematical practitioners active in England between 1507 and 1714,[12] drawing on contemporary works and diaries, bibliographical compilations, museum catalogs, and archival manuscripts. Since its publication, "[f]ew new [mathematical] practitioners have been added, and rarely has the category itself been seriously challenged" (Walton, 2017, p. 89).

Each biography reports first and last names, dates of flourishing (i.e., activity), workplaces, types of activity (e.g., instrument making, teaching, research), and connections to other practitioners.[13] Because we focus on the seventeenth-century panel, we restrict the sample to the 244 mathematical practitioners with a precisely geocoded London workplace whose recorded flourishing overlaps 1600–1699. Of these, 223 began flourishing during the century, while 21 began earlier and remained active into the century.[14] Each practitioner enters every decade spanned by their recorded flourishing and every parish with a recorded workplace, so the outcome is a stock of active practitioners.

Connections recorded by Taylor (1954) take various forms, including "friends," "master," "received advice from," "associated with," "visited," "employed or consulted," "corresponded with," and "mentioned by." Practitioners are recorded as connected whenever historical evidence indicates a social or intellectual association. Connections therefore suggest a general likelihood of influence or interaction. To extend this network,

[11] Appendix Figure B.3 presents an excerpt from Taylor (1954), and Appendix Figure B.19 shows examples of practitioners across cohorts.

[12] Tudor England begins in 1485; the earliest practitioner recorded by Taylor (1954) flourishes from 1507.

[13] Dates of flourishing generally indicate the period during which a mathematical practitioner was active. However, for the 65 practitioners for whom Taylor (1954) provides birth dates instead of dates of flourishing, we define flourishing as spanning from the year the individual turned 21 to the year of death or the last year of flourishing, following the implicit chronological order of biographies in Taylor (1954).

[14] Appendix Table B.3 reports the complete set of harmonized occupations for the 244 practitioners. Occupational categories may overlap: 130 practitioners are classified as scientific instrument makers, 54 as mathematical teachers, and 69 as other mathematical practitioners. Appendix Figure B.17 shows that about 60 percent of practitioners were active in London rather than elsewhere in England in a typical year.

we turn to the *Six Degrees of Francis Bacon* (SDFB) database of Warren et al. (2016), which uses machine learning to infer influence or interaction among early modern individuals from mentions in *Oxford Dictionary of National Biography* (ODNB, 2004) biographies. We identify ODNB entries for 80 of the 244 practitioners in our sample and manually link the 75 of them recorded in the SDFB.[15] This procedure identifies additional connections of the same type not recorded by Taylor (1954), bringing the panel network to 475 undirected connections among 204 practitioners.[16]

The data do not record when individuals became connected, and the direction of influence is uncertain. We therefore treat all connections as undirected, interpreting them as evidence that two individuals were socially or intellectually associated at some point. Formally, we set $g_{ij} = 1$ if practitioners i and j are ever connected in this sense, and 0 otherwise. To capture variation over time, we define $g_{ijt} = 1$ if $g_{ij} = 1$ and both i and j are active in period t, and 0 otherwise. This measure represents the maximum possible connectivity under the assumption that connections require both individuals to be active.[17]

Scientific Instrument Shops. To capture applied scientific activity in both human and physical capital, we compile data on scientific instrument shops, where instruments were manufactured, repaired, and sold. These data draw on Hay et al. (2025), which is based on the 1991 computerized database of scientific instrument makers compiled by Clifton (1991) and collaborators, as well as on the later published extract in Clifton (1995).[18] Much of the underlying material was assembled at the National Maritime Museum and the Royal Observatory, Greenwich, in the 1980s and 1990s. The 2025 version extends this work through the project *Tools of Knowledge: Modelling the Creative Communities of the Scientific Instrument Trade, 1500–1914*, which brought together curators, historians, and digital humanities experts from five institutions.

This dataset documents all known scientific instrument makers and shops with London addresses up to the 1690s, including each maker's name, shop address, and

[15]We identify ODNB entries by linking practitioners to Wikidata items that carry an ODNB index number. Of the 244 practitioners, 90 are linked to a Wikidata item and 80 of those items carry the identifier, so 80 is a lower bound on ODNB coverage in our sample.

[16]Of these connections, 83 appear only in the SDFB, 326 only in Taylor (1954), and 66 in both.

[17]The set of practitioner dyads (i, j) for which $g_{ij} = 1$ includes biological ties such as "father" and "son" recorded by Taylor (1954). Restricting the analysis to within-time connectivity, as defined by g_{ijt}, implicitly excludes such ties, since $g_{ij} = 1$ does not necessarily imply $g_{ijt} = 1$ for some t, and the fathers and sons in our dataset are not active in the same period. Hence, we restrict attention to non-familial connections.

[18]Much of our data originates from Clifton (1995), which is incorporated in Hay et al. (2025). We additionally consulted the published extract directly, primarily to correct entries with missing addresses. Appendix Figure B.4 shows an excerpt from Clifton (1995), including, for example, a record of "ALLEN Elias" opening a shop in 1606 in "Blacke Horse-ally, neere Fleetbridge, London."

active dates.[19] The panel contains 252 makers operating 345 shops that were active at some point during 1600–1699; all but one of these shops were first recorded during the century.[20] Shops enter every decade spanned by their recorded years of operation, so this outcome is a stock as well.

Other. Additional variables enter the balance comparisons, robustness checks, and mechanism tests. Appendix B defines them, each with its source.

Geocoding. Our sources give historical addresses rather than coordinates. We map each address by hand onto a contemporary Google Map of Greater London, using digital historical maps and gazetteers (Appendix B.8), and spatially join the resulting coordinates with a shapefile from Cummins et al. (2016), which represents the parochial geography of London in 1660 and delineates its 162 parishes.

4. EMPIRICAL ANALYSIS

4.1. Empirical Strategy

To estimate effects on scientific activity, we exploit the staggered introduction of coffeehouses across seventeenth-century London beginning in 1652. Specifically, we employ an event study model to examine changes before and after the first recorded coffeehouse opens in a parish. We focus on first entry because it provides the only transition from untreated to treated; later openings raise treatment intensity without creating a new transition, so the estimates capture the total effect of entry, including subsequent growth. Because openings are dated by first record and outcomes are measured by decade, the entry decade captures partial exposure.

The historical record indicates that entry was governed primarily by commercial considerations (Appendix A.1). Proprietors were middling merchants and traders who

[19] Appendix Figures B.17 and B.18 show that in a typical year about three-quarters of the British Isles' scientific instrument makers were active in London, above 80 percent from the 1660s, and that production was dominated by practical instruments such as dividers, sectors, and compasses until the 1660s, when experimental instruments including microscopes and air pumps began to expand rapidly.

[20] Our sample of mathematical practitioners from Taylor (1954) includes only 130 scientific instrument makers, against the 252 makers recorded by Clifton (1995). The gap reflects timing: Taylor (1954) is the earlier work and served as a source for Clifton (1995), which can be regarded as a partial follow-up. Not all instrument makers in Taylor (1954) appear in Clifton (1995), likely due to minor differences in classification. For instance, Christopher Wren (1632–1723) is listed as an instrument maker in Taylor (1954) but not in Clifton (1995). We do not merge the two datasets, as they are conceptually distinct: Taylor (1954) records dates of flourishing, whereas Clifton (1995) emphasizes dates of activity and shop operations. Accordingly, our analysis of scientific instrument shops relies exclusively on Clifton (1995).

chose sites for foot traffic and custom, and their clientele extended well beyond scientists to merchants, aristocrats, and politicians. Before 1650, recorded commercial ties among mathematical practitioners were rare (Appendix Table A.4). Coffee supply, excise, and licensing changed citywide, in the same decade across parishes. The Great Fire of 1666 was a common shock with uneven local exposure, so as a robustness check we allow exposed parishes to follow separate trends (Appendix C.4).

As descriptive evidence, Table 1 reports normalized differences between parishes with and without a coffeehouse. Treated parishes were poorer in 1582 but matched controls by 1638 in the share of substantial households and before 1652 in scientific letters and in goldsmiths, a proxy for financial capital. They were less densely populated. The largest differences were in social capital and commerce: treated parishes had more tradesmen's tokens, signs, taverns and inns, and booksellers. They also lay closer to major centers such as the Royal Exchange, Gresham College, and Paternoster Row. Below, we test whether these imbalances also predict how scientific activity would have evolved without coffeehouse entry, using the same comparison applied to pre-1652 changes (Appendix Table C.1) and adjustment for the observed predictors of entry.

Entry need not be random, and treated and control parishes may differ in levels. Identification requires instead that parishes did not change behavior in anticipation of a first opening, and that absent entry, scientific activity in treated parishes would have followed the path observed in never-treated parishes. Concretely, we estimate an unconditional staggered difference-in-differences model with multiple time periods that is robust to heterogeneous treatment effects across groups and time:[21]

$$y_{it} = \alpha + \sum_{g=1650}^{1690} \sum_{\substack{s=1600 \\ s \neq g-10}}^{1690} \beta_{gs} \mathbb{1}[s = t] \mathbb{1}[g = E_i] + \gamma_i + \delta_t + \epsilon_{it}. \tag{1}$$

Here, y_{it} denotes the number of mathematical practitioners or scientific instrument shops in parish i in decade t. γ_i and δ_t denote parish and decade fixed effects that control for local time-invariant differences and London-wide shocks and trends. E_i denotes the decade in which the first coffeehouse is recorded in parish i.[22] For each cohort, the omitted reference period is the decade before entry, $s = g - 10$. For $s \geq g$, β_{gs} is the average effect of coffeehouse entry for cohort g in decade s, relative to that decade and to the never-treated counterfactual, $E_i = \infty$. Earlier coefficients are pre-treatment contrasts, not effects. ϵ_{it} is an error term. Standard errors are clustered by parish.

[21] This addresses problems arising from treatment effect heterogeneity in staggered adoption designs. By contrast, two-way fixed effects estimators can place non-convex or negative weights on group-time treatment effects, while dynamic two-way fixed effects event study estimators can suffer from contamination across relative periods (de Chaisemartin and D'Haultfoeuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021).

[22] Appendix Figure B.14 shows the rollout of treatment across parishes. Appendix Figure B.16 shows coffeehouse counts by event time relative to the first coffeehouse entry.

Table 1—Pre-treatment summary statistics

	Parishes			Normalized difference
	Nonmissing	Treatment	Control	
Panel A. Demographics				
Baptisms, 1600s–1640s	130	84.72 (120.74)	57.44 (113.62)	0.23
Baptisms per km^2, 1600s–1640s	130	493.76 (349.55)	634.63 (503.77)	−0.32
Deaths, 1600s–1640s	110	117.25 (174.38)	86.08 (159.55)	0.19
Deaths per km^2, 1600s–1640s	110	740.21 (564.89)	872.94 (665.37)	−0.22
Households, 1638	107	249.00 (329.67)	157.87 (255.37)	0.31
Households per km^2, 1638	107	3419.34 (1368.22)	4114.09 (2010.83)	−0.40
Panel B. Wealth				
Median tax paid, 1582	98	93.20 (87.91)	124.53 (132.58)	−0.28
Substantial households (%), 1638	92	26.45 (15.99)	25.97 (20.17)	0.03
Panel C. Social capital and commerce				
Apothecaries, 1617–1640s	162	0.12 (0.32)	0.03 (0.11)	0.39
Booksellers, 1600s–1640s	162	1.53 (3.29)	0.19 (0.37)	0.57
Clay-pipe finds, 1600s–1640s	162	0.50 (2.50)	0.39 (1.98)	0.05
Dissenting meetings, 1600s–1640s	162	0.33 (0.85)	0.06 (0.34)	0.41
Goldsmiths, 1600–1651	162	0.18 (1.18)	0.05 (0.41)	0.15
Luxury shops, 1600s–1640s	162	0.07 (0.20)	0.05 (0.17)	0.13
Pubs, 1600s–1640s	162	3.01 (3.63)	0.53 (1.21)	0.92
Signs, 1600s–1640s	162	0.50 (0.90)	0.06 (0.18)	0.68
Theaters, 1600s–1640s	162	0.08 (0.23)	0.04 (0.19)	0.15
Tradesmen's tokens, 1648–1651	162	1.16 (1.88)	0.23 (1.02)	0.62
Panel D. Science before 1652				
Instrument shops, 1600s–1640s	162	0.15 (0.40)	0.05 (0.20)	0.32
Non-scientific letters, 1600s–1640s	162	3.87 (10.41)	1.09 (3.98)	0.35
Practitioners, 1600s–1640s	162	0.40 (0.95)	0.16 (0.48)	0.32
Scientific letters, 1600s–1640s	162	0.38 (1.08)	0.23 (1.38)	0.12
Panel E. Geography				
Area (km^2)	162	0.99 (4.23)	1.28 (4.37)	−0.07
City of London	162	0.80 (0.40)	0.63 (0.48)	0.38
Distance to Gresham College (km)	162	1.18 (1.02)	1.37 (1.20)	−0.18
Distance to Paternoster Row (km)	162	1.01 (0.88)	1.24 (1.12)	−0.24
Distance to the Royal Exchange (km)	162	1.01 (1.01)	1.22 (1.21)	−0.19
Inside the London Wall	162	0.66 (0.48)	0.56 (0.50)	0.19
Parishes	162	61	101	

Notes: Table compares London parishes with a first recorded coffeehouse opening during the 1650s–1690s (treatment) with parishes with no recorded opening by the end of the 1690s (control). The nonmissing column reports the total number of treatment and control parishes with a recorded value for each characteristic. Treatment and control columns report means, with standard deviations in parentheses. All characteristics predate the first London coffeehouse opening in 1652. Values labeled 1600s–1640s are averages of observed decadal counts from 1600 through 1640, except scientific letters, non-scientific letters, and dissenting meetings, which are period totals. The normalized difference is $(\overline{x}_{\mathrm{T}} - \overline{x}_{\mathrm{C}})/\sqrt{(s_{\mathrm{T}}^2 + s_{\mathrm{C}}^2)/2}$, where T and C denote treatment and control parishes. [Return to pages 18, 22, 13, 47, 53, 87]

Dynamic treatment effects are the estimands of interest. Following Wooldridge (2023), we estimate equation (1) by OLS and predict outcomes using all estimated coefficients and fixed effects, yielding $\widehat{y}_{it}$. We impute the untreated potential outcome, $y_{it}(\infty)$, by predicting from equation (1) using only the estimated intercept and fixed effects, yielding $\widehat{y}_{it}(\infty)$. The observation-specific treatment effect is therefore $\widehat{\tau}_{it} \equiv \widehat{y}_{it} - \widehat{y}_{it}(\infty)$. We estimate the dynamic treatment effect by averaging $\widehat{\tau}_{it}$ across parishes observed h years after the first coffeehouse opens:

$$\widehat{\tau}_h \equiv \frac{1}{|I_h|} \sum_{i \in I_h} \widehat{\tau}_{i,E_i+h}, \tag{2}$$

where I_h denotes the set of parishes observed in period $E_i + h$.[23] We plot these effects, measured in levels relative to the decade immediately before treatment.

The resulting dynamic treatment effect estimates and standard errors are numerically equivalent to those from the long-difference estimators of Callaway and Sant'Anna (2021). We adopt the approach of Wooldridge (2023) because, unlike long differences, its regression form extends to nonlinear models. Both outcomes are counts with many zeros, so as a robustness check we re-estimate the model by Poisson quasi-maximum likelihood with an exponential conditional mean (Appendix C.8):[24]

$$\mathbb{E}[y_{it} \mid i, t] = \exp\left(\alpha + \sum_{g=1650}^{1690} \sum_{\substack{s=1600 \\ s \neq g-10}}^{1690} \beta_{gs} \mathbb{1}[s = t] \mathbb{1}[g = E_i] + \gamma_i + \delta_t\right). \tag{3}$$

Identification requires that, absent a coffeehouse, mean outcomes in treated and control parishes would have grown by the same factor, not the same amount.

4.2. Mathematical Practitioners and Scientific Instrument Shops

Figure 4 reports estimates of equation (1) for both outcomes. Flat pre-trends support their validity.[25] Panel A shows a persistent increase in mathematical practitioners. The 61 treated parishes averaged 0.62 practitioners in the decade before entry, and the number rises by 0.68 on average thereafter, roughly doubling. Panel B shows a persistent increase in scientific instrument shops, from a baseline of 0.33 to 1.57 after entry, an increase of 1.24 and a nearly fivefold rise.

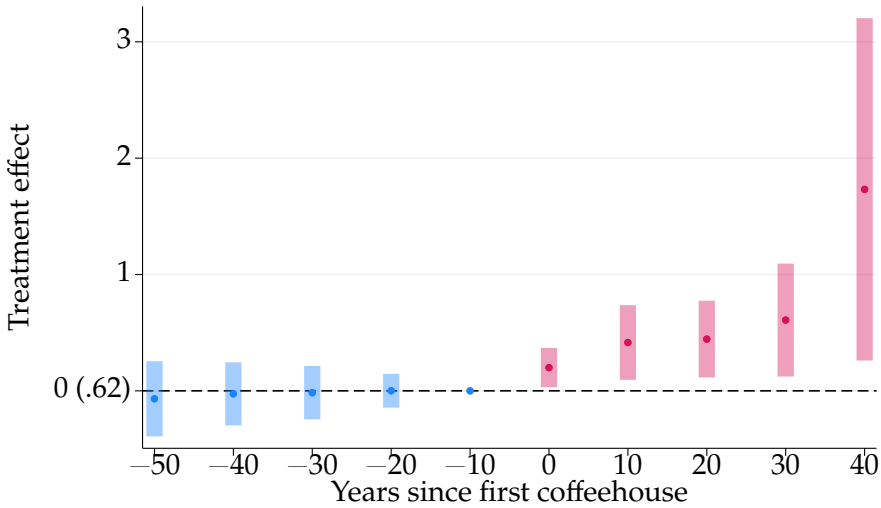
Despite data scarcity, the effects are precise, statistically significant at conventional levels, and large. Between the 1640s and the 1690s, London gained 68 mathematical

[23] Because the panel ends in the 1690s, fewer cohorts contribute at longer horizons: $\widehat{\tau}_{40}$ is identified from the 10 parishes treated in the 1650s (Appendix Figure B.14).

[24] The exponential mean rules out negative predictions and avoids the need for transformations such as the inverse hyperbolic sine (Chen and Roth, 2024; Roth and Sant'Anna, 2023; Wooldridge, 2023).

[25] We fail to reject the null that the pre-treatment contrasts two to five decades before entry are jointly zero ($p = 0.99$ for mathematical practitioners and $p = 0.29$ for scientific instrument shops).

(A) Mathematical practitioners



(B) Scientific instrument shops

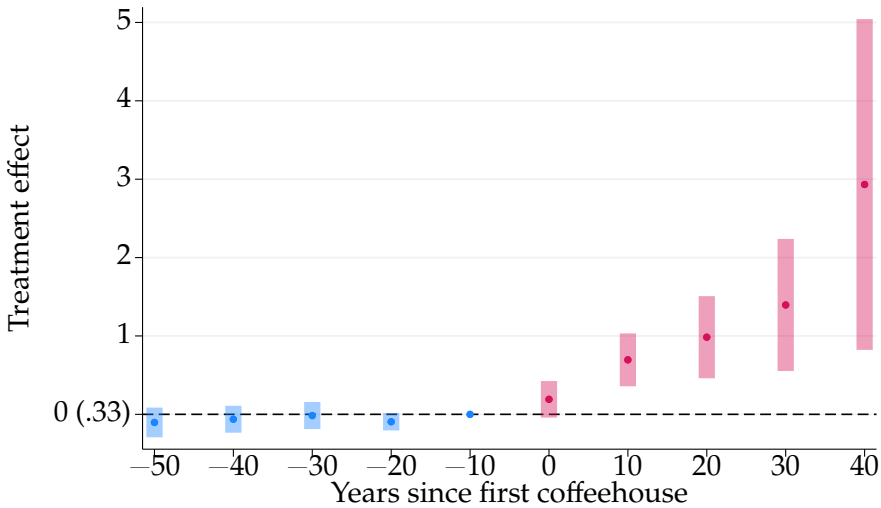


Figure 4. Effects on scientific activity

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 20]

practitioners and 136 scientific instrument shops. Aggregated across treated parishes, the estimated effects in the 1690s account for 49 percent of the increase in practitioners and 63 percent of the increase in shops.[26] Relative to total activity rather than growth, coffeehouse entry accounts for 20 percent of all mathematical practitioner-decades and 46 percent of all scientific instrument shop-decades recorded between the 1650s and the 1690s.[27] These results survive the robustness checks reported below.

The treatment and the two outcomes come from three distinct compilations, assembled by different scholars working from different archives and for different purposes. No single source generates both the coffeehouse locations and the scientific activity we measure, so the consistent effects across outcomes cannot be an artifact of one compilation's coverage. This also bears on observability bias, the concern that scientists who frequented coffeehouses were more likely to enter the historical record at all. The concern has some force for mathematical practitioners, who are drawn from a collective biography of notable individuals. It has little force for instrument shops, which are identified from signatures on surviving instruments in museum collections, guild records, and trade cards, none of which plausibly depends on whether a coffeehouse stood nearby.

4.3. Robustness

Entry could still have coincided with unobserved local shocks to scientific activity. We assess this concern by adjusting for the characteristics that predict where coffeehouses opened, by comparing the estimates against placebo assignments of treatment, and by testing for effects on outcomes that coffeehouses should not affect; Appendix C develops each check in more depth.

Coffeehouses did not open at random. Fourteen of twenty-eight pre-1652 measures in Table 1 show normalized differences above the 0.25 threshold of Imbens and Rubin (2015, p. 277), and treated parishes begin with more practitioners and more instrument shops, at 0.32 each. Level imbalances threaten parallel trends when the imbalanced characteristics also predict how scientific activity would have evolved without a coffeehouse (Baker et al., 2025). Two checks suggest they do not. First, balance in changes: between the 1600s–1610s and the 1630s–1640s, both before the first London coffeehouse in 1652, both outcomes are balanced in changes, at -0.05 and 0.08 against 0.32 in levels, and

[26] The standard errors of these shares are 18 and 16 percentage points, respectively.

[27] The numerator sums the estimated dynamic effects across treated parishes and post-treatment decades; the denominators are the 502 practitioner-decades and 412 shop-decades recorded across all 162 parishes from the decade of first entry onward. The shares give the fraction of observed activity statistically attributable to coffeehouse entry, with standard errors of 7 and 10 percentage points. Both sets of shares sum within-parish effects only, so they understate the total if openings also raised activity nearby.

only pubs and signs exceed 0.25, two outcomes that entry leaves unmoved (Appendix Table C.1). Second, adjustment: effects under regression adjustment (0.57 practitioners and 1.15 shops) and inverse probability weighting (0.56 and 0.69) remain close to the unadjusted 0.68 and 1.24 and statistically significant, with pre-treatment estimates jointly indistinguishable from zero (Appendix C.1).

We next compare the estimated effects against a benchmark in which parish labels and opening decades are random. Across 1,000 placebo samples matching the size of the treated group, post-treatment effects based on historical timing lie in the extreme upper tail of the placebo distributions for both outcomes, while pre-treatment effects are centered near the medians (Appendix C.2). Because that benchmark places coffeehouses without regard to where they actually went, we repeat the exercise drawing placebo locations to match the estimated probability of entry and preserving the observed entry decades; the post-treatment estimates remain in the upper tail under this more demanding assignment.

Because coffeehouses made up only a small share of all establishments, we do not expect them to directly affect the number of pubs, luxury shops, or other types of signs, nor general non-scientific correspondence within the Republic of Letters or population density. Any correlation with these variables would likely reflect unobserved differences between parishes with and without coffeehouses; the estimated effects are statistically insignificant and economically small (Appendix C.3).

Two features of London's geography could move coffeehouses and scientific activity together. The Great Fire of 1666 displaced poorer residents, concentrated wealth in the rebuilt districts, and shifted commerce westward (Ager et al., 2025), and it destroyed records that determine when a coffeehouse is first observed. The London Wall marks a second divide: the guilds controlled trade inside it, no guild existed for instrument making (Cormack, 2017, p. 79), and rents were higher within the walls (Baer, 2010). We allow separate nonparametric trends for parishes exposed and not exposed to the fire, and for parishes inside and outside the wall; neither changes the estimates (Appendix C.4).

We noted above that observability bias is less likely for instrument shops, identified from surviving objects and guild records, than for practitioners, who enter the record through diaries and published work (Taylor, 1954); for both, survival and registration are not independent of local prosperity. On the outcome side, we restrict the sample to the 175 of 252 instrument makers for whom a guild is recorded, with and without separate trends for parishes exposed to the Great Fire, which destroyed many guild records. On the treatment side, we re-estimate after excluding, in turn, each broad and each finer category of source through which a coffeehouse is first recorded. The estimates are unchanged throughout (Appendix C.5).

The remaining checks vary one ingredient of the design at a time. We change how treatment is defined and timed, moving from decades to two-, three-, and five-year intervals, allowing treatment to switch off, and estimating the effect of closures, which reduce scientific activity, symmetric with entry (de Chaisemartin and d'Haultfoeuille, 2024) (Appendix C.6). We change the unit and the standard errors, re-estimating on a hexagonal partition of the city and computing Conley (1999) standard errors (Appendix C.7). We change the control group and the estimator, adding not-yet-treated parishes (Callaway and Sant'Anna, 2021) and re-estimating under Poisson and inverse hyperbolic sine specifications (Appendix C.8). Finally, we remove differential trends and influential observations, detrending within treatment cohorts (Goodman-Bacon, 2021) and dropping each of the 162 parishes in turn (Appendix C.9). None changes the conclusion.

4.4. Spillovers, Expansion, and Relocation

The estimates above measure the effect of a coffeehouse on its own parish: activity rose more in parishes that received a coffeehouse than in parishes that did not, beginning when the first one opened and not before, and the checks just reported defend that comparison. What the comparison does not give is the effect on London. Two things separate the two: coffeehouses may have raised activity beyond the parish housing them, and some of the activity we count may have moved rather than appeared.

Coffeehouses may also raise activity nearby: actors in neighboring parishes could reach a coffeehouse on foot, and such spillovers onto control parishes, if positive, bias the parish-level estimate downward (Butts, 2023). To measure them, we redefine treatment to require that no coffeehouse opened earlier within r kilometers of the parish centroid, excluding contaminated controls, and vary r. We find positive spillovers for mathematical practitioners extending up to 700 meters and none for scientific instrument shops (Appendix Figure C.15).[28]

Two implications follow. The parish-level estimates are lower bounds on the total effect of an opening, since part of the response accrues to neighbors coded as controls. And the aggregate shares reported in Section 4.2, which sum only within-parish effects, understate the share of London's scientific activity attributable to coffeehouses.

Three patterns favor new activity over a reshuffling of the stock already in London. Scientific activity expanded both in London and elsewhere in England over the period (Appendix Figure B.17). Decomposing the post-treatment effects into entry and expansion components shows both margins responding, and for shops entry dates from

[28]This spatial range is broadly consistent with the mobility patterns of Robert Hooke, shown in Appendix Figure C.17. In his diary, Hooke recorded 2,497 coffeehouse visits between March 1672 and May 1683, 2,096 of which were within 1 km of his lodgings.

the year a maker is first recorded, so it cannot come from moves between recorded London locations (Appendix Figure C.21). The positive spillovers for mathematical practitioners documented above are likewise difficult to reconcile with displacement from neighboring parishes. Moves from unrecorded locations, or from outside London, would still register as entry.

5. MECHANISMS

The observed effect on scientific activity could operate through several channels. Coffeehouses turned geographic proximity into knowledge exchange, lowering the cost of entering the public sphere of natural philosophy while widening access beyond established elites. As open commercial venues, they also brought natural philosophers with a demand for experimental instruments into contact with instrument makers. These channels predict stronger effects among practitioners with weak institutional ties, more links between theoretical and practical knowledge, and greater production of experimental instruments. Ordinary sociability would not generate these patterns.

5.1. Lowering Barriers to Entry

Coffeehouses may have raised scientific activity by lowering the cost of accessing knowledge that others already held, as emphasized by Mokyr (2005, p. 312). Contemporaries called them "penny universities" (Ellis, 1956); before their arrival, scientific interaction was largely confined to aristocratic households and college chambers (Cowan, 2005, pp. 102ff.). If coffeehouses relaxed these access constraints, effects should be strongest among practitioners with the weakest inherited ties to elite institutions. Following Clark and Cummins (2014), we proxy such ties by the relative representation of a practitioner's surname s among Oxford and Cambridge (Oxbridge) alumni before 1650:

$$z(s) \equiv \frac{\text{share of } s \text{ among Oxbridge alumni before 1650}}{\text{share of } s \text{ among English couples married 1538–1649}}. \tag{4}$$

The denominator proxies the share of s in the adult English population before 1650, so higher values of $z(s)$ indicate stronger ties. Surnames are observed for all 244 practitioners; paternal occupation, the more direct measure, is recorded for only 56.[29]

[29] Paternal occupation comes from the Wikidata-linked biographies described in Section 3 and, for a small number of practitioners, from Taylor (1954) directly, whose brief entries rarely record parentage. For a further 42 practitioners these sources do not identify the father's occupation, and the remaining 146 have no biographical entry beyond Taylor (1954) to search. The cost of the surname proxy is that $z(s)$ measures representation at a particular set of institutions rather than parental status, and values within a paternal occupation are widely dispersed. Appendix Figure B.20 plots the individual values of $z(s)$ by paternal occupation, including those for whom it is unobserved.

Figure 5 shows the predicted pattern. Average post-treatment effects, measured relative to the mean in the decade before entry, are concentrated among practitioners below the median of $z(s)$ and markedly smaller above it (Panel A). Panel B estimates effects for the bottom x percent of practitioners ranked by $z(s)$: the effect declines monotonically, from approximately 5 for the 17 percent of surnames that never appear in the matriculation registers of either university to about 1.1 once the most represented are included. Oxbridge representation may capture other inherited differences, so this heterogeneity alone cannot establish that coffeehouses lowered barriers to access. Together with the historical evidence, however, it shows that the expansion of applied scientific activity was concentrated among practitioners outside established elite networks, the group with the most to gain from a venue with low barriers to entry.

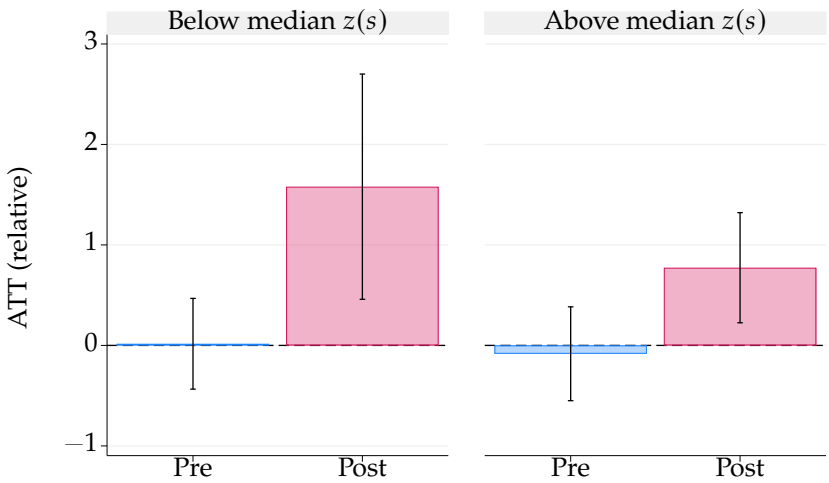
5.2. Connecting Theory and Practice

Coffeehouses presumably not only facilitated the circulation of knowledge across social and occupational groups (Mokyr, 2005, 2016), but also functioned as a decentralized institution that matched previously segmented communities: craftsmen trained in the guild system and natural philosophers coming into science from Oxbridge. Coffeehouses were thus likely to connect individuals holding prescriptive knowledge (knowledge how) with those holding propositional knowledge (knowledge what).[30] This view is supported by Ellis (2006, pp. x–xi), who describes coffeehouses as spaces where scientific virtuosi conducted business with instrument makers and where the experimental method was debated by the wider public.

The first prediction is that coffeehouses increased social connections among scientific practitioners, with particularly strong effects involving instrument makers and theoretically oriented practitioners. Figure 6 compares average treatment effects before and after coffeehouse entry. Panel A shows that connections increase for practitioners overall and separately for theorists and makers. Panel B decomposes makers' connections: those among makers and those to theorists both increase after entry, while the corresponding pre-treatment effects are close to zero. The rise in cross-type connections is especially informative, since it joins practitioners who produced instruments with those most likely to use them in theoretical and experimental work. Read together with the heterogeneity in Figure 5, this is the matching pattern the second channel predicts, and not one that circulation alone would produce.

[30] This maps onto the older epistemological distinction between knowing-how and knowing-that. The distinction between propositional and prescriptive knowledge was made popular by Mokyr (2002) and has more recently been studied in the history of science by Koschnick (2025a).

(A) Below and above median split



(B) Along the Lorenz curve

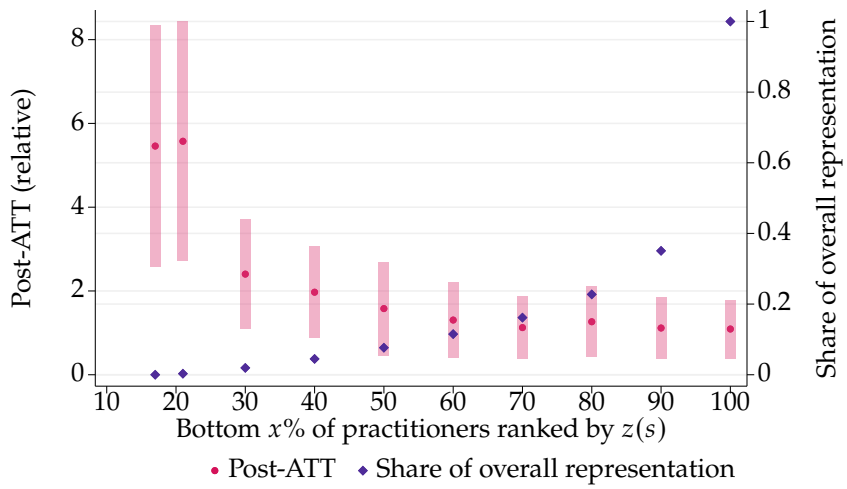
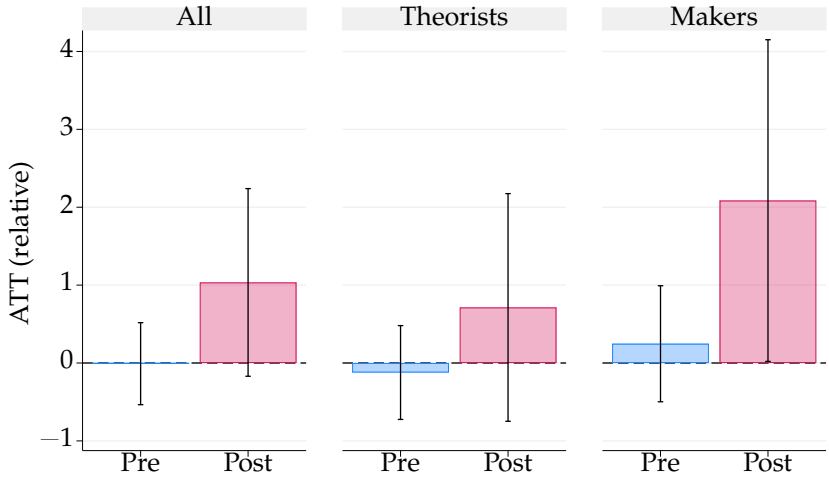


Figure 5. Effects on mathematical practitioners by Oxbridge representation

Notes: Figure shows ATTs and 95 percent confidence intervals based on event study estimates from equation (1) of the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners for given values of the relative representation $z(s)$ of a practitioner's surname s at Oxbridge before 1650. Panel A splits by values of $z(s)$ above or below the median of its empirical distribution. Panel B splits by values of $z(s)$ within the bottom x percent of its empirical distribution. Each outcome is divided by its reference mean, i.e., the sample mean of the outcome one decade before the first coffeehouse opened. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. Standard errors clustered by parish. [Return to page 26]

(A) All practitioners, theorists, and makers



(B) Maker-to-maker and maker-to-theorist connections

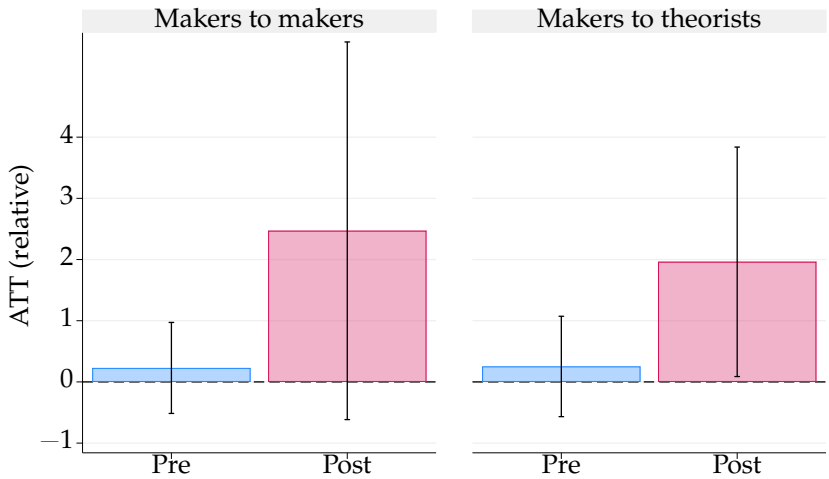


Figure 6. Effects on connections by practitioner type

Notes: Figure shows average treatment effects and 95 percent confidence intervals from equation (1) of first coffeehouse entry on practitioners' connections. Panel A reports effects for all mathematical practitioners and separately for theoretically oriented practitioners and scientific instrument makers. Panel B decomposes makers' connections into those among makers and those from makers to theorists. "Pre" averages event study estimates from 50 to 20 years before entry; "Post" averages estimates from the decade of entry through 50 years afterward. Each outcome is divided by its reference mean, the sample mean one decade before the first coffeehouse opened. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to page 26]

5.3. Experimental Science

Publicly performed experiments stimulated interest in testing and demonstrating scientific theories using the new instruments of experimental inquiry. If coffeehouses brought theorists and makers into more frequent contact, makers could learn about theorists' needs and encounter a larger market for instruments that made new phenomena visible and measurable. This yields a second prediction: coffeehouse entry should increase the supply of experimental instruments, not only established practical tools.

Figure 7 compares average treatment effects on practical and experimental instrument shops before and after coffeehouse entry. The number of shops producing experimental instruments rises sharply after entry, alongside an increase in shops producing mathematical, navigational, and surveying instruments. The estimated increase is larger for experimental instruments, although the difference between the two post-treatment effects is not statistically significant. The pattern is nevertheless consistent with coffeehouses strengthening the link between experimental inquiry and the craftsmen who supplied its material tools.

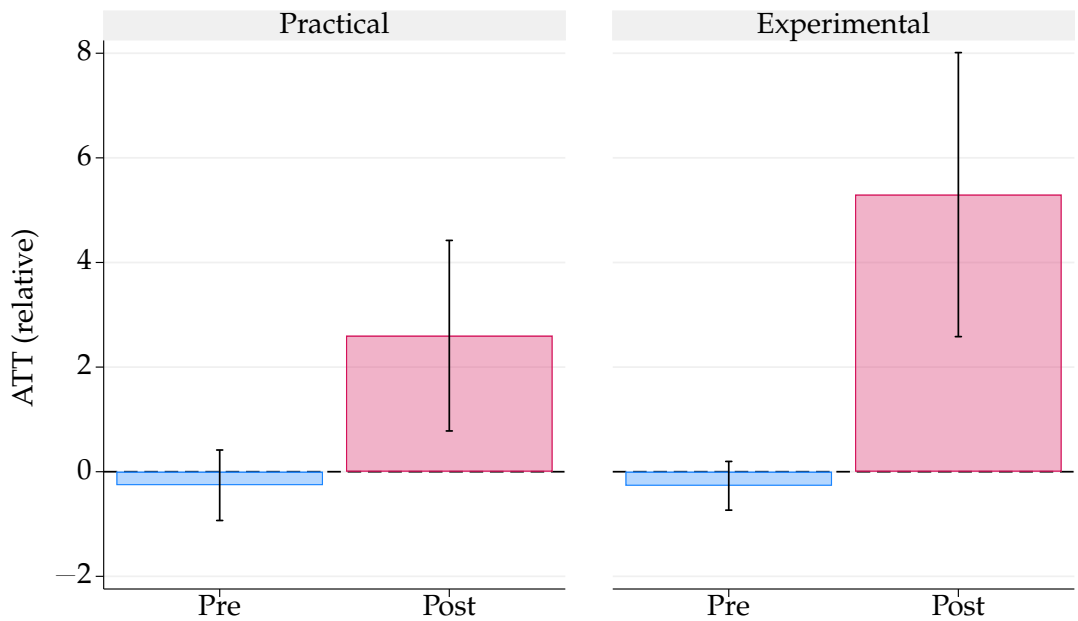


Figure 7. Effects on scientific instrument shops by type

Notes: Figure shows average treatment effects and 95 percent confidence intervals from equation (1) of first coffeehouse entry on practical (mathematical, navigational, and surveying) and experimental (optical and philosophical) instrument shops. "Pre" averages event study estimates from 50 to 20 years before entry; "Post" averages estimates from the decade of entry through 50 years afterward. Each outcome is divided by its reference mean, the sample mean one decade before the first coffeehouse opened. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to page 29]

5.4. Pubs and Ordinary Sociability

Pubs, understood here as taverns and inns, were long-standing venues for everyday social interaction. Since the Middle Ages, they had supported sociability through the provision of food, drink, lodging, and convivial exchange (Clark, 1983). Coffeehouses, by contrast, were a novel institution. They were similarly low-cost and sociable public venues, but centered on news, debate, and business, attracting civil, curious, and cosmopolitan customers, including virtuosi engaged in learned discourse (Cowan, 2005, p. 89). Scientific activity could and did occur in pubs (Stewart, 1992, p. 142), but historians link coffeehouses more closely to the virtuosi and the culture of experimental inquiry (Cowan, 2005; Ellis, 2004). As Cowan (2005, p. 260) argues, the coffeehouse was "not simply one among many backdrops" but "the product of the cultural world forged by the virtuosi in Britain's age of scientific revolution." In this sense, coffeehouses complemented rather than replaced pubs.

This distinction motivates a placebo test using pubs as an alternative class of meeting spaces. If meeting places alone raised scientific activity, pub openings should raise it too. Because pub and coffeehouse openings are correlated once coffeehouses appear, potentially reflecting common factors such as commercial rents (Appendix Table C.2), the informative sample is the 1550s–1640s, before coffeehouses existed. Figure 8 reports the estimated effects of the first seventeenth-century pub opening on this sample: pub openings do not increase mathematical practitioners or scientific instrument shops. Full-period estimates, which strong pre-trends render uninformative, and a detrended variant are reported in Appendix C.10.

5.5. Entry, Transmission, and Institutional Reach

Figure 9 reports average pre- and post-treatment effects for four outcomes that trace the wider implications of these mechanisms. Coffeehouses increase the number of apprentices employed by scientific instrument makers, indicating that the response extended beyond incumbent masters to training and entry into scientific trades. Exposure to public experimental science may have redirected young entrants, typically around age fourteen (Wallis, 2025), into instrument-making apprenticeships. The increase in connections from older to younger mathematical practitioners likewise points to intergenerational transmission, with established practitioners integrating younger cohorts into scientific communities.

The same figure shows an increase in fellows elected to the Royal Society, consistent with locally generated scientific activity reaching elite institutions rather than remaining outside them. Booksellers also expanded after coffeehouse entry. Because booksellers were themselves an important source of access to written knowledge, their response suggests that coffeehouse locations developed into broader sites of knowledge exchange

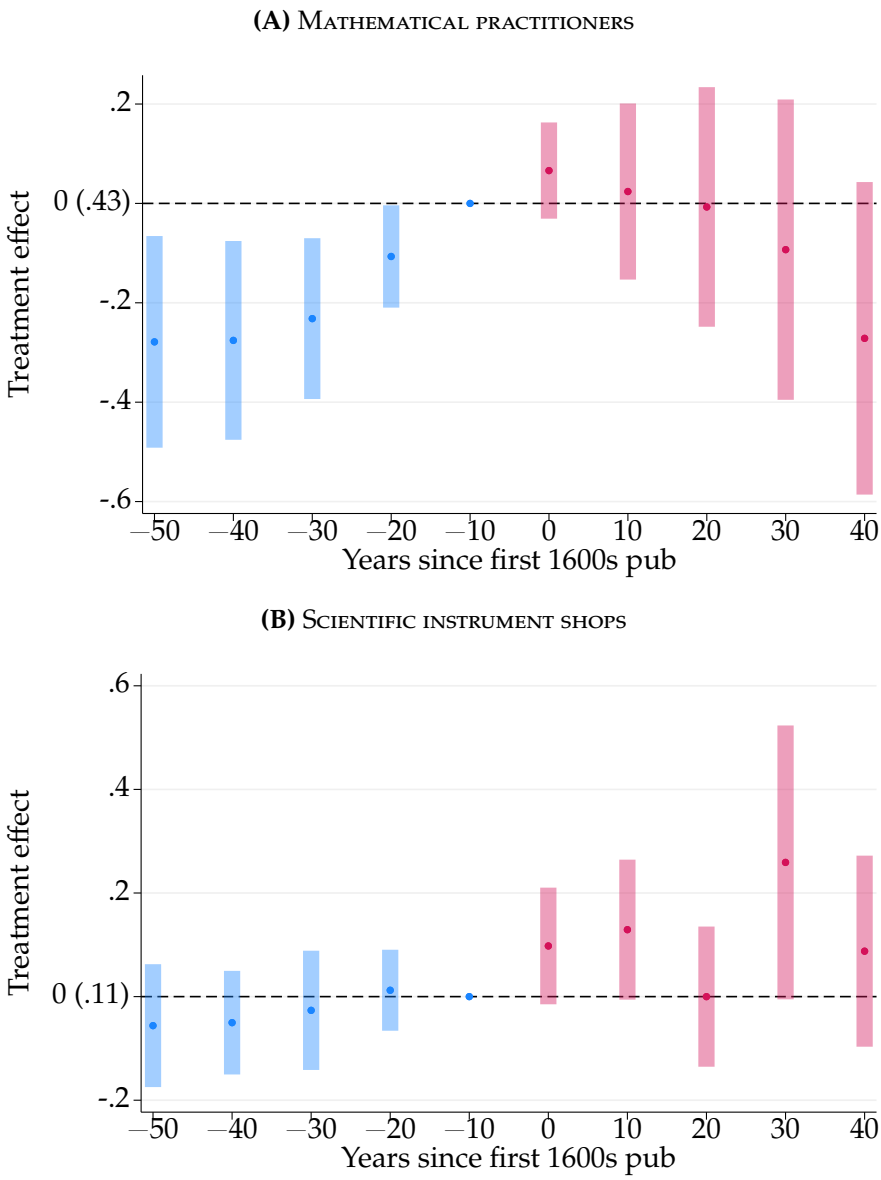


Figure 8. Pub effects on scientific activity

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first pub opening on scientific activity, estimated on the 1550s–1640s, before the first coffeehouse. Pubs are defined as taverns and inns. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Each outcome is divided by its reference mean, i.e., the sample mean of the outcome one decade before the first pub opened. Sample includes all 162 parishes. Unit of observation is parish-decade. Standard errors clustered by parish. [Return to page 30]

and agglomeration. These outcomes are not separate mechanism tests; together, they trace how lower entry barriers and greater contact propagated through training, social networks, and scientific institutions.

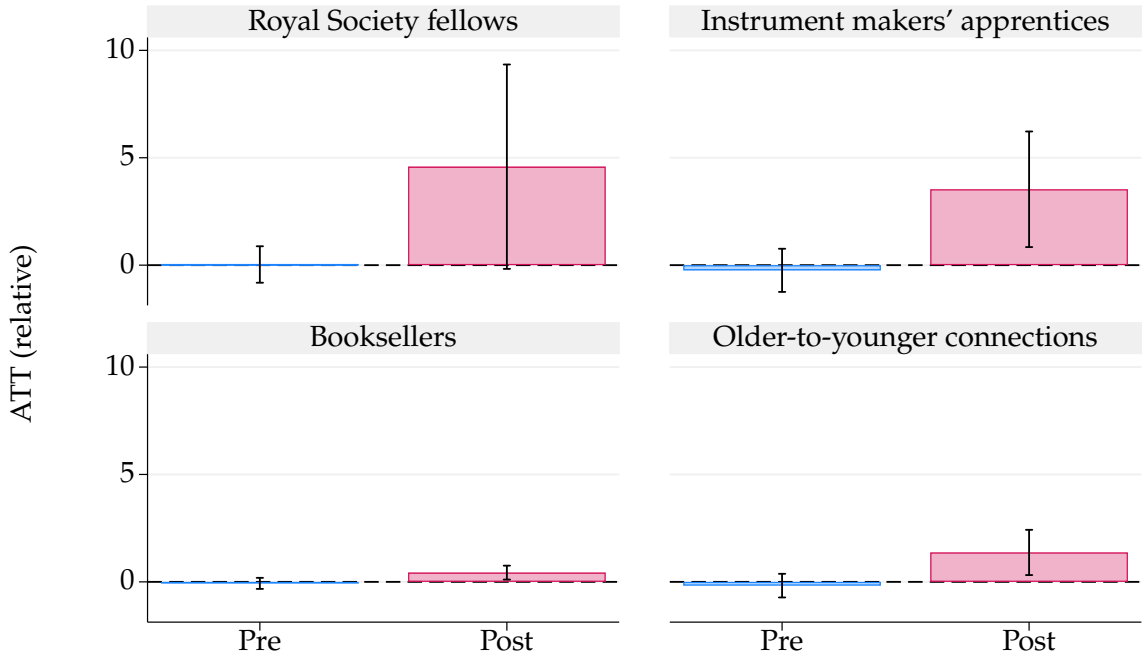


Figure 9. Effects on entry, transmission, and institutional reach

Notes: Figure shows average treatment effects and 95 percent confidence intervals from equation (1) of first coffeehouse entry on elected Royal Society fellows, scientific instrument makers' apprentices, booksellers, and connections from older to younger mathematical practitioners. "Pre" averages event study estimates from 50 to 20 years before entry; "Post" averages estimates from the decade of entry through 50 years afterward. Each outcome is divided by its reference mean, the sample mean one decade before the first coffeehouse opened. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to page 30]

6. CONCLUSION

This paper asks whether a low-cost venue for face-to-face exchange raised the production of useful knowledge. Coffeehouses spread parish by parish across seventeenth-century London after 1652, while the historical record tracks practitioners, instrument shops, connections, apprentices, and formal scientific membership. Using geocoded records and a staggered event study across 162 parishes, we find that the first recorded coffeehouse roughly doubled the number of mathematical practitioners and raised scientific instrument shops nearly fivefold, with effects that persisted. The results are not explained by differential pre-trends, observed predictors of entry, or coincident local booms, and survive placebo treatment assignments, alternative exposure definitions, and checks on how coffeehouses and scientists entered the historical record. Earlier pub openings produce no comparable increase. The historical setting supports this interpretation: coffeehouse founders and natural philosophers came from distinct social worlds, but philosophers were early customers who helped turn coffeehouses into venues for empirical discussion.

The magnitudes are large. Estimated effects account for 20 percent of mathematical practitioner-decades and 46 percent of scientific instrument shop-decades recorded in London from the 1650s through the 1690s, shares statistically attributable to entry under parallel trends. Because these estimates sum effects within treated parishes, they describe the response where coffeehouses opened rather than a London-wide equilibrium. Coffeehouses did not merely reflect London's growing scientific culture. They helped organize it. Where the response came from helps explain why. Effects are largest among practitioners whose surnames were least represented at Oxford and Cambridge. Connections between instrument makers and theoretically oriented practitioners rise, experimental-instrument shops become more common, makers take more apprentices, and Fellows associated with treated parishes increase in later decades. These patterns do not isolate a single channel, but together they are consistent with coffeehouses lowering the cost of reaching knowledge that others already held. The mathematical practitioners and instrument makers we count are the skilled implementers that accounts of Britain's later technological change place at its center (Meisenzahl and Mokyr, 2012; Mokyr, 2016). Our panel ends in 1699 and cannot reach that change; what it shows is that a venue costing a penny raised the local supply of such men.

That mechanism speaks to a question modern settings cannot yet answer. Wider access to a frontier technology can be observed immediately, but whether outsiders enter, relationships persist, and training and formal institutions follow takes decades to learn. Seventeenth-century London provides that horizon. Coffeehouses did not create the Scientific Revolution. But they made science more open, connected, and useful.

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ONLINE APPENDIX

"Coffeehouses and the Rise of Science"

Monir Bounadi & Jens Oehlen

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A. HISTORICAL BACKGROUND

A.1. Why Coffeehouses Opened

Identification in Section 4 requires the timing and location of first openings to be unrelated to trends in local scientific activity. The concern is that keepers anticipated scholarly demand and opened where scientific activity was already poised to grow. The documentary record cannot rule out such selection, but it points instead to non-scientific demand. Every recorded motive is commercial. Table A.2 documents the middling economic status of coffeehouse keepers, while Table A.4 shows that commercial ties among mathematical practitioners were rare before 1650.

The first coffeehouse in London illustrates this decision rule. Pasqua Rosée was a Greek servant whom the Smyrna merchant Daniel Edwards brought to London in 1651 to prepare coffee (Cowan, 2017; Ellis, 2004b). When visitors seeking coffee overran his household, Edwards sponsored Rosée in a shed in the churchyard of St. Michael Cornhill because membership in the Levant Company barred Edwards from retailing coffee himself. Alehouse keepers then petitioned the Lord Mayor to stop a non-freeman from trading. Rosée overcame this obstacle in 1654 by taking in Christopher Bowman, a freeman of the Grocers' Company who brought no knowledge of coffee but did bring the freedom of the City. In 1656, the partners leased premises for four pounds a year, and Rosée advertised the drink with a handbill invoking Galenic health claims (Rosée, 1652). Coffee thus entered London as a commodity with a supply chain, a licensing problem, a landlord, and competitors.

The other documented proprietors differed only in the commercial niches they served. Thomas Garraway built his Exchange Alley house around auctions, share dealing, and commercial news (Cowan, 2004a). Edward Lloyd made his house the resort of shipbrokers and marine underwriters and began publishing shipping intelligence in 1692 (Palmer, 2007). The house run by William Urwin attracted Dryden and the wits (Cowan, 2004c), while Alexander Man opened near Charing Cross in 1666 to capture Court trade (Lillywhite, 1963). Trade, finance, faction, and the Court exhaust the recorded motives. Even the hard case confirms the pattern. The Grecian, the house most closely associated with the Royal Society, was founded by George Constantine, a Greek immigrant and former mariner who was selling coffee in Threadneedle Street by 1665. Its initial appeal lay in the classical associations of his name and its location beside the Temple (Harris, 2000). A Royal Society clientele is documented only from 1709, and Newton did not settle in London until 1696. The scientific custom arrived four decades after the founding decision it would need to explain.

Timing was shaped by shocks common to the whole city: bulk imports by the East India Company from 1657 and its first sale in 1660 (Table A.3), the Excise Act of 1660,

the licensing requirement introduced by the excise reform of 1663, and the Fire of 1666 (Cowan, 2005; Ellis, 2004a). None varied with scientific activity in a particular parish. Repeated attempts by the Crown to suppress coffeehouses, from 1666 through the proclamation of December 1675, accused them of sedition and licentious discussion of affairs of state, never of natural philosophy (Cowan, 2004b, 2005).

The record cannot, however, rule out co-location. Coffeehouses concentrated in the wards around the Exchange, as did printers, instrument makers, and mathematical practitioners (Stewart, 1999). The historical evidence therefore addresses whether keepers deliberately targeted anticipated scientific demand, not whether coffeehouses and scientific activity shared the same commercial geography. Section 4 addresses the latter concern using pre-treatment dynamics, covariate adjustment, randomization inference, and placebo outcomes.

Selection into the historical record is also unlikely to explain the evidence. The houses discussed above are famous partly because historians later connected them to science, which makes them the houses most likely to have been sited on the outcome, yet their documented origins still lie in insurance, auctions, literary custom, and Court trade. The anonymous establishments comprising most of the sample are even less likely to have been founded in response to scholarly demand. This does not deny that the virtuosi shaped the reception of coffee or that coffeehouses later became consequential for science (Cowan, 2005; Pincus, 1995). The narrower claim is that the available evidence identifies coffee supply, commercial geography, immigrant expertise, taxation and licensing, and non-scientific clientele as the main determinants of where and when coffeehouses opened.

A.2. Coffee, Coffeehouses, and Science

Table A.1 traces coffee, coffeehouses, and science from the first Ottoman coffeehouses to the end of the seventeenth century. Two patterns bear on what follows. English natural philosophers wrote about coffee as a botanical and medical curiosity decades before the first London coffeehouse opened. And once the houses existed, what passed through them was not only natural philosophy but mathematical practice and instrument making: designs handed from theorists to clockmakers, calculating devices shown across a table, quadrants and watches commissioned and revised, printers and makers carried into the Royal Society.

Table A.1—Chronology of coffee, coffeehouses, and science

Coffee becomes an object of scientific inquiry

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- 1555 The Ottoman chronicler Ibrahim Pecevi dates Istanbul's first coffeehouses to about this year.
- 1573 Leonhard Rauwolf, a German physician and botanist, visits a coffeehouse in Aleppo and writes the earliest European description of coffee, which he circulates to naturalists including Carolus Clusius.
- 1592 Prospero Alpini, an Italian physician and botanist, publishes the first European botanical description and illustration of the coffee plant in *De plantis Aegypti*.
- 1623 Francis Bacon, the philosopher of the experimental method, discusses coffee in *Historia Vitae et Mortis*.
- 1627 Bacon returns to coffee in *Sylva Sylvarum*, classing it with tobacco and opium among drugs that "condense the spirits" and sharpen the mind.
- 1640 John Parkinson, apothecary to James I, introduces coffee to English botanical literature in *Theatrum Botanicum*, describing it as the "Turkes berry drinke."
- 1650s William Harvey, who established the circulation of the blood, drinks coffee privately with his merchant brother Eliab "before Coffee-houses were in fashion in London," according to Aubrey; the family's Levant and East India trade was the likely channel.

The coffeehouse becomes a site of scientific work

- 1652 Pasqua Rosée, a Greek servant of the Smyrna merchant Daniel Edwards, opens the first London coffeehouse near the Old Exchange.
- 1654 Samuel Hartlib, the intelligencer at the center of England's scientific correspondence network, notes in his *Ephemerides* the erection of "a cuphye-house or a Turkish, as it were ale-house [. . .] neere the Old Exchange," serving "a Turkish kind of drink made of water and some berry or Turkish beane."

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1655 Robert Boyle's circle, including Christopher Wren and John Wilkins, meets in the coffee-room of the Oxford apothecary Arthur Tillyard, the earliest documented gathering of natural philosophers in an English coffee-room. Wood dates the club at Tillyard's to about this year.

1657 The East India Company orders bulk imports, ending the Levant Company's monopoly on English coffee.

1657 Walter Rumsey, a Welsh judge and virtuoso, describes coffee as a "wakefull and civil drink."

1657 The Baconian projector John Beale writes to Hartlib that "the Turkish Coffa, which is soe much praysed by my Lord Bacon [. . .] is nowe brought into public sale."

1659 Edward Pococke, Laudian Professor of Arabic at Oxford, publishes *The Nature of the Drink Kahui, or Coffe*, a translation of an Arabic treatise; Hartlib circulates it in manuscript among the virtuosi and John Wallis later renders it into Latin.

1659 The Rota Club, a debating society founded by the political theorist James Harrington, meets at Miles's Coffeehouse at the Turk's Head; Hunter (1989) estimates that eleven of its twenty-seven identifiable members later became Fellows of the Royal Society.

1659 Peter Stahl, a German chemist brought to Oxford by Robert Boyle and lodged in his own house, becomes the first public teacher of chemistry in the university, instructing a circle tied to Tillyard's coffee-room; Richard Lower, John Locke, and others attend, and several later become Fellows of the Royal Society (Turnbull, 1953).

1660 The Royal Society is founded; the East India Company holds its first official coffee sale; the Excise Act taxes coffee at the keeper.

1660–62 Boyle's air-pump experiments, and Thomas Hobbes's attack on them, make the experimental method and the instruments that embody it a matter of public controversy.

1662 Robert Hooke becomes Curator of Experiments at the Royal Society.

1662 A pamphlet defending the *fuga vacui* account of the Torricellian experiment follows a dispute in a Wilde Street coffeehouse.

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1663	Samuel Pepys, the naval administrator and diarist, records "good discourse about physique and chymistry" at a coffeehouse, including news of a projector's design for "an instrument to sink ships."
1666	The Great Fire destroys and reorders the premises of the City.
1670s	Contemporaries begin to speak of "coffee-house philosophy" as a recognized form of debate.
1672	Thomas Willis, the Oxford physician and anatomist, analyzes the physiological effects of coffee in *De Anima Brutorum*, describing it as counteracting sleep.
1672–83	Hooke's diary records near-daily visits to at least 56 London coffeehouses, where he exchanged information, displayed instruments, and debated scientific questions.
1674	Hooke tells the clockmaker Thomas Tompion "at Childs coffee house of new Dividing compasses screw upon a Rule"; in October he is at Child's again with Henry Oldenburg, John Collins, Moses Pitt, and Joseph Moxon, who shows a calculating device made from Napier's bones.
1675	Hooke and Tompion meet at Garraway's to discuss Hooke's proposed arrangement of springs for a watch; the design passes through inspection and revision to presentation before the king.
1675	Charles II, who had first conferred with Clarendon on suppressing the houses in 1666, proclaims their suppression; the keepers petition at Whitehall and the order is rescinded before it takes effect. The charge is sedition, never natural philosophy.
1678	Joseph Moxon, a printer who moved into globes, instruments, and mathematical authorship through Hooke's coffeehouse circle, is elected to the Royal Society, an exceptional election for a tradesman.
1679	Hooke and Wren work through the "Planetary catena and coyled cone for Celestiall theory" at Bruin's coffeehouse, five years before the Garraway's meeting.
1680s	European physicians publish numerous treatises on the physiological and medicinal effects of coffee.

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1681 John Aubrey frets over "what the academiques say at the coffee-houses" about his life of Hobbes, an early sign of scholarly reputation being contested in the coffeehouses.

1684 Hooke, Wren, and Edmond Halley debate planetary motion at Garraway's Coffee House, prompting Halley's visit to Newton and the manuscript *De motu corporum in gyrum*, the basis of the *Principia*.

1686 John Ray, the naturalist, describes the coffee plant in *Historia Plantarum*.

1687 Antonie van Leeuwenhoek studies coffee seeds under the microscope and reports his observations to the Royal Society.

1689 Naturalists begin to club together at the Temple Coffee House, among them Hans Sloane and the apothecary James Petiver, meeting on Friday evenings to exchange specimens and botanical intelligence until about 1706. The membership of forty often attributed to the club is an error repeated from a misreading of the sources (Riley, 2006).

1690s Public lecture courses in mathematics, chemistry, and natural philosophy are advertised in London coffeehouses, often with demonstrations using experimental apparatus.

1697–1702 James Brydges moves deliberately among coffeehouses and taverns according to the company he expects to find, and leaves when the clientele proves unpromising: patrons treated venues as differentiated search technologies.

1698 Henri Misson de Valbourg, a French traveler, records that London's coffeehouses are "extreamly convenient": "You have all Manner of News there [. . .] you meet your Friends for the Transaction of Business, and all for a Penny, if you don't care to spend more" (Misson de Valbourg, 1719, p. 40).

1698 John Harris begins lectures on mathematics and natural philosophy at the Marine Coffee House in Birchin Lane.

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1699	John Houghton, an apothecary, coffee merchant, and Fellow of the Royal Society, publishes *A Discourse of Coffee* in the *Philosophical Transactions*, giving a history of the coffee trade and a natural history of the plant, and concluding that the "coffee-house makes all sorts of people sociable, they improve arts, and merchandize, and all other knowledge."
1701	Houghton returns to the theme in his *Collection for the Improvement of Husbandry and Trade*: an inquisitive man "may find out such coffee-houses, where men frequent, who are studious in such matters as his enquiry tends to," and there "gain the pith and marrow of the others reading and studies," getting "more in an evening than he shall by books in a month."

Notes: Table summarizes key dates linking coffee, coffeehouses, natural philosophy, mathematical practice, and instrument making in Europe, England, and London to the end of the seventeenth century based on Clark (2000); Cowan (2005); Ellis (2006); Hattox (2014); Lillywhite (1963); Mount (2021); Shapin and Schaffer (1985), on the diaries of Hooke (1935) and Pepys (2026), and on Houghton (1699, 1701). [Return to page 2]

Table A.2—Relative wealth in the London victualling trades, 1692–93

Trade	Individuals	Householders	Mean Rent, £	Mean Stock, £
Victuallers	773	768	21	26
Coffeemen and Women	137	135	30	20
Vintners	131	123	80	149
Innholders or Keepers	91	91	80	74
Tapsters	23	3	–	–
Alehouse-keepers	10	10	21	25
Strongwater-men	10	10	16	42
Total	1,175	1,140		

Notes: Data from Cowan (2005, table 7). [Return to page 1]

Table A.3—Coffee trade of the East India Company, 1650s–80s

Period	Activity	Pounds
1657	1st coffee order	22,400
1659	2nd coffee order	44,800
1660	1st official coffee sale	–
1660s	Coffee imports	45,000–56,000 per year
1680s	Coffee imports	280,000 per year

Notes: Avoirdupois pounds. Data from Smith (2001, pp. 264–5). [Return to page 1]

Table A.4—Commercial Connections of Mathematical Practitioners before 1650

Practitioner network size	Practitioners	With commercial tie	Commercial ties / all ties
1–9 ties	7	0	$0/36 \approx 0.0\%$
10–19 ties	15	3	$6/197 \approx 3.0\%$
≥ 20 ties	9	6	$12/348 \approx 3.4\%$
Total	31	9	$18/562 \approx 3.2\%$

Notes: The sample is the mathematical practitioners whose recorded flourishing ends before 1650. Network size is the number of SDFB relationships touching each practitioner; relationships are treated as undirected. Commercial contacts comprise merchants, traders, mercers, drapers, grocers, haberdashers, clothiers, shopkeepers, innkeepers, tavern keepers, victuallers, vintners, brewers, and publicans. Booksellers, printers, stationers, publishers, bankers, and financiers are excluded. The third column counts practitioners with at least one such contact. The final column counts each relationship once within a network-size group and once in the total. A relationship joining practitioners in different size groups appears in both relevant rows, so row denominators need not sum to the total.

B. DATA APPENDIX

B.1. Treatment Variable

Treatment is the opening of the first coffeehouse in a parish, so the treatment date is constructed from the coffeehouse counts defined here. Appendix Section B.7 assesses their completeness against independent records.

Coffeehouses, 1652–1699 (Lillywhite, 1963, 1972). The number of coffeehouses established between 1652 and 1699 in a given parish is based on public houses identified as coffeehouses by Lillywhite (1963, 1972), excluding entries explicitly marked as duplicates. When Lillywhite (1963, 1972) is uncertain whether two mentions refer to the same establishment, both are retained as separate entries. For any year t, the count includes all coffeehouses whose recorded years of activity encompass t, as determined by their earliest and latest mentions. In cases where only a decade is known (9 of the 286 coffeehouses), activity years are set to the full decade range (e.g., 1660s as 1660–1669). The count also includes chocolate houses, which Lillywhite (1963, 1972) treats as one subject with coffeehouses and at times cannot separate, typing a house "Chocolate or Coffee-house?". Five of the 286 are recorded as chocolate houses, four of them in St. James Westminster, a parish treated from 1659 on Harper's Coffee House. The fifth, in Queen's Head Alley, is the earliest record in St. Botolph Bishopsgate, at 1657; without it that parish enters in the 1660s.

B.2. Outcome Variables

The two main outcomes, mathematical practitioners and scientific instrument shops, measure applied scientific activity in a parish and decade; they draw on Taylor (1954) and Clifton (1995); Hay et al. (2025) respectively. The remaining variables support the connection and mechanism analyses. All are counts, and a practitioner or maker recorded at addresses in more than one parish contributes to each of them.

Mathematical Practitioners, 1600–1699 (Taylor, 1954). The number of mathematical practitioners in a given parish and decade is based on Taylor (1954), restricted to practitioners with at least one workplace located precisely enough to be geocoded within London and whose recorded flourishing overlaps 1600–1699. Each practitioner contributes a record for every decade from the decade containing the first year of flourishing to the decade containing the last, and is assigned to the parish of each recorded workplace. Within a parish-decade, a practitioner is counted once, however many workplaces Taylor (1954) records there; a practitioner with workplaces in more

than one parish contributes to each.

Connections Between Mathematical Practitioners, 1600–1699 (Taylor, 1954; Warren et al., 2016). The number of connections in a given parish and decade counts the undirected pairs g_{ijt} defined in Section 3, assigned to the parish of practitioner i and restricted to decades in which both i and j are flourishing. Connections are further split by whether each endpoint is a maker of scientific instruments or a theorist, defined as any other mathematical practitioner, so that a connection from a theorist in one parish to a maker elsewhere is counted in the theorist's parish.

Scientific Instrument Shops, 1600–1699 (Clifton, 1995; Hay et al., 2025). The number of scientific instrument shops in a given parish and decade is based on Clifton (1995); Hay et al. (2025), which record a shop address and years of operation for each maker. Addresses are geocoded and assigned to parishes as described in Appendix B.8. A shop contributes a record for every decade encompassed by its recorded years of operation and is counted once per parish-decade.

Practical Instrument Shops, 1600–1699 (Clifton, 1995; Hay et al., 2025). Shops whose makers are recorded as producing mathematical, navigational, or surveying instruments, counted as above. These are instruments for measuring, calculating, and setting out: sectors, dividers, and slide rules for calculation; quadrants, nocturnals, and compasses for navigation; theodolites, circumferentors, levels, and waywisers for survey. Surviving objects in Hay et al. (2025) include a brass sector attributed to Elias Allen, a horary quadrant by Henry Sutton dated 1658, and a surveying compass by the same maker dated 1661.

Experimental Instrument Shops, 1600–1699 (Clifton, 1995; Hay et al., 2025). Shops whose makers are recorded as producing optical or philosophical instruments, counted as above. These are instruments for observation and for producing effects under controlled conditions: microscopes, refracting and reflecting telescopes, and lenses on the optical side; air pumps, barometers, and thermometers on the philosophical side. A maker recorded in both groups contributes a shop to each, so the practical and experimental counts need not sum to the total number of shops.

Guild-Linked Instrument Shops, 1600–1699 (Clifton, 1995; Hay et al., 2025). Scientific instrument shops restricted to makers for whom Clifton (1995); Hay et al. (2025) record a London guild, counted as above. Of the 252 makers active in the panel, 175 have a recorded guild. No guild was dedicated to instrument making, so makers joined

existing companies, and most London makers did (Cormack, 2017, p. 79). The restriction therefore selects makers whose guild affiliation survives in the record, not makers who belonged to a guild, and it enters Section 4 as a check on selective visibility in the historical record rather than as a subgroup of independent interest.

The four outcomes that follow trace entry, transmission, and institutional reach in Section 5 rather than applied scientific activity directly.

Royal Society Fellows, 1600–1699 (The Royal Society, 2024). The number of Fellows of the Royal Society associated with a parish in a given decade, drawn from the Society's own catalogs and restricted to fellows whose recorded burial place or place of death lies in London. A fellow is assigned to the parish containing their geocoded burial site and contributes a record for every decade from the decade of election through the last decade of recorded fellowship. Burial is the only locator available at this resolution, so the variable places a fellow where their life ended rather than where they worked. It is therefore evidence on which parishes the Society's membership was eventually drawn from, not on where any particular piece of scientific work was done, and the lag between working and being buried should be kept in mind when reading the post-treatment horizon. The measure counts fellows associated with a parish in a decade rather than fellows newly elected in it.

Instrument Makers' Apprentices, 1600–1699 (Clifton, 1995). The number of apprentice bindings recorded to scientific instrument makers in a parish and decade. Clifton (1995) records each master's apprentices as a free-text list of names and years, which we transcribe and parse into one record per named apprentice and year. Apprentices recorded without a name are dropped, so a master whose entry notes an unnamed cohort contributes only the apprentices it names and the count is a lower bound. An apprentice named in two years, for instance at binding and again at turnover, contributes to both, so the variable counts binding-years rather than distinct individuals. The source records the master an apprentice was bound to, not the shop at which he served. Where a master kept more than one shop in a year, the binding is therefore counted in each of that master's parishes, since the evidence does not identify which one; parish totals consequently sum to 280 rather than to the 252 distinct binding-years recorded.

Booksellers, 1600–1699 (Isaac et al., 2024). The number of members of the London book trades recorded at an address in a parish and decade, from the British Book Trade Index. Addresses are geocoded and assigned to parishes as described in Appendix B.8. A trader recorded more than once within the same parish is counted once, since repeated entries reflect alternative descriptions of a single address, and each trader contributes a

record for every decade between the first and last recorded trading dates. Booksellers enter Section 4 as a covariate and Section 5 as an outcome.

Older-to-Younger Practitioner Connections, 1600–1699 (Taylor, 1954; Warren et al., 2016). Connections as defined above, restricted to those in which the practitioner assigned to the parish began flourishing in an earlier decade than the practitioner they are connected to. Each such connection is counted in the earlier practitioner's parish, so the measure captures ties running from established practitioners to younger ones rather than the reverse.

B.3. Covariates

The covariates are pre-treatment parish characteristics. They enter the balance comparisons in Tables 1 and C.1, the inverse-probability weighted and regression-adjusted specifications in Section 4, and, for several of them, the placebo outcomes reported in the appendix figures. Table B.1 gives the source for each. Definitions follow the order of the rows in Table 1 and close with exposure to the Great Fire, which is not a row in that table but enters Section 4 as a separate decade trend for exposed parishes. Counts recorded as an interval of activity are assigned to every decade the interval spans, and addresses are geocoded and assigned to parishes as described in Appendix B.8.

Households and Baptisms and Deaths (Cummins et al., 2016). Parish counts of households in 1638 and of baptisms and deaths by decade, taken from the parish register data assembled by Cummins et al. (2016). Densities divide each count by parish area in square kilometers. Baptisms and deaths are observed for 130 and 119 of the 162 parishes respectively, and the balance table reports the number of parishes with a nonmissing value in each row.

Median Tax Paid, 1582 (Cummins et al., 2016). The parish median assessment in the lay subsidy of 1582, in the units reported by Cummins et al. (2016).

Substantial Households, 1638 (Cummins et al., 2016). The share of households living in properties with an annual rent of at least £20 in 1638.

Tradesmen's Tokens, 1648–1651 (Burn, 1855). The number of tradesmen's tokens issued in a parish between 1648 and 1651, from the catalog of Burn (1855). Tokens were issued by individual traders as small change and are used here as a measure of the density of retail commerce immediately before the first coffeehouse opened.

Goldsmiths, 1600–1651 (Lillywhite, 1972). The number of goldsmiths recorded at an address in a parish before 1652.

Signs (Lillywhite, 1972). The number of signed premises recorded in a parish and decade, excluding taverns, inns, other pubs, and coffeehouses. Before street numbering, premises were identified by a hanging sign, so the residual category counts signed establishments that were not drinking houses.

Pubs (Lillywhite, 1972). The number of public houses active in a parish and decade, counted in every decade between the first and last recorded mention. The category runs wider than taverns and inns: it also takes in alehouses, ale men, wine houses, victuallers, and mum houses. The companion measure counts public houses newly recorded in the decade; the placebo figures and the balance tables use the active count.

Booksellers (Isaac et al., 2024). Defined among the outcomes above, where booksellers also appear in Section 5.

Dissenting Meetings (Hine, 1976). The number of dissenting meeting places first recorded in a parish and decade, from Hine (1976), a manuscript index of dissenting chapels in the City of London held at the Guildhall Library under shelfmark SL 18. The index is closed access and was transcribed on site. Each meeting place is dated by its earliest known date, which the source records either to the year or to the decade. End dates are not recorded, so the variable measures the number of newly recorded meeting places in a decade rather than a stock.

Clay-Pipe Finds (Museum of London, 2013). The number of excavated clay tobacco pipes assigned to a parish and decade. Finds are dated by the typological interval supplied with the record, and each retained find contributes to every decade its interval spans. Records carrying the non-informative interval 1580–1910 are excluded, since they would otherwise contribute to every decade in the panel.

Luxury Shops (Lillywhite, 1972). The number of shops in luxury trades recorded in a parish and decade, active in every decade between the first and last recorded mention. Trades are read from the description the source records for each sign, and the measure counts grocers, comfit makers, confectioners, tobacconists, and pastry cooks; the silk trades, meaning silk weavers, silk dyers, silk mercers, silkmen, and throwsters; mercers, lacemen and lace shops, milliners, and perfumers; cabinet makers and upholsterers; musical instrument makers and music sellers; and toy shops, wax

chandlers, and glass sellers. The measure is meant to capture retailers of the imported and fashionable goods that coffee itself belonged among, so three groups are excluded by construction: drinking and sociability venues, which lie too close to treatment; the book, print, map, and instrument trades together with clockmakers, which overlap the outcomes; and goldsmith-bankers, which are financial rather than retail establishments. Goldsmiths and silversmiths, apothecaries and druggists, hatters, glovers, calico printers, cheesemongers, and fruiterers are coded as borderline and left out. The narrower variant, restricted to the exotic imported consumables that reached London on the same ships as coffee, namely grocers, comfit makers, confectioners, and tobacconists, is constructed but not used in the paper.

Apothecaries, 1617–1640s (Wallis and Webb, 2000). The number of distinct masters named in geocoded binding records of the Apothecaries' Company in a parish and decade. The source records apprenticeship bindings rather than a complete stock of practicing apothecaries, so the variable measures masters who took an apprentice in the decade, not apothecaries present. It begins in 1617, so the pre-treatment average excludes the 1600s.

Theaters (Wikipedia, 2024). The number of playhouses whose operating interval overlaps a given decade. We construct the venue list ourselves, starting from the index of English Renaissance theatres on Wikipedia (Wikipedia, 2024) and the venue pages it links: we separate the first and second Blackfriars theaters, add venues the index omits, and date each playhouse by the end of ordinary or legal performance rather than by demolition, so operating intervals are shorter than a naive reading of the venue records would give. The list holds 19 venues, 18 of which fall inside the parish geography of the panel; the Hope, on Bankside, geocodes just outside it. Eleven had already closed before the Civil War, the earliest being the Red Lion in 1568 and the last the Swan around 1632. The other eight were still playing when the Long Parliament suppressed stage plays on 2 September 1642, and all eight are dated to that order. Playing continued illicitly at the Fortune, the Red Bull, the Cockpit, and Salisbury Court, and legal playing resumed at the Restoration, but the variable follows ordinary or legal performance, so no venue in the list reaches the 1650s and the count is zero in every decade from the first coffeehouse onward.

Scientific and Non-Scientific Letters (Hotson and Lewis, 2024). The number of letters sent or received from an address in a parish in a given decade, recorded in Early Modern Letters Online. Each correspondent is recorded in a single field holding a name, dates, and a short descriptive gloss, and a letter is scientific when the field for the author or the field for the recipient contains one of ten strings, matched in lower

case and anywhere in the field. Three are complete words, namely "cartographer", "meteorologist", and "pharmacist". Seven are stems, cut short so as to pick up the variants of a term: "astro" for astronomer and astrologer, "natur" for natural philosopher and naturalist, "experim" for experimental philosopher, "math" for mathematician, "physic" for physician and physicist, "chem" for chemist and alchemist, and "botan" for botanist. All remaining letters are non-scientific. Other learned descriptors are not treated as scientific, among them unqualified philosopher, theologian, historian, philologist, economist, humanist, professor, agriculture, and the book trades. The counts used here are restricted to letters whose location is recorded directly rather than interpolated. Because the classification keys on the correspondents rather than on the contents of the letter, it identifies correspondence involving people described in scientific terms, not correspondence about science.

Mathematical Practitioners and Scientific Instrument Shops Before 1652. Defined among the outcomes above, measured over the decades preceding the first coffeehouse.

City of London and London Wall (Cummins et al., 2016). The City of London indicator covers all 113 parishes within the City. The Inside the London Wall indicator covers the 97 of these parishes located within the historic London Wall and is therefore narrower. Both are constructed from the parish geography of Cummins et al. (2016).

Distances and Area. Great-circle distance in kilometers from the parish centroid to the Royal Exchange, Gresham College, and Paternoster Row, and parish area in square kilometers. Centroids and areas are taken from the parish geography of Cummins et al. (2016).

Exposure to the Great Fire. We construct this indicator by hand for each parish, recording whether the parish lay in the area destroyed by the Great Fire of 1666. We read the burnt area from the map of the fire's extent in Schofield (1984, pp. 172–173), the same map digitized by the study of the fire's economic impact that we cite in Section 4.

B.4. Data Sources

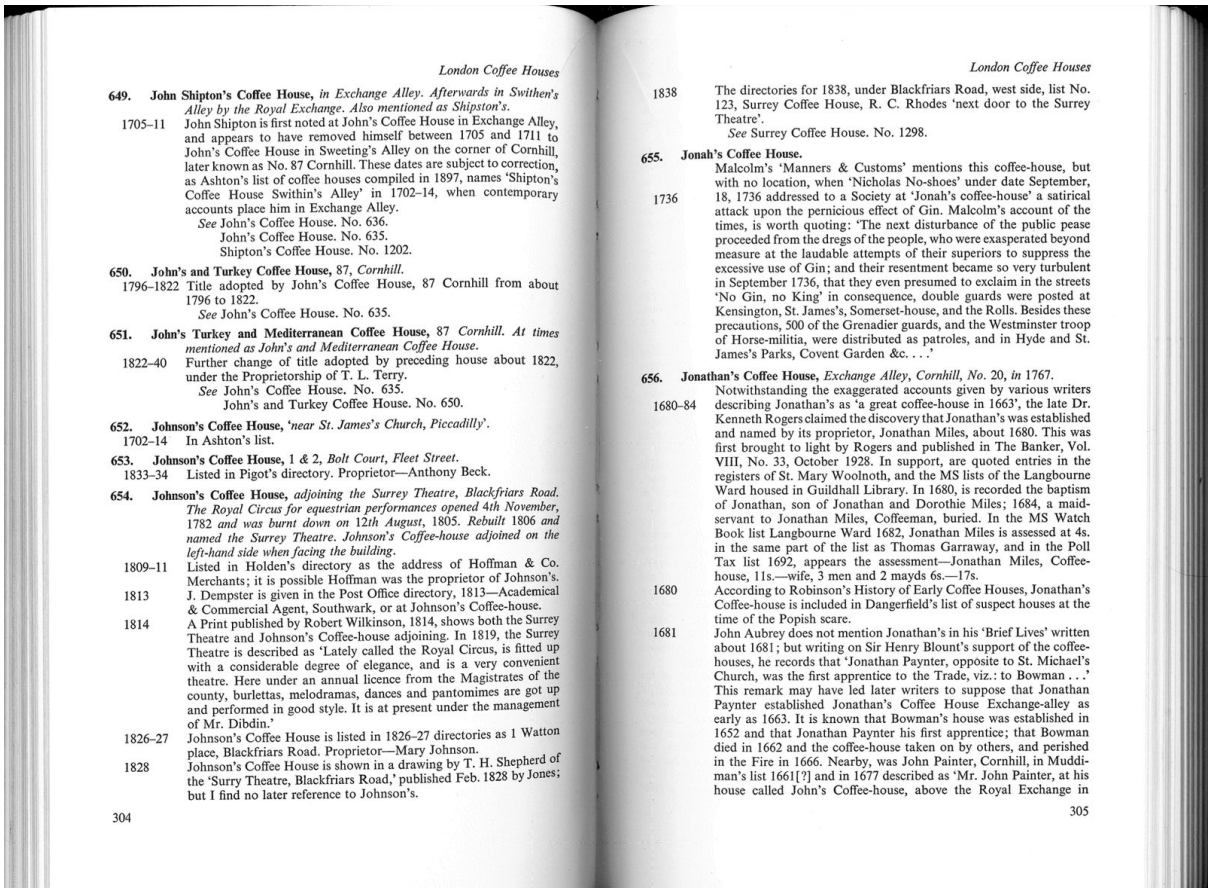
Appendix Table B.1 lists the source of every variable used in the paper.

Table B.1—Data sources

Data Source	Online Description	Variable(s)
Burn (1855)	Internet Archive	Tradesmen's Tokens 1648–1651
Taylor (1954)	Internet Archive	Mathematical Practitioners, Connections Between Mathematical Practitioners
Lillywhite (1963)	Internet Archive	Coffeehouses
Lillywhite (1972)	Internet Archive	Coffeehouses, Signs, Taverns, Inns, Goldsmiths
Clifton (1995)	Internet Archive	Scientific Instrument Shops, Scientific Instrument Makers
Hay et al. (2025)	National Museums Scotland	Scientific Instrument Shops, Scientific Instrument Makers
Clark and Cummins (2014)	Human Nature	Surname Counts Among Alumni at the University of Cambridge and Oxford
Cummins et al. (2016)	Economic History Review	Median Tax Paid 1582, Percentage of Substantial Households 1638, Baptisms, Deaths
Warren et al. (2016)	Six Degrees of Francis Bacon	Connections Between Figures in the *Oxford Dictionary of National Biography*
FamilySearch (2025)	FamilySearch	Surname Counts Among English Couples Married 1538–1649
Hotson and Lewis (2024)	Early Modern Letters Online	Letters Sent and Received
Isaac et al. (2024)	University of Oxford	Booksellers
The Royal Society (2024)	The Royal Society	Fellows of the Royal Society
Hine (1976)	Guildhall Library	Dissenting Meeting Places
Wallis and Webb (2000)	LSE Research Online	Apothecaries
Museum of London (2013)	Museum of London	Clay-Pipe Finds
Wikipedia (2024)	Wikipedia	Theaters

Notes: Table lists the historical data sources used to construct the study variables. Online descriptions link to the relevant catalogue, database, or source. [Return to pages 13, 16]

B.5. Pages of Original Historical Data



London Coffee Houses

649. John Shipton's Coffee House, *in Exchange Alley. Afterwards in Swithen's Alley by the Royal Exchange. Also mentioned as Shipston's.*

1705–11 John Shipton is first noted at John's Coffee House in Exchange Alley, and appears to have removed himself between 1705 and 1711 to John's Coffee House in Sweeting's Alley on the corner of Cornhill, later known as No. 87 Cornhill. These dates are subject to correction, as Ashton's list of coffee houses compiled in 1897, names 'Shipton's Coffee House Swithin's Alley' in 1702–14, when contemporary accounts place him in Exchange Alley.

See John's Coffee House. No. 636.
John's Coffee House. No. 635.
Shipton's Coffee House. No. 1202.

650. John's and Turkey Coffee House, 87, *Cornhill.*

1796–1822 Title adopted by John's Coffee House, 87 Cornhill from about 1796 to 1822.

See John's Coffee House. No. 635.

651. John's Turkey and Mediterranean Coffee House, 87 *Cornhill. At times mentioned as John's and Mediterranean Coffee House.*

1822–40 Further change of title adopted by preceding house about 1822, under the Proprietorship of T. L. Terry.

See John's Coffee House. No. 635.
John's and Turkey Coffee House. No. 650.

652. Johnson's Coffee House, '*near St. James's Church, Piccadilly*'.

1702–14 In Ashton's list.

653. Johnson's Coffee House, 1 & 2, *Bolt Court, Fleet Street.*

1833–34 Listed in Pigot's directory. Proprietor—Anthony Beck.

654. Johnson's Coffee House, *adjoining the Surrey Theatre, Blackfriars Road. The Royal Circus for equestrian performances opened 4th November,* 1782 *and was burnt down on 12th August,* 1805. *Rebuilt* 1806 *and named the Surrey Theatre. Johnson's Coffee-house adjoined on the left-hand side when facing the building.*

1809–11 Listed in Holden's directory as the address of Hoffman & Co. Merchants; it is possible Hoffman was the proprietor of Johnson's.

1813 J. Dempster is given in the Post Office directory, 1813—Academical & Commercial Agent, Southwark, or at Johnson's Coffee-house.

1814 A Print published by Robert Wilkinson, 1814, shows both the Surrey Theatre and Johnson's Coffee-house adjoining. In 1819, the Surrey Theatre is described as 'Lately called the Royal Circus, is fitted up with a considerable degree of elegance, and is a very convenient theatre. Here under an annual licence from the Magistrates of the county, burlettas, melodramas, dances and pantomimes are got up and performed in good style. It is at present under the management of Mr. Dibdin.'

1826–27 Johnson's Coffee House is listed in 1826–27 directories as 1 Watton place, Blackfriars Road. Proprietor—Mary Johnson.

1828 Johnson's Coffee House is shown in a drawing by T. H. Shepherd of the 'Surry Theatre, Blackfriars Road,' published Feb. 1828 by Jones; but I find no later reference to Johnson's.

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London Coffee Houses

1838 The directories for 1838, under Blackfriars Road, west side, list No. 123, Surrey Coffee House, R. C. Rhodes 'next door to the Surrey Theatre'.

See Surrey Coffee House. No. 1298.

655. Jonah's Coffee House.

1736 Malcolm's 'Manners & Customs' mentions this coffee-house, but with no location, when 'Nicholas No-shoes' under date September, 18, 1736 addressed to a Society at 'Jonah's coffee-house' a satirical attack upon the pernicious effect of Gin. Malcolm's account of the times, is worth quoting: 'The next disturbance of the public pease proceeded from the dregs of the people, who were exasperated beyond measure at the laudable attempts of their superiors to suppress the excessive use of Gin; and their resentment became so very turbulent in September 1736, that they even presumed to exclaim in the streets 'No Gin, no King' in consequence, double guards were posted at Kensington, St. James's, Somerset-house, and the Rolls. Besides these precautions, 500 of the Grenadier guards, and the Westminster troop of Horse-militia, were distributed as patroles, and in Hyde and St. James's Parks, Covent Garden &c. . . .'

656. Jonathan's Coffee House, *Exchange Alley, Cornhill, No.* 20, *in* 1767.

1680–84 Notwithstanding the exaggerated accounts given by various writers describing Jonathan's as 'a great coffee-house in 1663', the late Dr. Kenneth Rogers claimed the discovery that Jonathan's was established and named by its proprietor, Jonathan Miles, about 1680. This was first brought to light by Rogers and published in The Banker, Vol. VIII, No. 33, October 1928. In support, are quoted entries in the registers of St. Mary Woolnoth, and the MS lists of the Langbourne Ward housed in Guildhall Library. In 1680, is recorded the baptism of Jonathan, son of Jonathan and Dorothie Miles; 1684, a maid-servant to Jonathan Miles, Coffeeman, buried. In the MS Watch Book list Langbourne Ward 1682, Jonathan Miles is assessed at 4s. in the same part of the list as Thomas Garraway, and in the Poll Tax list 1692, appears the assessment—Jonathan Miles, Coffee-house, 11s.—wife, 3 men and 2 mayds 6s.—17s.

1680 According to Robinson's History of Early Coffee Houses, Jonathan's Coffee-house is included in Dangerfield's list of suspect houses at the time of the Popish scare.

1681 John Aubrey does not mention Jonathan's in his 'Brief Lives' written about 1681; but writing on Sir Henry Blount's support of the coffee-houses, he records that 'Jonathan Paynter, opposite to St. Michael's Church, was the first apprentice to the Trade, viz.: to Bowman . . .' This remark may have led later writers to suppose that Jonathan Paynter established Jonathan's Coffee House Exchange-alley as early as 1663. It is known that Bowman's house was established in 1652 and that Jonathan Paynter his first apprentice; that Bowman died in 1662 and the coffee-house taken on by others, and perished in the Fire in 1666. Nearby, was John Painter, Cornhill, in Muddiman's list 1661[?] and in 1677 described as 'Mr. John Painter, at his house called John's Coffee-house, above the Royal Exchange in

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Figure B.1. Coffeehouses in London (Lillywhite, 1963, pp. 304–5)

Notes: Excerpt from Lillywhite (1963), showing London coffeehouse entries and their historical references. [Return to page 13]

Numb. 11712.

December 7. 1728.

LOST or Miſlaid, laſt Thurſday, betwixt the Hours of Two and Five in the Afternoon, in Ab-Church-Lane, or thereabouts, a Ring with Six Brilliants, and one Emerald.

Whoever will bring it to Mrs. Branch, at the Sword-Blade Coffee-Houſe, in Birchen-Lane, ſhall have Two Guineas Reward, and no Queſtions ask'd; or if offer'd to be pawn'd, ſold, or valued, you are deſired to ſtop it, and give Notice as above, and you ſhall have the ſame Reward.

BENJAMIN PYNE, *Beadle*, at *Goldſmiths-Hall.*

Numb. 11924. *March 12. 1730.*

LOST on Thurſday the 11th of March, coming out of the Play-Houſe in Lincoln's-Inn-Fields, a Silver-Hilted Sword, wrought Work on the Shell and Guard, new faſhion'd: If offer'd to be pawn'd or ſold, pray ſtop it, and give Notice at Slaughter's Coffee-houſe, S. Martin's-lane, and you ſhall have *One Guinea* Reward, or if already pawn'd or ſold, your Money again with Content.

BENJAMIN PYNE, Beadle, at *Goldſmith's-Hall.*

PLATE 16

Reward Notices issued by the Beadle at Goldsmiths-Hall advertising rewards paid for the recovery of Lost property. Sword-Blade Coffee-Houſe in Birchen Lane. Dec. 7 1728. Slaughter's Coffee-houſe S. Martin's-lane. March 12 1730.

1162 **Sandals** Coffee House "opposite" or "over against the Custom House" Thames St. 1702-14.

13056 "**Sandford** Coffee House Lawrence Lane" [Cheapside] 1673-74.

1163 **Santrys** Coffee House No. 245 Borough High Street 1838.

The SARACENS HEAD sign in London appears in the fourteenth century. In early contemporary records industrious scribes have produced some ingenious spelling, including—Sarasens Head, Sarasines heved, Sarazenshed, Saresyneshede, Sarazineshed, Saresynes heved, Sarrecyn Head, Sarisons Head, Sarozons Hedd, Sarsons Hedd, Sarsyns Heedd, Sarsynshede, Sarzynesheved, Sarsvnesheved, Sazzinhede, and Saracens Head. Possibly another in "Sareseyneshe in Churche Acton" in 1551. It is found in use by inn and tavern keepers, grocers, chandler, mercer, skinner, and a goldsmith. The sign seems to have disappeared in present-day London. There remains one at Kings Langley, and elsewhere in the country the Saracens Head survives.

Saracen is a term used conveniently to denote non-European. Brewer gives various origins of the word; probably, he says, it is the Arabic sharakyoun or sharkeyn, the Eastern people, as opposed to Magharibe, the Western people, i.e. of Morocco. The Latin caracenus is derived from the Arabic shangri, meaning East. To the Romans, the Saracen denoted any of the nomadic tribes that raided the Syrian borders of their empire. In Britain, the word Saracen is an inheritance from the Crusades, a term used loosely to denote Easterner. Although applied mostly to Turks, it might be deemed to cover Muslims of many races.

According to Bagford's MS. (Harl. MSS. 5910) "Sarason Head" is the badge of "ye Ld. Audley and ye Ld. Cobham." John Selden writing about 1634-54, says: "When our countrymen came home from fighting the Saracens, and were beaten by them, they pictured them with huge, big, terrible faces (as you still see the sign of the Saracen's Head is) when, in truth, they were like other men. But this they did to save their own credit."

1164 "**Saresyneshede** wt ynne Algate" [Saracens Head within Aldgate]; "Sarozons Hedd within Aldgate" 1423-1539.

"**The Sarasens Head** within Algate". Chandler. c1648-60s; "Sarazens Head Inn Leadenhall St." 1677; "Sarazens-head within Aldgate" 1681-1804; "Saracens Head Tavern & Coffee-house Aldgate" 1809-11; "Saracens Head Inn, Tavern & Hotel" 1831; "Saracens Head Inn formerly opposite Aldgate Pump" 1855-56.

Saracens Head "in Northumberland Alley" 1904; No. 92 Fenchurch Street 1935.

13057 **Saracens Head** inn Camomile Street Bishopsgate c1670s-1851; No. 7 Camomile Street 1826.

13058 **Saracens Head** "at Bowe Bridge" [Bow, Middlesex] c1648-72.

13059 **Saracens Head** "in Iewen Street" [Jewin St. Cripplegate]. Grocer. 1667.

13060 "**Saracens Head** on the west part of the Back Alley or approach to the Tavern commonly called the Popes Head" [Popes Head Alley Cornhill]. Skinner. 1582.

13061 "**Sarazineshed** in the parish of St. Vedast" [Cheapside]. Tenement. 1356.

13062 "**Sarsynshede** in Fletestrete". Hostel. 1424.

13063 "**Saracens Head** in Gracious Street" [Gracechurch Street]. Inn. 1637.

13064 "**Sarasines heved** at the end of the lane called St. Clements in the parish of St. Edmund" [St. Clements Lane Lombard Street] 1380-82; 1414-15 ?

13065 "**Sazzinhede**" "Sarazenshed" Friday Street. Tenement. 1377-1401; 1518-32 [?]; "Sarazens heade Friday Street" 1549-1666 Inn consumed in the Fire.

"**Sarisons head** Inne in ffryday street next St. Mathews Church" 1669; Sarazens Head Inn west side of Friday Street 1677-c1844-50.

FIGURE B.2. SIGNS IN LONDON (LILLYWHITE, 1972, PP. 480–1)

Notes: Excerpt from Lillywhite (1972), showing information about seventeenth-century London signs. [Return to page 13]

to a mathematician for reading a mathematical lecture to his Majesty's servants relating to his Navy and instructing them in the art of navigation and other parts of the mathematics'. The syllabus he offered was of the usual type, but under 'Navigation' he added 'the construction and application of instruments for the taking of observations, heights, distances, plotting of countries, working of traverse etc., and the making of maps and charts'. He had read of the lectureship in a work on gauging by Henry Bond (144), who had held it, but there seems no record of whether his request was acceded to.

254. SUGAR, JOHN (fl. 1645–53), was a *globe-maker* at the Sign of the Atlas on Parnassus Hill, near St Michael's, Cornhill, making celestial and terrestrial globes of 14 in. and 15 in. diameter, as appears from his advertisements in Booker's and Wharton's Almanacks for 1653. The name of Joseph Moxon (228) is here associated as partner with that of Sugar, and as this is the first mention of Moxon, and the last of Sugar, the latter may have been at the end of his career. John Pell (173) writing in 1645 from Amsterdam to John Leake, a London stationer, said he had spoken to 'Mr Sugar' about some papers sent to London, which suggests that Sugar (like Moxon) had business in Holland.

255. ATKINSON, JOHN (ob. 1673), was a *compass-maker* at Harwich, Essex, who is known only by his will.

256. COULTON, JOHN (fl. 1653–4), was a *mathematical practitioner* living at Cobham, Surrey, whose Almanack was printed by R. & W. Leybourne.

257. OSBORNE (or OSBURN), HENRY (fl. 1653–86), a gentleman living in the Strand and later in Ireland, was praised by William Molyneux of Dublin as an excellent *mathematician* and astronomer. He was the correspondent of the young astronomer Jeremy Shakerley (233) who wrote to say that he had observed the solar eclipse of 1652 in Surat, and of Robert Hooke (270) who supplied him with instruments including a quadrant fitted with telescopic sights, a telescope and a micrometer, which were sent out to him in Drogheda. Edmund Halley (401) later recorded Osborne's observations of a solar eclipse in Ireland in his edition of Streete's *Astronomia Carolina* (*269*).

258. PIGOT, FRANCIS (fl. 1653–66), a *mathematical practitioner* who published an Almanack during the period 1654–62 which was 'rectified' for the meridian of Ludlow, himself lived at Cleobury Mortimer in Shropshire. Here he was ready to instruct any 'heroic spirit or generous gentleman' in the use of all sorts of mathematical and surveying instruments, the use of the globes, and so on.

259. SUTTON, WILLIAM (fl. 1653–63), was presumably the brother or near kinsman of Henry Sutton (188) since their names appear jointly in advertisements over a period of years. 'All manner of Mathematical Instruments either for Sea or Land are exactly made in Brass or Wood by

Henry Sutton or by William Sutton'. The latter had premises 'a little beyond the Church' in Upper Shadwell, which is down the Thames below Wapping. No examples of his work are known to have survived.

260. WREN, CHRISTOPHER (1632–1723), was from boyhood fertile in designing and making *mathematical instruments*, including a rain-gauge (1662), the moon globe ordered by Charles II, a new type of level (1667), an instrument for calculating the times of eclipses, an 'instrument for perspective' which Pepys saw when he visited Oldenburg (Secretary of the Royal Society) in May 1669, and many others, while several of his fine sundials survive. John Aubrey says that as a boy he was grounded in arithmetic and geometry by his sister's husband, the Rev. William Holder, while when he went to Oxford he was closely associated with Dr John Wilkins (181), and in London with Robert Hooke (270) who said of him 'Since the time of Archimedes there scarce ever met in one Man in so great a Perfection, such a mechanical Hand and so philosophical a Mind'. Yet designing instruments was only incidental to Wren's main occupations as successively Gresham and Savilian Professor, Surveyor-General after the Fire of London, and architect of the rebuilding. He was knighted in 1673. Work: *277*.

261. BRADFORD, JOHN (fl. 1654), is known by a mention of him as a *mathematical instrument-maker* in Foster's *Elliptical Horologiography*, published in 1654 by John Twysden (162).

262. COLEY, HENRY (1633–1707), was born at Oxford and, starting as a young clerk, came to London in 1654 to become amanuensis and later successor to the noted astrologer William Lilly. He practised as an astrologer throughout his life and taught this subject as well as the whole range of practical mathematical subjects, besides establishing his own *mathematical school* at a house 'over against the Old Hole in the Wall, Baldwin's Court, Baldwin's Gardens', a Court which ran out of Gray's Inn Lane. Here he taught for over thirty years. Prior to 1663 he had lived in Rose and Crown Court, Gray's Inn Lane. Coley advertised himself widely, in his own almanacks and elsewhere, and had a large circle of friends, including Elias Ashmole and John Kendal (393) of Colchester, both devoted to the mathematical arts. Several of his note-books survive and indicate the wide range of his reading, and his method of work. Work: *441*.

263. EYRE, JOHN (fl. 1654), who describes himself as a '*practitioner in the mathematics*' wrote a text-book on surveying, and presumably practised and taught the art. He was associated with Walter Hayes (251) as instrument-maker. Work: *216*.

264. SINCLAIR, GEORGE (fl. 1654, ob. 1696), was at first (1654) a schoolmaster at St Andrews, and took part in some experiments on the diving-bell (1655). An M.A. of Glasgow was conferred upon him (1654) and he was appointed to a Chair of Philosophy there which he held until 1666. Returning then to Edinburgh to teach mathematics, he determined

FIGURE B.3. MATHEMATICAL PRACTITIONERS IN ENGLAND (TAYLOR, 1954, PP. 240–1)

Notes: Excerpt from Taylor (1954), showing biographical entries of mathematical practitioners. [Return to page 15]

ALLEN James*
Known to have sold: sextant, repeating circle
Sources: Ts39 (1992/3) item 23; Bn; H; Und; Bennett (1985) p.19,22; Stimson (1985) p.103–04,113

ALLAN John
w 1790–1794
Sextant M, Quadrant M
London
1790–1794 12 Blewitt's Buildings, Fetter Lane, London
Father of ALLAN James*
Succeeded by ALLAN James*
Known to have sold: sextant
Sources: Ts39 (1992/3) item 23; W; JAC

ALLBUT Isaac
w 1811–1845
Rule M
Alternative name: ALLBUTT
1811–1845 Salop St, Wolverhampton
1818 105 Salop St, Wolverhampton
See also ALLBUTT I.*
Sources: PB; Pg; Wh

ALLBUTT I.
w 1845
Rule M
1845 Birmingham
See also ALLBUT Isaac*
Sources: Roberts (1982)

ALLCOCK Thomas
w 1851
Chrono M, Watch M
1851 14 South Island Place, Clapham Rd, London
Sources: PO

ALLEN -
w 1820
Alternative name: Possibly Alexander ALLAN
1820 Near the College, Edinburgh
Instrument advertised: geometric solids
Sources: Larkin (1820) (DJB)

ALLEN B.
w 1851
Optician
1851 2 Lower Copenhagen St, Islington, London
Sources: Wk

ALLEN Elias
w 1607 d 1653
Math IM (in brass), Book plate engraver
Alternative name: ALLIN
Blackhorse Alley, Fleet St, London
Horseshoe over against St. Clement's Church, Strand, London
1606–1611 Blacke Horse-ally, neere Fleetbridge, London
1623–1639 Without Temple Bar, over against St.Clement's Church, London
1618 At the Bull's head over against St Clement's Church, Strand, London
1653 Horseshoe without Temple Bar near St Clement's Church, London
1645 The Blackmoor without Temple Bar, London
Guild: Grocers, Clockmakers
Apprenticed to WHITWELL Charles c.1602 GC
Had apprentice:
BLAYTON (BLIGHTON) Edward 1612 GC
BLIGHTON John*nd fr 1620 GC
SHEWSWELL Thomas fr 1623 [possibly
SHASWELL *] GC
ALLEN John (I)* 1617 GC
SEFTON Henry 1620 GC
DAVENPORT Robert*1623 GC
BROOKES Christopher* 1629 GC
WINCKFIELD Edward 1629 GC
COOKE George 1635 GC
JORDAN William 1649/50 GC
GREATOREX Ralph* 1639 by t/o CKC
CHENEY Withers* 1646 by t/o CKC
GRIMES Edward 1640/41 by t/o CKC
PRUJEAN (PRIGEON) John* CKC
Took over from WHITWELL Charles*
Succeeded by GREATOREX Ralph*
Associated with
THOMPSON John (I)*
HAYES Walter*
THOMPSON Anthony*
fr GC 1612, fr CKC 1633; d 1653; another Elias Allen, who carried out surveys for Charles I was d by 1637
Known to have sold: armillary sphere, compass (magnetic), ellipsograph, marine astrolabe, mural quadrant, rule, sector, sundial
Instruments advertised: mathematical instruments
Sources: Brown J (1979a) p.24–25; Brown J (1979b) p.11–14,27; Bryden (1992) p.306n,308,318; DG

ALLEN James
w 1825–1826
Math IM
Alternative name: ALLAN?
1825–1826 196 Piccadilly London
See also ALLAN James *
Same premises as WORTHINGTON & ALLEN*
Attended London Mechanics Institute 1825–1826, not known as a master on his own
Sources: LMIR (AM)

ALLEN James Patishall
w 1850–1852
Math IM
1850–1852 20 King St, Stepney, London
Guild: Merchant Taylors, fr 1861
Son of ALLEN James [no trade given]
Apprenticed to LILLEY John (I)*or (II)* 1841
Sources: PO; Wk; GL: MTC MF 320, 324 (MAC)

ALLEN John (I)
w 1630–1642
Math IM (in brass)
1630–1631 Near the Savoy, Strand, London
Guild: Grocers fr 1631/2, ?Clockmakers 1653
Apprenticed to ALLEN Elias*
Had apprentice HAYES Walter* 1631/2 GC
Working in own name before free in 1631/2; a John Allen admitted to Clockmakers 1653
Known to have sold: astrolabe, sector
Sources: Brown J (1979a) p.26; Brown J (1979b) p.14,27; Bryden (1992) p.309

ALLEN John (II)
w 1842–1855
Phil IM, Drawing IM
1842–1845 35 St.Swithin's Lane, London
1847–1855 5 Three King Court, Lombard St, London
Succeeded by ALLEN Mrs.A.
Sources PO

ALLEN M.H. & J.W.
c 1838–1840
[Drawing IS]
Dame St, Dublin
Known to have sold: beam compass invented and made by SMITH W. & A.*
Sources: inst MHS; Pg

ALLEN Nathaniel
w 1790 w 1793
Ship chandler
1793 Wapping New Stairs, London
Guild: Merchant Taylors, fr 1766
Apprenticed to EADE Jonathan (I)* 1754
Son of ALLEN James, Gent , d, of Dulwich, Kent
Had apprentice ALLEN Thomas James, his son, 1781
Master MTC 1790
Sources: Wil; GL: MTC MF 319,320,324 (MAC)

ALLEN Thomas (I)
d 1767
Math IM
1767 Dublin
Sources: Burnett & Morrison-Low (1989) p.120

ALLEN Thomas (II)
w 1850–1856
Rule M
1850 12 St. Mary's Row, Birmingham
1850 (Residence) Aston Road, Birmingham
Took over from ALLEN & ROWE *
Associated with
ROWE James
ROWE Thomas
Sources: Roberts (1982); Sl

ALLEN William (I)
w 1788–1791
Phil IM, Math IM
1787 37 High St, Birmingham
1791 Bull Ring, Birmingham
Sources: Pye

ALLEN William (II)
fl 1838
Math IM, Phil IM
29 Seward St, Goswell St. London
Said by Taylor (1966) p.466 to be listed in directories, but not verified; possibly AILES William*

ALLEN & ROWE
w 1849–1850
Rule M

Figure B.4. Scientific instrument makers in the British Isles (Clifton, 1995, p. 6)

Notes: Excerpt from Clifton (1995), showing entries on scientific instrument makers in the British Isles. [Return to page 16]

B.6. Primary and Secondary Sources

This section presents examples of primary and secondary sources on which our main data sources are based (Clifton, 1995; Hay et al., 2025; Lillywhite, 1963, 1972; Taylor, 1954).

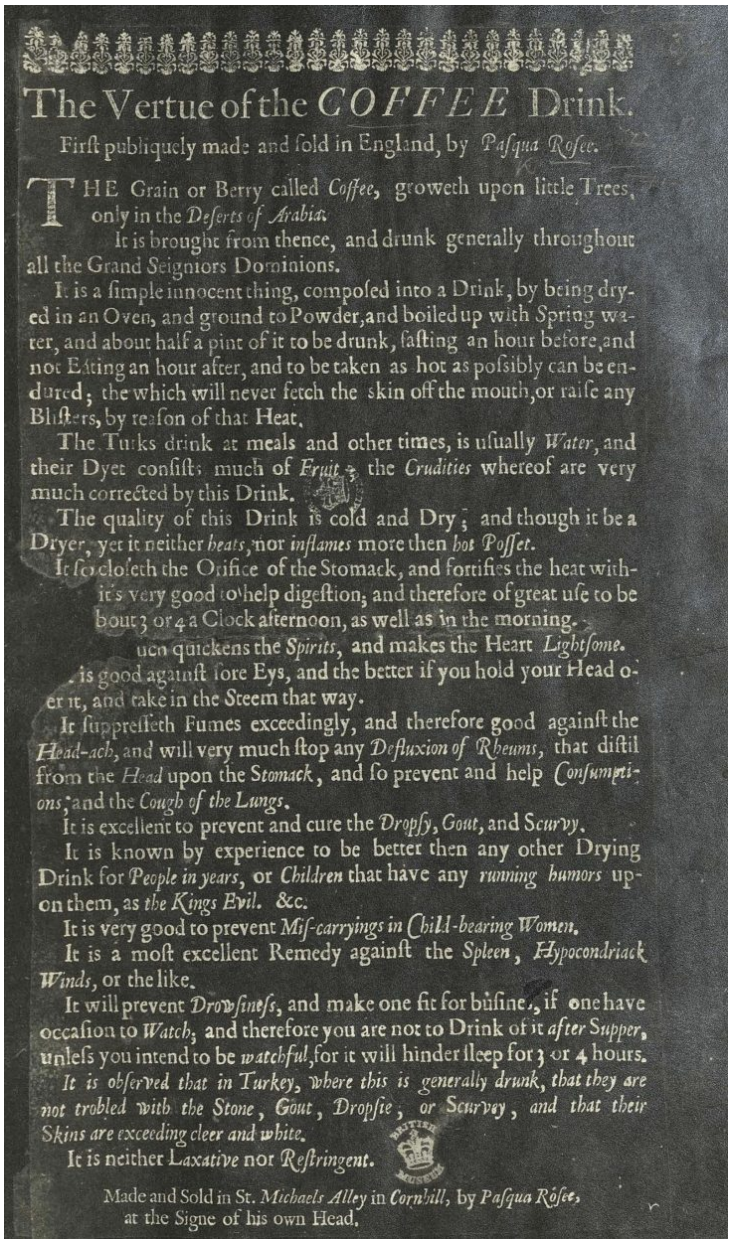
The works by Lillywhite (1963, 1972) draw on a wide range of primary sources. For 1652 to 1672, these mainly include catalogs of tokens issued by London coffeehouses; Appendix Figure B.5 provides an example. Another key source is the diary of Samuel Pepys, which covers 1660 to 1669. Lillywhite also relies extensively on contemporary advertisements, such as the one in Appendix Figure B.6, and archival materials on London history held in the Guildhall Library.

Taylor (1954) is based on a broad set of primary and secondary sources, detailed in Appendix Figure B.7. The 628 works on applied mathematics from about 1400 to 1715 are not listed here, as they are already cataloged in her study.

The underlying bibliography for the data on scientific instrument shops and makers in Hay et al. (2025) is available at https://toolsofknowledge.org/sources/. It covers 441 primary and secondary sources, with Clifton (1995) and its cited bibliographies serving as key references. Examples include trade cards, such as Appendix Figure B.8, and signed instruments, such as Appendix Figure B.9. These are often supplemented by later identification in guild records, since most scientific instrument makers belonged to a guild, although none was dedicated specifically to instrument making (Cormack et al., 2017, p. 4).

Figure B.5. The Turk's Head coffeehouse token, 1669

Notes: Copper alloy trade token issued by Nicholas Strange in 1669 for his coffeehouse in St. Ann's Lane, now part of Gresham Street, Aldersgate Ward, City of London. The obverse bears the inscription "NICH. STRAINGE. AT. YE. COFFEE" surrounding a Turk's head device. The reverse reads "HOVSE.IN.ST.ANNS.LANE.69" and shows a hand pouring coffee into a cup. London Museum, object ID 96.66/100*. [Return to page 22]



The Vertue of the *COFFEE* Drink.

First publiquely made and sold in England, by *Pasqua Rosee.*

THE Grain or Berry called *Coffee*, groweth upon little Trees, only in the *Deserts of Arabia.*

It is brought from thence, and drunk generally throughout all the Grand Seigniors Dominions.

It is a simple innocent thing, composed into a Drink, by being dryed in an Oven, and ground to Powder, and boiled up with Spring water, and about half a pint of it to be drunk, fasting an hour before, and not Eating an hour after, and to be taken as hot as possibly can be endured; the which will never fetch the skin off the mouth, or raise any Blisters, by reason of that Heat.

The Turks drink at meals and other times, is usually *Water*, and their Dyet consists much of *Fruit*; the *Crudities* whereof are very much corrected by this Drink.

The quality of this Drink is cold and Dry; and though it be a Dryer, yet it neither *heats*, nor *inflames* more then *hot Posset.*

It so closeth the Orifice of the Stomack, and fortifies the heat with-
it's very good to help digestion; and therefore of great use to be
bout 3 or 4 a Clock afternoon, as well as in the morning.
ucn quickens the *Spirits*, and makes the Heart *Lightsome.*
. is good against sore Eys, and the better if you hold your Head o-
er it, and take in the Steem that way.

It suppresseth Fumes exceedingly, and therefore good against the *Head-ach*, and will very much stop any *Defluxion of Rheums*, that distil from the *Head* upon the *Stomack*, and so prevent and help *Consumptions*; and the *Cough of the Lungs.*

It is excellent to prevent and cure the *Dropsy*, *Gout*, and *Scurvy.*

It is known by experience to be better then any other Drying Drink for *People in years*, or *Children* that have any *running humors* upon them, as *the Kings Evil.* &c.

It is very good to prevent *Mis-carryings in Child-bearing Women.*

It is a most excellent Remedy against the *Spleen*, *Hypocondriack Winds*, or the like.

It will prevent *Drowsiness*, and make one fit for busines, if one have occasion to *Watch*; and therefore you are not to Drink of it *after Supper*, unless you intend to be *watchful*, for it will hinder sleep for 3 or 4 hours.

It is observed that in Turkey, where this is generally drunk, that they are not trobled with the Stone, Gout, Dropsie, or Scurvey, and that their Skins are exceeding cleer and white.

It is neither *Laxative* nor *Restringent.*

Made and Sold in St. *Michaels Alley* in *Cornhill*, by *Pasqua Rôsee*, at the Signe of his own Head.

Figure B.6. The Vertue of the COFFEE Drink, 1652

Notes: This 1652 handbill, "The Vertue of the COFFEE Drink," is the earliest known advertisement for coffee in England. The final lines identify the coffeehouse as Pasqua Rosée's Coffee House, located in St. Michael's Alley in Cornhill. Reproduced by Williams (1936) from the original held at the British Museum. [Return to page 22]

BIBLIOGRAPHY OF SECONDARY WORKS

The Works listed in Part III provide the main source material for the book, and in addition a large number of contemporary works (including annual almanacks) compiled by or referred to by the Mathematical Practitioners have been examined for biographical details. The manuscript material used is mainly that in the British Museum, supplemented by the Ashmolean MSS. in the Bodleian Library, and the Minutes and Letter Books (with a few miscellaneous original Papers) of the Royal Society.

AUBREY, JOHN. *Letters written by Eminent Men . . . and Lives of Eminent Men*. London 1813.

BIRCH, THOS. *History of the Royal Society of London*, 1756–7.

Calendars of State Papers.

CLAY, R. S. and COURT, T. H. *History of the Microscope*, 1932.

CUDWORTH, W. *Life of Abraham Sharp*, 1889.

EDLESTONE, J. *Correspondence of Newton and Cotes*, 1850.

GUNTHER, R. T. *Early Science in Oxford*, 1923–35.

GUNTHER, R. T. *Early Science in Cambridge*, 1937.

HALLIWELL, J. O. *Collection of Letters illustrative of the Progress of Science in England*, 1841.

HALLIWELL, J. O. *Rara Mathematica*, 1841.

HALLIWELL, J. O. *Private Diary of John Dee*, 1842.

JOHNSON, F. M. *Astronomical Thought in Renaissance England*, 1937. [With a Bibliography of Works relating to the History of Mathematical Science].

MACPIKE, E. F. *Correspondence and Papers of Edmund Halley*, 1932.

PEARCE, E. M. *Annals of Christ's Hospital*, 1920.

PEPYS, SAMUEL. *Catalogue of Manuscripts* (Navy Records Society, Vols. 27, 36).

PEPYS, SAMUEL. *Tangier Papers* (Navy Records Society. Vol. 73).

PEPYS, SAMUEL. *Naval Minutes* (Navy Records Society, Vol. 60).

RIGAUD, S. P. *Correspondence of Scientific Men of the Seventeenth Century*, 1841.

ROBINSON, H. W. and ADAMS, W. *The Diary of Robert Hooke*, 1935.

STONE, EDMUND. *Construction and Use of . . . Mathematical Instruments* (2nd edn.), 1758.

TAYLOR, E. G. R. *Tudor Geography*, 1930.

TAYLOR, E. G. R. *Late Tudor and Early Stuart Geography*, 1935.

TAYLOR, E. G. R. Contributions (since 1928) to the *Geographical Journal*, *Imago Mundi*, *Journal of the Institute of Navigation* and *Mariner's Mirror*.

TURNBULL, H. W. *James Gregory Tercentenary Memorial Volume*, 1939.

WARD, JOHN. *Lives of the Professors of Gresham College*, 1740.

WOLF, A. *History of Science, Technology and Philosophy in the 16th and 17th Centuries*, 1935.

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FIGURE B.7. PRIMARY AND SECONDARY SOURCES USED BY TAYLOR (1954)

Notes: Selection of primary and secondary sources cited in Taylor (1954). [Return to page 22]

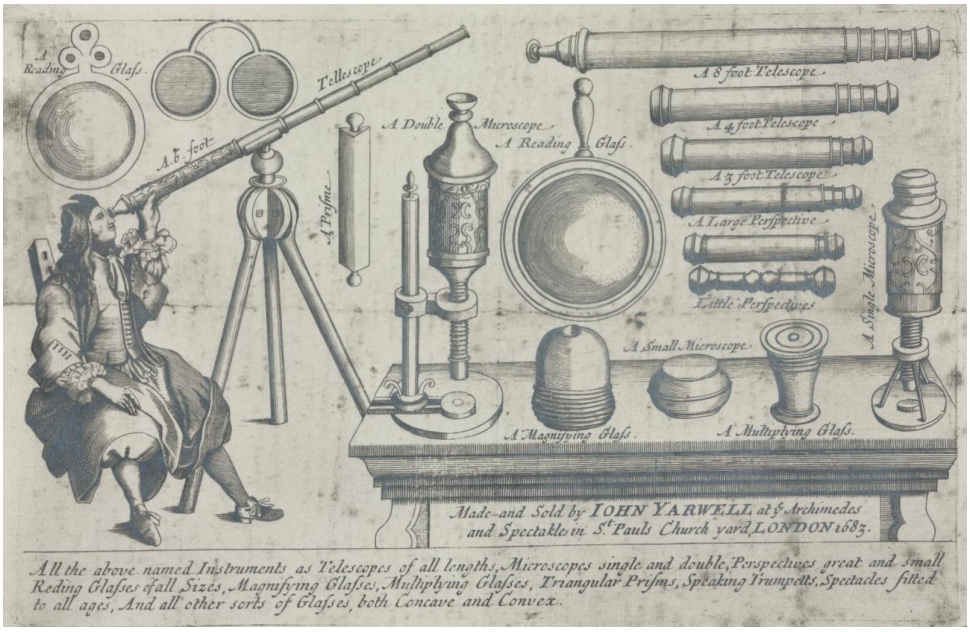


Figure B.8. Trade card of John Yarwell, London, 1683

Notes: Trade card of the optical instrument maker John Yarwell, St. Paul's Churchyard, London, 1683. Science Museum Group Collection, object no. 1951-687/45. [Return to page 22]

Figure B.9. Compendium by Elias Allen, London, 1630–1653

Notes: Compendium consisting of a sundial, compass, and calendar indices, made by Elias Allen in London, 1630–1653, near St. Clement's Church close to the Strand. Inscribed "Elias Allen fecit," with the outer lid engraved with the royal coat of arms, attributed to the reign of Charles I. Science Museum Group Collection, object no. 1883-135. [Return to page 22]

B.7. Data Validation

Coffeehouses. First, we assess the completeness of the coffeehouse dataset by benchmarking the number of recorded coffeehouses against counts from the City of London Magistrates (1663) survey and the 1692–1698 poll tax returns reported by Cowan (2005). The 1663 survey lists 82 coffeehouses in the City of London, while Lillywhite (1963, 1972) records 31.[31] The 1692–1698 poll tax lists 90 coffeehouses in 13 of 26 wards for which data are available, while 1701 administrative records note 34 more in 7 of the 13 previously missing wards, giving a total of about 124 coffeehouses in the late seventeenth century, slightly above our estimate of 113 for 1692–1698 based on Lillywhite (1963, 1972). This pattern suggests that Lillywhite (1963, 1972) covers late seventeenth-century coffeehouses more comprehensively than those from mid-century, likely reflecting the loss of records associated with the 1666 Great Fire. Observation delays also contribute. "Henry Willington" in "Dowgate" is listed in the 1663 survey, with "H. Wellington" in "Dowgate" first noted in a 1665 token by Lillywhite (1963, 1972). Similarly, Lillywhite (1963, 1972) may have ceased observing a coffeehouse before 1663. To facilitate a broader 1663 comparison, we consider a margin of error: allowing a margin of ±1 year around 1663 results in 37 coffeehouses recorded by Lillywhite (1963, 1972), ±2 years in 42, and ±3 years in 71.[32]

Second, Mackie (2013) attempts to extend Lillywhite (1963) using modern searchable databases, including Electronic Enlightenment, Old Bailey Online, and British Periodicals, among others.[33] This effort yields only a small number of additional and often ambiguous cases. We conduct a parallel search using two Gale resources, the *Seventeenth and Eighteenth Century Nichols Newspapers Collection* and the *Seventeenth and Eighteenth Century Burney Newspapers Collection*, focusing on mentions of "coffee" and its variants. These sources reference coffeehouses less frequently than would be expected based on Lillywhite (1963, 1972). Furthermore, when "coffee" is associated with a location not listed in those sources, it is often unclear whether the venue is a coffeehouse, a tavern, or an inn. This ambiguity underscores the difficulty of identifying additional establishments from digitized archives and reinforces the conclusion that it is hard to improve upon Lillywhite (1963, 1972). Moreover, claims that thousands of coffeehouses operated in London by the late seventeenth or early eighteenth century (e.g., Iliffe, 1995) rely primarily on secondary sources and lack primary documentation. In fact, the first systematically documented count appears in 1739, when William Maitland recorded 551 coffeehouses in his *History of London*, compiled over an eleven-month period (Ellis,

[31] Lillywhite (1963, 1972) does not mention City of London Magistrates (1663), likely because the survey lists coffeehouses only by owner and ward, without names or specific addresses.

[32] The sharp increase under the ±3 margin reflects a spike in 1666 shown in Appendix Figure B.10, likely driven by the extensive documentation of properties affected by the Great Fire, which destroyed nearly all of London within the city walls.

[33] Mackie (2013) does not draw on Lillywhite (1972).

2006, pp. xxix–xxx).

Third, Appendix Figure B.10 plots the number of coffeehouses in seventeenth-century London in the dataset. The series exhibits discrete shifts that align with major historical events. The first recorded opening occurs in 1652, and counts increase sharply from 14 in 1659 to 26 in 1660, coinciding with the Stuart Restoration. The Great Fire of 1666 is associated with a temporary disruption in recorded coffeehouses and documentation, and the series does not display a pronounced decline in 1666, consistent with incomplete observation. The number of new coffeehouses increases sharply following the Rebuilding Acts of 1666 and 1670, and the upward trend persists through the end of the century.

Fourth, Appendix Figure B.11 plots the frequency of coffeehouse-related terms in the British English corpus from the Google Books Ngram Viewer. Because most coffeehouses in the British Isles were located in London (Cowan, 2005), movements in the corpus likely reflect developments in London. The close alignment between the two series suggests that Lillywhite (1963, 1972) provides a reasonably representative account of the historically observed universe of coffeehouses. Mentions in the early seventeenth century, prior to the first London coffeehouse opening in 1652, likely reflect the emergence of discourse about coffee and coffeehouses rather than physical establishments (Smith, 2001).

Mathematical Practitioners. To our knowledge, no independent source exists to cross-verify the set of so-called mathematical practitioners compiled by Taylor (1954), beyond the consensus noted in Section 3 that subsequent research has added only a small number of additional practitioners and that the list is largely considered definitive (Walton, 2017, p. 89). A simple internal validity exercise nonetheless lends credibility to the dataset. Appendix Figure B.12 reports, by decade, the number of connections held by the most connected practitioner. These central figures align closely with established accounts of seventeenth-century London science.

Before the prominence of the polymath Robert Hooke (1635–1703), widely known for frequent coffeehouse visits and highly sociable engagement with fellow scientists, the leading instrument maker Elias Allen (c. 1588–1653) consistently ranks among the most connected practitioners. Allen had an extensive clientele, including Kings James I and Charles I, and maintained ties with prominent mathematicians such as Edmund Gunter (1581–1626) and William Oughtred (1574–1660), inventor of the slide rule and the multiplication sign. Alongside these figures appears William Leybourne (1626–1716), an active mathematician, land surveyor, author, printer, and bookseller.

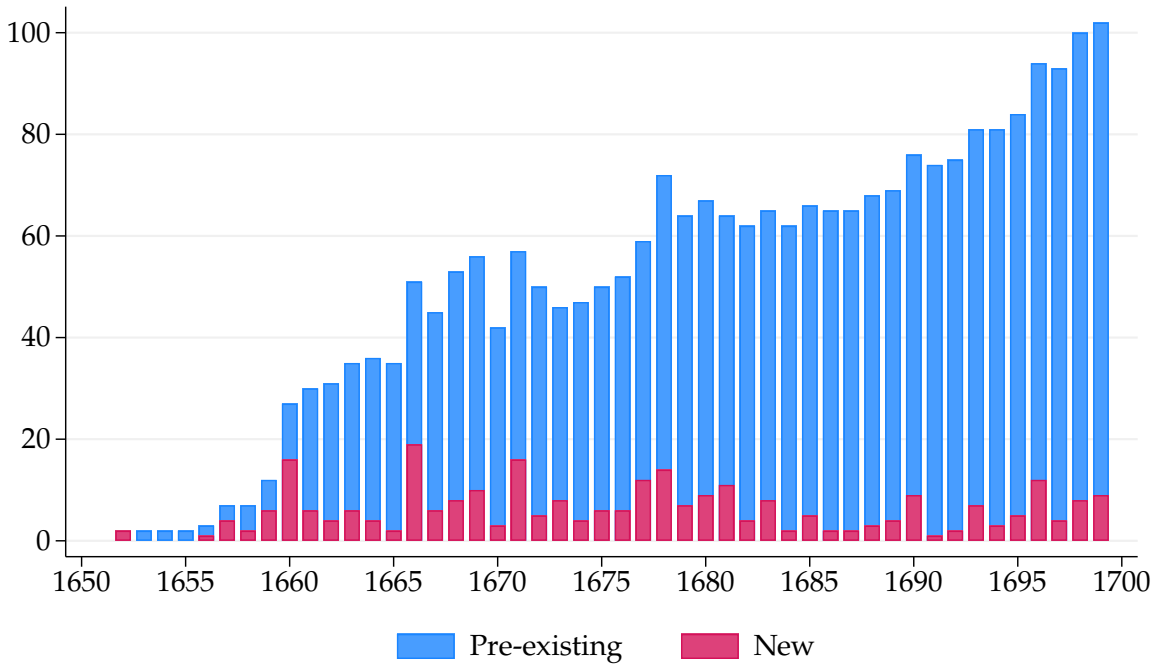


Figure B.10. Coffeehouses in London over time

Notes: Figure plots the annual number of coffeehouses in London from 1652, when the first opened, to 1699, distinguishing between those already established and those newly opened. Data from Lillywhite (1963, 1972). [Return to pages 27, 28]

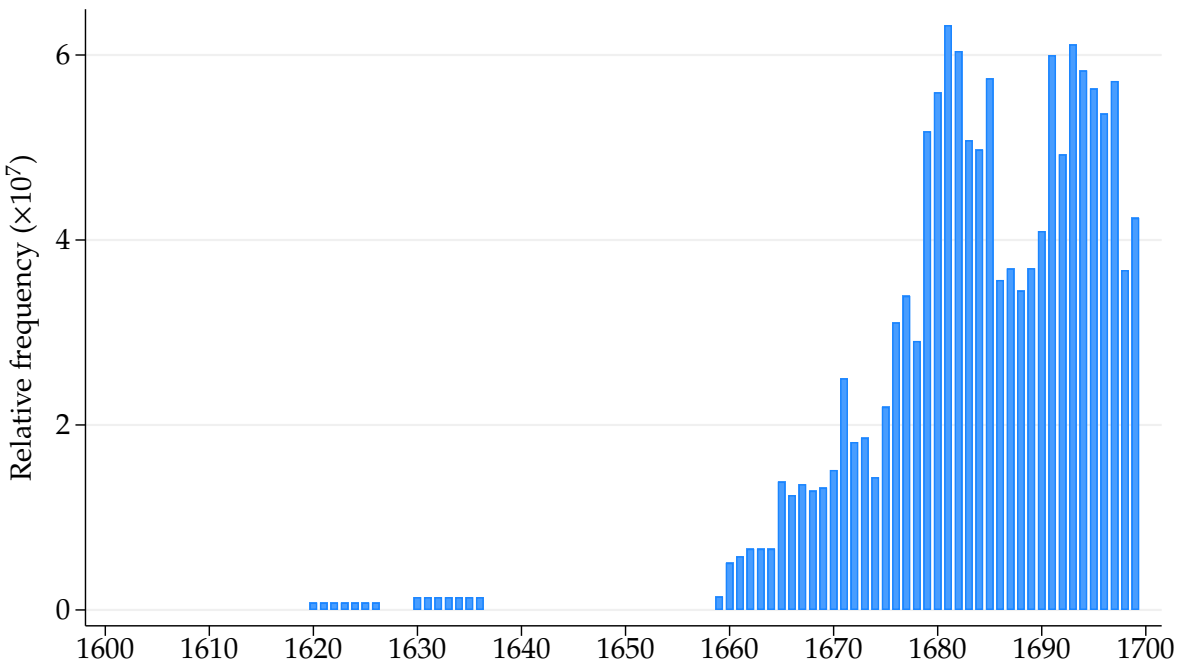


Figure B.11. Frequency of n-grams containing coffeehouse terms over time

Notes: Figure plots the annual relative case-insensitive frequency of n-grams containing the terms "coffee house" and "coffeehouse" from 1600 to 1699. Data from Google Books Ngram Viewer, British English corpus, accessed November 5, 2025. [Return to page 28]

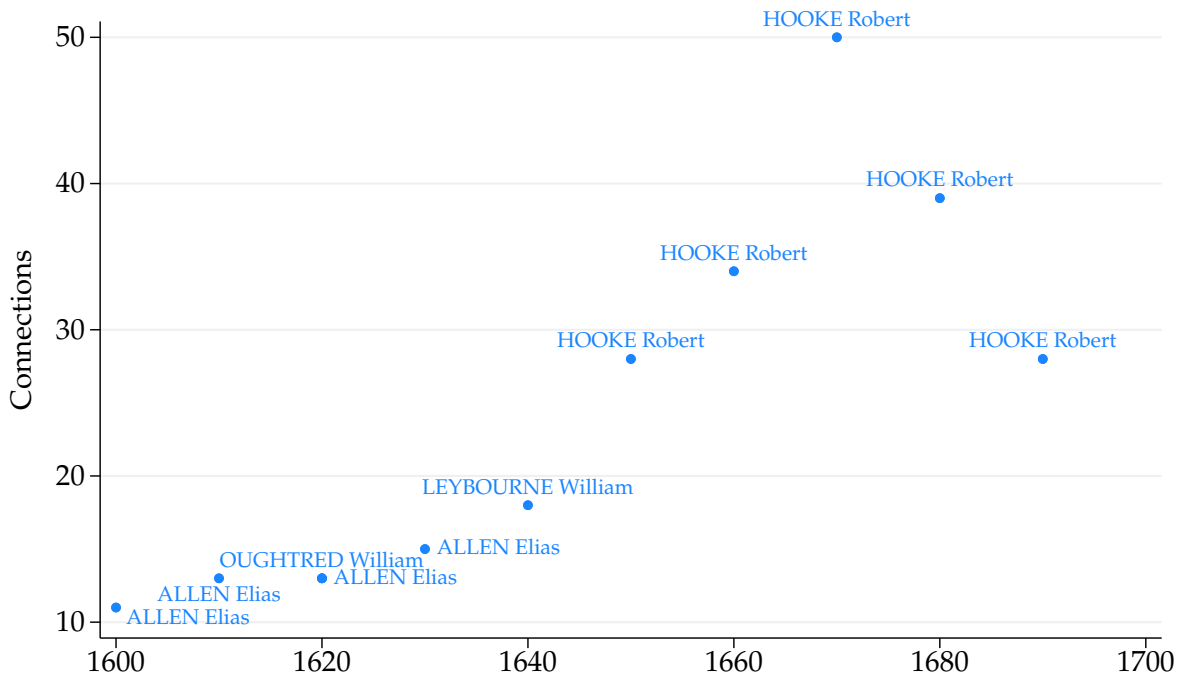


Figure B.12. Most connected mathematical practitioner over time

Notes: Figure shows, for each decade, the number of connections of the most connected mathematical practitioner. In the 1620s, William Oughtred and Elias Allen are tied with 13 connections each. [Return to page 28]

B.8. Geocoding

B.8.1 Procedure

Each historical address is assigned a geographic coordinate through a two-step, manually performed process aided by digital tools:

1. The address is located on a historical map of London.
   - Digitized historical maps of London are available on the Grub Street Project website (https://www.grubstreetproject.net/). Several of these maps support searchable places. See Figure B.13.[34]
   - If the address cannot be found on a historical map of London, we use contextual information from the source or additional resources (e.g., Wikipedia, historical gazetteers, historical works on London) to identify either a nearby address that can be located on a historical map of London or, failing that, the smallest containing geography that can be so located, typically the street. We prefer the nearby address where one is available, and fall back on the containing geography only when the exact position within it cannot be recovered.
2. The geographic coordinate of the location identified in Step 1 is estimated by visually overlaying the historical map onto a contemporary Google map of London, aligning key geographic features (e.g., rivers, streets, and churches) that survive in both. This comparison is inherently imperfect, owing to the limited accuracy of seventeenth-century maps of London. John Rocque's 1746 map constitutes the earliest topographic survey of the city precise enough to allow comprehensive georeferencing against modern maps, so for the seventeenth century the alignment rests on individual features whose present-day position is known independently rather than on the geometry of the historical map itself.[35]

Additionally, though infrequently, we may deviate from this process and rely on other credible sources. For example, we use a map of about 100 London workplaces from Taylor (1954), whose plotted points are themselves transferred to coordinates by the overlay described in Step 2, and coordinates for roughly 600 addresses already geocoded in the Early Modern Letters Online project (Hotson and Lewis, 2024), which supplies them directly. All coordinates are manually verified.

[34] A digital gazetteer of locations from the Woodcut Map of London (early 1560s) has been created on the Map of Early Modern London website (https://mapoflondon.uvic.ca/index.htm), which was occasionally used for hard-to-geocode addresses.

[35] Cf. *Locating London's Past: Recreating Rocque, London 1746*, available at https://locatinglondonspast.wordpress.com/2011/06/22/recreating-rocque-london-1746, accessed September 5, 2025.

B.8.2 Worked Examples

Below we geocode four historical addresses, ordered from the most to the least straightforward, to demonstrate the procedure.

Direct match, no modern name. Geocode "Jewen St," recorded as the address of a scientific instrument maker active in 1671.

1. Strype's 1720 survey and accompanying map, reproduced in Figure B.13, record Jewen (Jewin) Street running east from Aldersgate Street to Redcross Street, immediately north of the churchyard of St. Giles-without-Cripplegate.[36]

2. Unlike the cases below, the street has no modern counterpart that can be matched by name: Jewin Street and the neighboring Redcross Street were demolished in the twentieth century for the construction of the Barbican Estate.[37] The coordinate is therefore obtained by overlaying the historical map onto a contemporary Google map and aligning two features whose present-day position is known, the church of St. Giles-without-Cripplegate and the line of Aldersgate Street. The midpoint of the street yields the following coordinate: $(51.51955, -0.09577)$.

Direct match, surviving name. Geocode "St. Katharine's Stairs."[38]

1. The Grub Street Project provides points on digitized maps of London from 1553 to 1736 indicating the location of "St. Katherine's Stairs."[39]

2. The 1736 map clearly shows that the location lies just southeast of the Tower of London, next to the Thames. Because the name survives, the corresponding modern location is identified directly on Google Maps as "St. Katharine Docks," and the overlay of Step 2 serves only to confirm the match against the Tower and the river frontage. This yields the following coordinate: $(51.50640, -0.07187)$.

Nearby landmark. Geocode "Pasqua Rosée's Coffee House" in "St. Michael's Alley, Cornhill."

[36] Strype describes the yard of the Castle Inn on Aldersgate Street as having "a passage into Jewen street" (Strype, 1720). See *The Grub Street Project :: Places :: Castle and Falcon*, available at https://www.grubstreetproject.net/places/945/, accessed July 27, 2026.

[37] *Jewin Street*, London Picture Archive, The London Archives, available online, accessed July 27, 2026.

[38] Spelling varies across sources between "Katharine" and "Katherine"; we retain each source's form when quoting it.

[39] *The Grub Street Project :: Places :: St. Katherine's Stairs*, available at https://www.grubstreetproject.net/places/4318/, accessed September 4, 2025.

1. The location refers to a medieval alley next to St. Michael's Church in Cornhill.[40] The original church, destroyed in the Great Fire of London (1666), was replaced in 1670 by the present church on the same site.[41]

2. The exact position of the coffeehouse within the alley cannot be recovered, so we substitute the adjacent church, whose site is unchanged and which Google Maps locates directly. This yields the following coordinate: (51.51325, −0.08556).[42]

Containing street. Geocode "Pilkington Court."

1. The location refers to a court in Little Britain, according to a contemporary obituary register kept by the London bookseller and antiquary Richard Smyth.[43]

2. We are unable to identify the exact location of Pilkington Court within Little Britain, and no nearby address is recoverable, so we fall back on the containing street. Little Britain is a sufficiently precise reference, being a short and well-known street in seventeenth-century London, and its Wikipedia entry provides the following coordinate directly: (51.51699, −0.09780).[44] Accordingly, these coordinates are assigned to "Pilkington Court."

[40] *The Grub Street Project :: Places :: St. Michael's Alley*, available at https://www.grubstreetproject.net/places/4421/, accessed August 5, 2025.

[41] *St Michael, Cornhill*, Wikipedia, available at https://en.wikipedia.org/wiki/St_Michael,_Cornhill, accessed August 5, 2025.

[42] *St Michael Cornhill Saint Michael's Alley, London* on Google Maps, available at https://maps.app.goo.gl/9DJKJm9cwTVkz1fN7, accessed August 5, 2025.

[43] Smyth's 1661 entry records "Mr. Franck, a juryman at Pilkington Court in Little Britain" (Smyth, 1849, p. 53). The register was published posthumously in 1849 and was discovered through a Google search for `"Pilkington Court" "London" filetype:pdf`.

[44] *Little Britain, London*, Wikipedia, available at https://en.wikipedia.org/wiki/Little_Britain, accessed September 5, 2025.

Figure B.13. 1720 London (Strype): Excerpt from the Grub Street Project website

Notes: Digitized 1720 map of London with a geocoded layer of streets, roads, thoroughfares, public markets, bodies of water, and places, from the Grub Street Project at the University of Saskatchewan, based on *A New Plan of the City of London, Westminster, and Southwark* in Strype (1720). [Return to pages 31, 32]

B.9. Figures

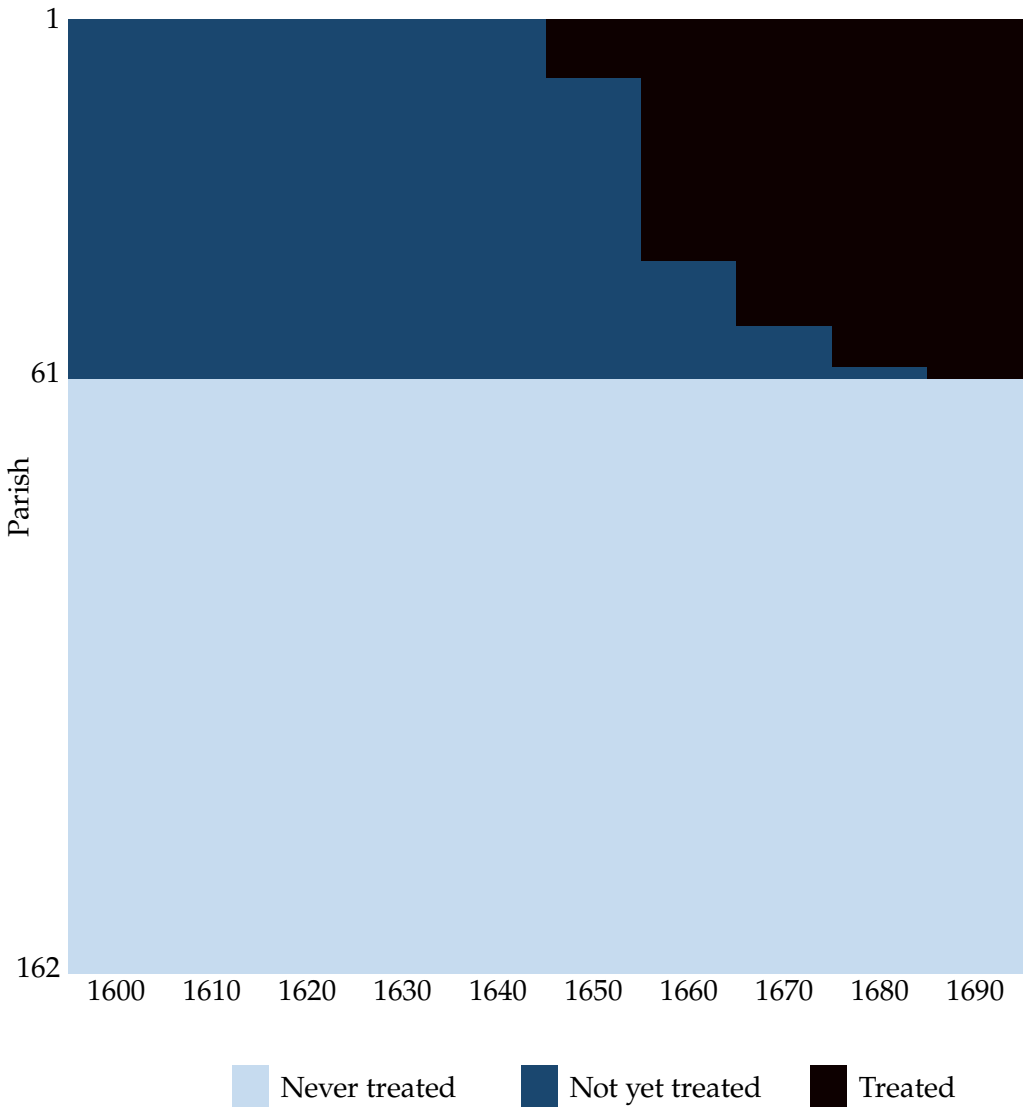


Figure B.14. Treatment rollout: first coffeehouses

Notes: Figure shows the decades in which the first coffeehouse opened across all 162 parishes, grouped by decade of first opening. Parishes are ordered from earliest to latest opening decade, followed by those with no coffeehouse openings. [Return to pages 18, 20]

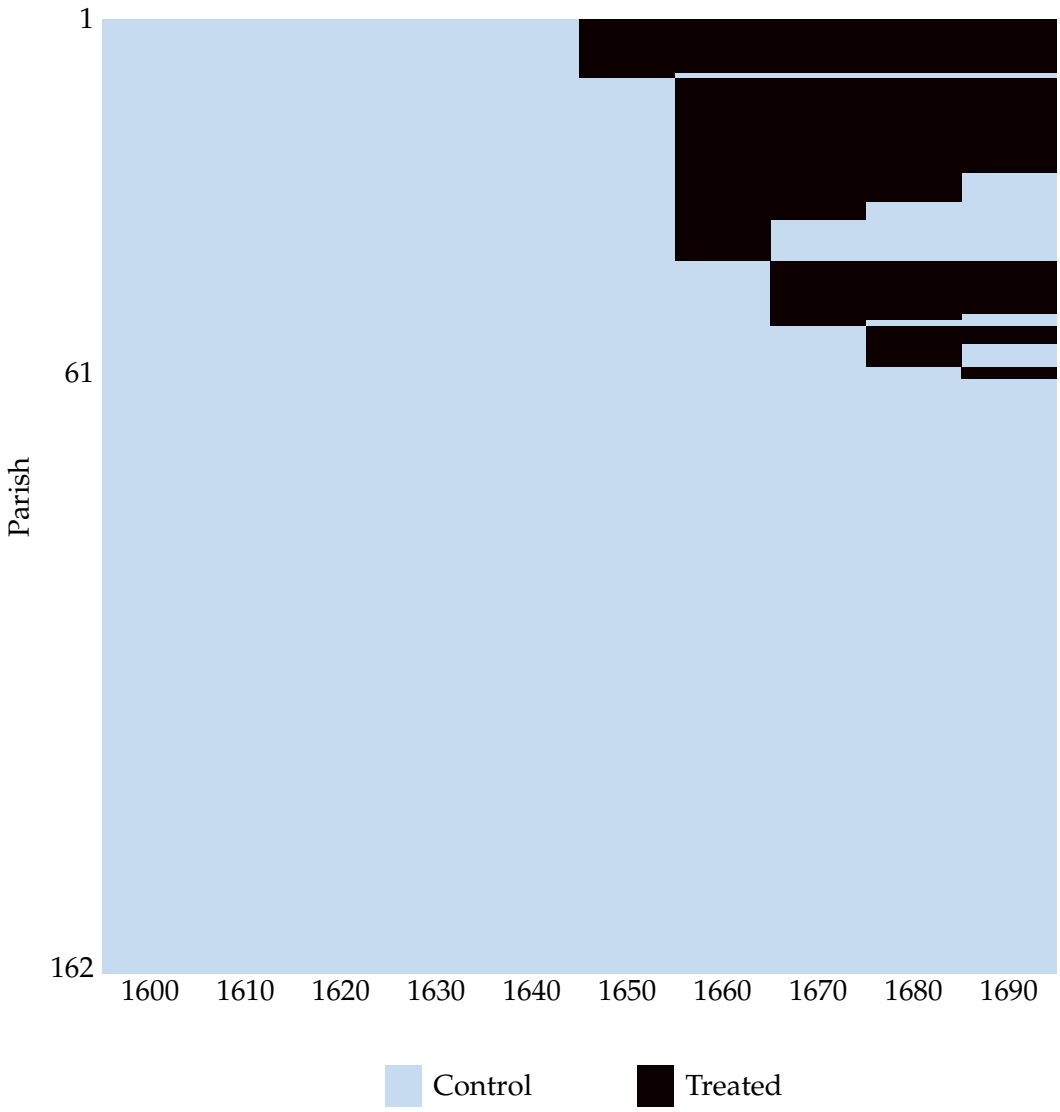


Figure B.15. Treatment rollout: coffeehouse presence

Notes: Figure shows the decades in which a coffeehouse is open across all 162 parishes, grouped by decade of first opening. Parishes are ordered from earliest to latest opening decade, followed by those with no coffeehouse openings. [Return to page 49]

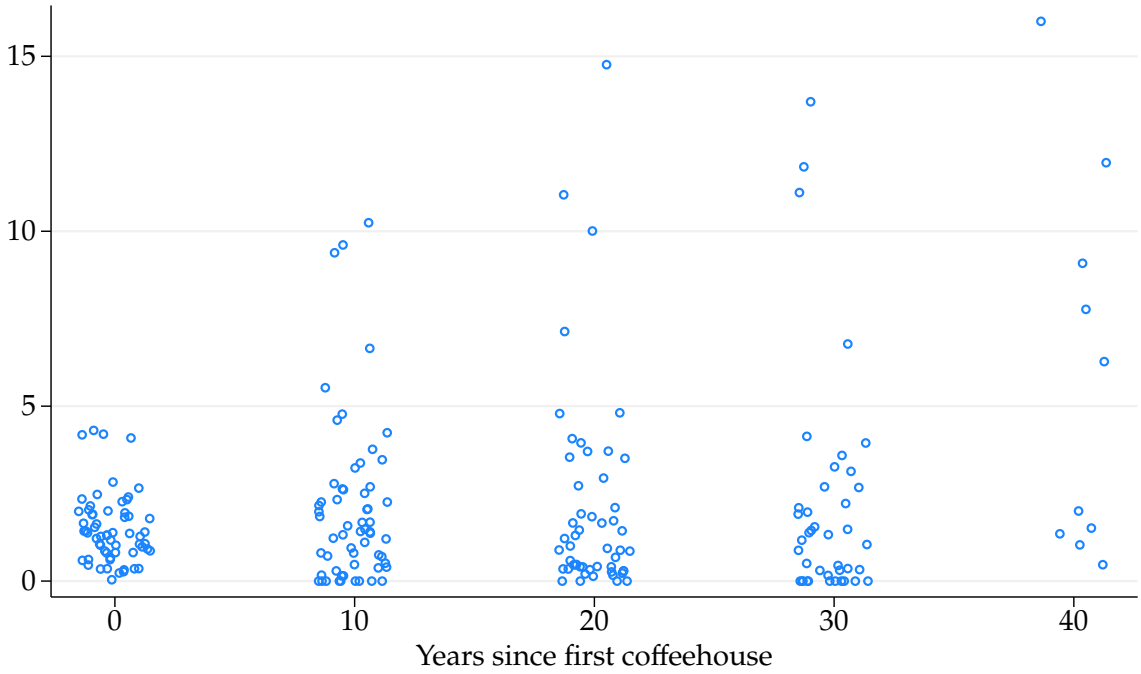
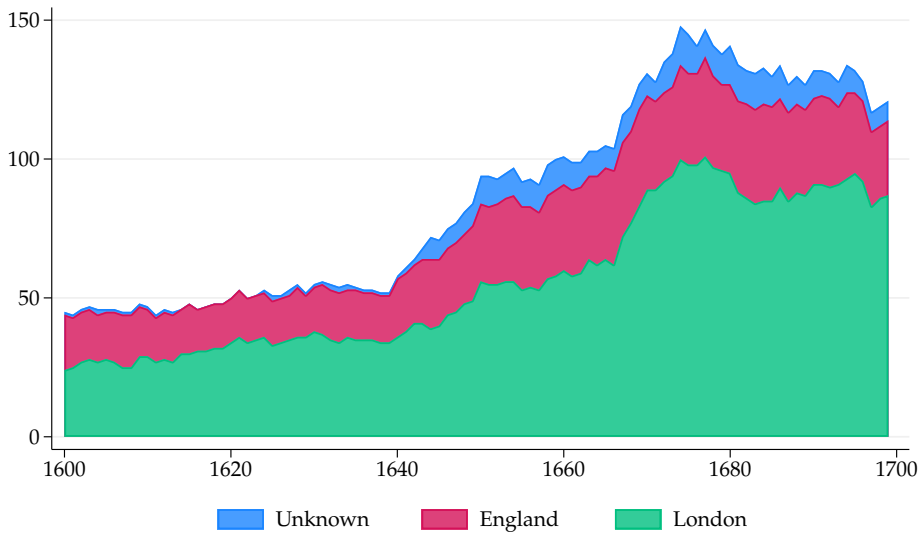


Figure B.16. Coffeehouses by years since first opening

Notes: Figure shows a jittered strip plot of the number of coffeehouses by years since the first coffeehouse opened. Sample includes the 61 parishes that ever have a coffeehouse from the 1600s to the 1690s. [Return to page 18]

(A) Mathematical practitioners



(B) Scientific instrument makers

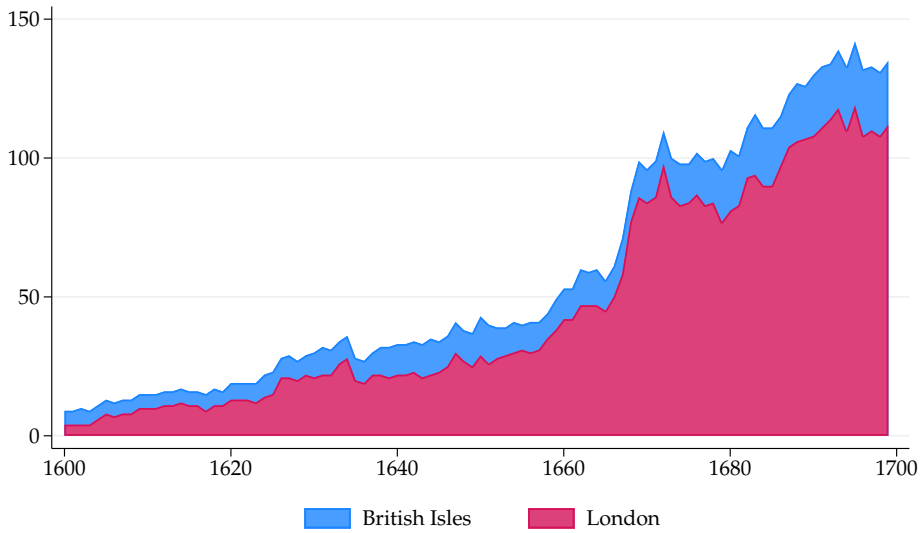


Figure B.17. Science in London relative to England and the British Isles over time

Notes: Panel A plots the annual number of mathematical practitioners in seventeenth-century England, separated by whether they were ever active in London or only outside it but still within England. Unknowns were active in England, but their London activity is unknown. Panel B plots the annual number of scientific instrument makers in the seventeenth-century British Isles and London. Data from Clifton (1995); Hay et al. (2025); Taylor (1954). [Return to pages 15, 17, 24]

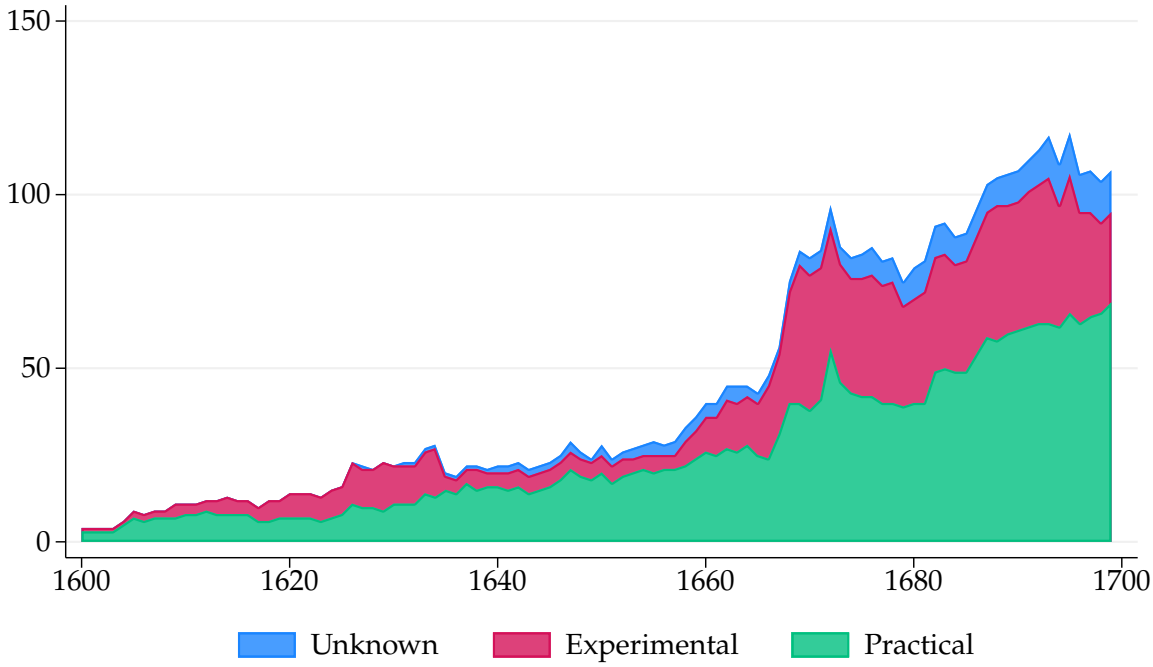


Figure B.18. Scientific instrument makers in London over time by type

Notes: Figure plots the annual number of scientific instrument makers in seventeenth-century London by type. Experimental makers produced optical (e.g., telescopes, microscopes) and philosophical (e.g., air pumps, barometers, electric machines) instruments. Practical makers produced mathematical (e.g., dividers, sectors, scales), navigational (e.g., compasses, astrolabes), and surveying (e.g., theodolites, circumferentors) instruments. Data from Clifton (1995); Hay et al. (2025). [Return to page 17]

Figure B.19. Examples of mathematical practitioners (Taylor, 1954)

Notes: Figure shows three mathematical practitioners for each twenty-year cohort of first flourishing in the London sample described in Section 3, labeled by the years the cohort spans. Portrait slots go to practitioners matched to an entry in the *Oxford Dictionary of National Biography* (Oxford Dictionary of National Biography, 2004) and use images from Wikipedia; their number rounds the cohort's matched share to thirds, and the remaining slots name a practitioner and stand in a silhouette. Beneath each practitioner is a facsimile of the opening lines of their entry in Taylor (1954), and Christopher Wren's entry is boxed on the page reproduced at left. Orange marks instrument makers. [Return to page 15]

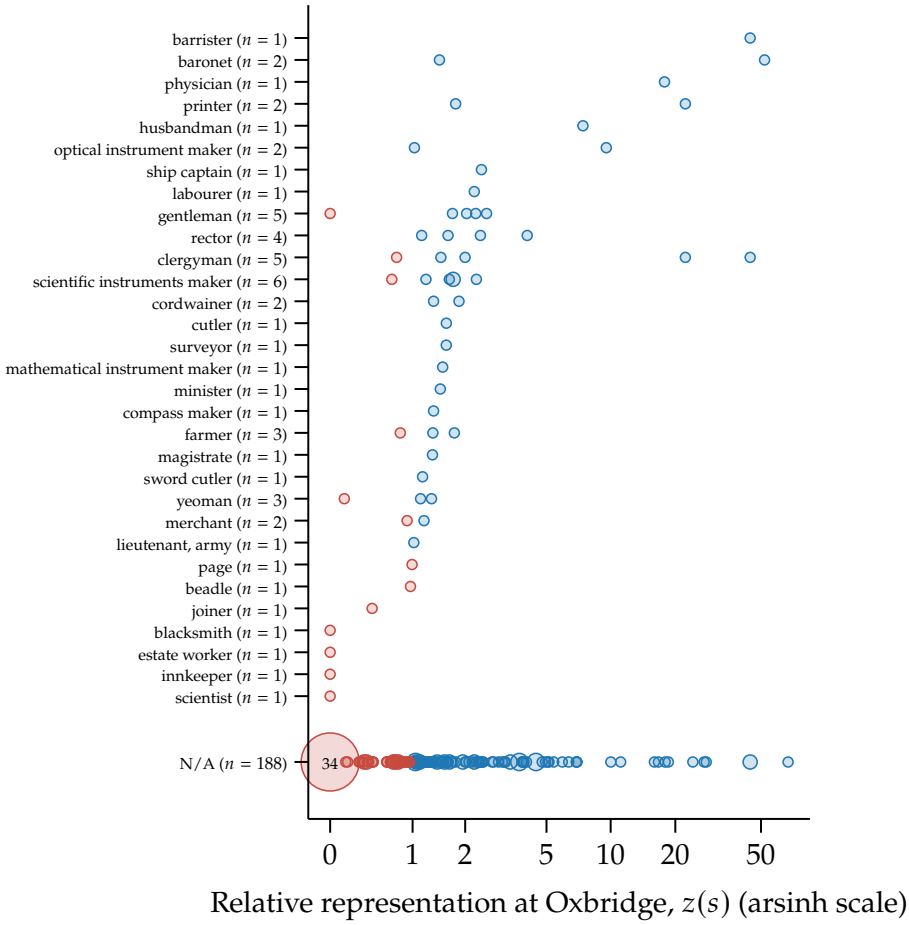


Figure B.20. Relative Oxbridge representation by father's occupation

Notes: Sample includes all 244 mathematical practitioners whose London activity interval overlaps 1600–1699. The horizontal axis shows relative surname representation among pre-1650 Oxbridge alumni, $z(s)$, on an inverse hyperbolic sine (arsinh) scale. Each circle is one value of $z(s)$ within a category, with area proportional to the number of practitioners sharing that value, and counts are printed inside circles drawn large enough to hold them. Blue circles have $z(s) > 1$; red circles have $z(s) \leq 1$. Numbers in parentheses give the number of practitioners in each category, and the 31 observed occupations are ordered by their median $z(s)$. The bottom row holds the 188 practitioners whose paternal occupation is unobserved, 34 of whom carry a surname that never appears among pre-1650 Oxbridge alumni. The median $z(s)$ in that row is 1.14, against a median of 1.51 across the observed occupation medians. Occupations are coded from fathers' occupational titles using the PST system developed by Wrigley (2010). Data from the authors' dataset. [Return to page 25]

B.10. Tables

Table B.2—Coffeehouse source categories

	Coffeehouses	Per coffeehouse
Panel A. Source categories		
Published and private	158	0.55
Printed books, pamphlets, and literary works	47	0.16
Newspapers and periodicals	44	0.15
Secondary histories and reference works	40	0.14
Manuscripts and private papers	36	0.13
Diaries, memoirs, and personal writings	32	0.11
Advertisements, notices, and ephemera	31	0.11
Catalogues, sales, and auctions	8	0.03
Material and visual	98	0.34
Trade tokens	65	0.23
Maps, views, inscriptions, and topographical evidence	36	0.13
Administrative and official	90	0.31
Parish, civic, and local records	44	0.15
Company, commercial, and financial records	34	0.12
State, legal, and court records	33	0.12
Unknown	52	0.18
No source, unidentified, or unclear	52	0.18
Panel B. Summary statistics		
Coffeehouses	286	1
Sources	617	2.16
Sources by finer categories	502	1.76
Sources by broader categories	398	1.39

Notes: Panel A reports source-category coverage for distinct coffeehouses. The first column reports counts, and the second divides counts by the total number of distinct coffeehouses. Broad rows are broader source categories; indented rows are finer source categories. Fine rows need not sum to broad rows because a coffeehouse can appear in multiple finer categories. Panel B reports summary totals and averages per coffeehouse. [Return to page 14]

Table B.3—Detailed types of mathematical practitioners

Occupation	Mathematical practitioners (distinct)
Any	244
Other mathematical practitioners	69
Mathematical practitioner	25
Surveyor	5
Hydrographer	4
Mathematician	4
Land surveyor	3
Amateur mathematician	2
Engineer	2
Almanac maker; mathematics teacher; land surveyor; dial maker	1
Applied mathematics student; mathematics teacher	1
Astrologer	1
Astrologer; dial maker; surveyor	1
Astronomer; astrologer; mathematical practitioner	1
Bookseller	1
Chart maker; surveyor	1
Dial maker; mathematical practitioner	1
Magnetism researcher	1
Marine hydrographer	1
Marine surveyor	1
Master of the mint	1
Master printer	1
Mathematical bookseller	1
Mathematics promoter	1
Mathematics student	1
Navigational instrument seller	1
Navigator	1
Operator to the Royal Society	1
Physician	1
Professional surveyor	1
Surveyor; cartographer; instrument designer	1
Surveyor; instrument maker	1
Surveyor; mathematical practitioner	1
Teachers	54
Mathematics teacher	21
Mathematics professor	6

Continued on next page

Table B.3 continued

Occupation	Mathematical practitioners (distinct)
Mathematics schoolmaster	6
Navigation teacher	4
Practical mathematics teacher	3
Astronomy professor	2
Geometry professor	2
Mathematics lecturer	2
Almanac maker; mathematics teacher; land surveyor; dial maker	1
Applied mathematics student; mathematics teacher	1
Applied mathematics teacher	1
Instrument maker; mathematics teacher	1
Mathematics school founder	1
Mathematics teacher or lecturer	1
Mathematics tutor	1
Practical mathematics and navigation teacher	1
Makers	130
Instrument maker	44
Mathematical instrument maker	25
Optical instrument maker	19
Clockmaker	5
Chart maker	4
Compass maker	4
Globe maker	4
Glass grinder	3
Dial maker	2
Engraver	2
Globe maker; mathematical instrument maker	2
Almanac maker	1
Almanac maker; mathematics teacher; land surveyor; dial maker	1
Astrologer; dial maker; surveyor	1
Astronomical instrument maker	1
Chart maker; surveyor	1
Craftsman	1
Dial maker; calendar maker	1
Dial maker; mathematical practitioner	1
Engraver; mathematical instrument maker	1
Instrument maker; mathematics teacher	1

Continued on next page

Table B.3 continued

Occupation	Mathematical practitioners (distinct)
Instrument repairer	1
Master craftsman; smith	1
Mechanic	1
Nautical instrument maker	1
Surveyor; cartographer; instrument designer	1
Surveyor; instrument maker	1

Notes: Counts are distinct mathematical practitioners with a usable London geocode whose recorded flourishing overlaps 1600–1699, matching the period covered by the empirical panel. A given practitioner can belong to multiple categories; together, the categories are exhaustive. Indented rows report occupations harmonized from raw occupation strings. [Return to page 15]

C. ROBUSTNESS CHECKS

This section develops the robustness checks summarized in Section 4, in the same order. None changes the conclusions of the main text.

C.1. Covariate Balance and Adjustment

Coffeehouses did not open at random. Table 1 and Appendix Figure C.1 compare parishes that ever received a coffeehouse with parishes that never did: fourteen of twenty-eight pre-1652 measures show normalized differences above the 0.25 threshold of Imbens and Rubin (2015, p. 277), with the largest gaps in pubs, signs, tradesmen's tokens issued between 1648 and 1651, and booksellers. Treated parishes also begin with more practitioners and more instrument shops, at 0.32 each. The 1582 tax difference is likely minor, since a temporally closer indicator of wealth, the share of substantial households in 1638, is balanced. Level imbalances of this kind threaten parallel trends only if the imbalanced characteristics also predict how scientific activity would have evolved without a coffeehouse.

Balance in changes provides the first check. Table C.1 reports normalized differences in the change in each characteristic between the 1600s–1610s and the 1630s–1640s; both halves of the window precede the first London coffeehouse in 1652, so no change can reflect treatment. Both outcomes are balanced in changes, at -0.05 and 0.08 against 0.32 in levels, and booksellers fall from 0.57 in levels to -0.02 in changes. Only pubs and signs exceed 0.25, and both are outcomes that coffeehouse entry leaves unmoved (Figures C.7 and C.8).

Adjustment provides the second. We estimate the propensity score of ever being treated with a probit on pre-1652 pubs, tradesmen's tokens, booksellers, and an indicator for the City of London. Weighting on this score cuts the mean absolute normalized difference from 0.30 to 0.18. Effects under regression adjustment, which interacts the same covariates with decade fixed effects, are 0.57 practitioners and 1.15 shops (Figure C.3); effects under inverse probability weighting are 0.56 and 0.69 (Figure C.2). Both remain close to the unadjusted 0.68 and 1.24 and statistically significant, and the pre-treatment estimates are jointly indistinguishable from zero.

C.2. Randomization Inference

We benchmark the estimates against a null in which parish labels and opening decades carry no information. We construct 1,000 placebo samples by randomly assigning treatment to 61 of the 162 parishes, matching the size of the treated group, and drawing the decade of first entry for each placebo parish from the 1650s to the 1690s, coding the remainder as never treated. We then re-estimate equation (1) for each draw.

Figure C.4 plots the resulting placebo distributions by event time. For both outcomes, post-treatment effects based on historical timing lie in the extreme upper tail of the placebo distributions, while pre-treatment effects are centered near the medians. The association between historical entry and scientific activity is therefore unusual relative to random parish labels and random timing.

Reassigning treatment uniformly discards two features of the historical rollout: entry followed commercial geography, and it was concentrated in the 1660s, when 31 of the 61 treated parishes received their first coffeehouse. We therefore repeat the exercise under a more demanding assignment. Using the propensity score estimated above, we group parishes into quintiles and draw the observed number of treated parishes within each, so that placebo entry is as likely as observed characteristics imply; treatment rates across the quintiles range from 0.09 to 0.78. We then deal the observed entry decades among the drawn parishes, preserving the number of parishes contributing at each event time. Because placebo entry now concentrates where actual entry was most likely, and those parishes gained scientific activity over the century, the placebo distributions center above zero: the test asks whether the observed estimates exceed what a commercially selected but causally inert assignment would produce. They do. Across 1,000 draws, the post-treatment averages lie in the upper tail ($p = 0.011$ for mathematical practitioners and $p = 0.002$ for scientific instrument shops), while the pre-treatment averages sit closer to zero than the typical placebo draw (Figure C.5). This assignment reproduces where coffeehouses went and how many arrived each decade, not the association between the two; it is a benchmark, not the entry process.

C.3. Placebo Outcomes

Because coffeehouses made up only a small share of all establishments, they should not directly affect the number of pubs, luxury shops, or other types of signs, nor general non-scientific correspondence within the Republic of Letters or population density. Any correlation between coffeehouse openings and these variables would therefore point to unobserved differences between parishes with and without coffeehouses. Figures C.7, C.6, C.8, C.9, and C.10 show that the estimated effects on these placebo outcomes are statistically insignificant and economically small.

C.4. Local Confounders: The Great Fire and the London Wall

Two features of London's geography could jointly determine coffeehouse locations and scientific activity. The Great Fire of 1666 reshaped the city's economic geography, displacing poorer residents, concentrating wealth in rebuilt areas, and shifting commerce toward wealthier districts (Ager et al., 2025), and the loss of records in the fire may bias observed treatment timing. The London Wall marks a second divide: the guilds

controlled nearly all trade within the walls, no guild existed for scientific instrument making (Cormack, 2017, p. 79), and residential rents were higher inside (Baer, 2010). We additively allow for separate nonparametric time trends in parishes exposed and not exposed to the fire (Figure C.13) and for locations inside and outside the wall (Figure C.14). The main results are robust to both controls.

C.5. Selection into the Historical Record

Our outcome and treatment measures both depend on survival into the historical record, and coffeehouse activity could in principle affect that survival. On the outcome side, prominent sources such as the diaries of Samuel Pepys and Robert Hooke often mention coffeehouses in connection with leading scientists, reflecting idiosyncratic reporting. Data on mathematical practitioners, which rely largely on diaries and published materials, are more exposed to this concern; data on scientific instrument shops come largely from museum catalogs of signed instruments, guild records, and trade cards. The difference is one of degree, not of kind: survival and registration are not independent of local prosperity either. To address the remaining exposure, we restrict the sample to the 175 of 252 instrument makers active in the seventeenth-century panel for whom a London guild is recorded (Figure C.22), and, because many guild records were destroyed in the Great Fire of 1666, we additionally allow separate trends for parishes exposed to the fire (Figure C.23). On the treatment side, the decade in which a coffeehouse is first recorded could depend on the type of source that records it. We therefore re-estimate the baseline after excluding, in turn, coffeehouses first recorded in published or private sources, administrative or official sources, material or visual sources, and sources of unknown type, and again after excluding each detailed source category (Figures C.11 and C.12). The estimates are broadly unchanged throughout.

C.6. Treatment Definition and Timing

Event timing is based on the first recorded mention of a coffeehouse, which may differ from its actual opening year; the decade-level design absorbs this error at the cost of coarser aggregation. Re-estimating equation (1) at two-, three-, and five-year intervals shows no evidence of pre-trends and leaves the main results unchanged (Figure C.18).[45] Treatment need not be absorbing: applying the method of de Chaisemartin and d'Haultfoeuille (2024) to coffeehouse presence rather than first entry, using the variation shown in Figure B.15, yields results that closely match the baseline (Figure C.25). The same method estimates the effect of losing the last coffeehouse in a parish. If the entry

[45] Annual specifications are infeasible due to limited outcome variation after controlling for parish and year fixed effects. For scientific instrument shops, the same constraint also precludes biennial specifications.

effects reflected differential trends rather than coffeehouses, closures should not reverse them; instead, closures reduce scientific activity, symmetric with entry (Figure C.26).

C.7. Spatial Aggregation and Inference

The parish is the natural unit of analysis because many historical addresses identify locations only by their nearest parish church, but many records are finer. Re-estimating equation (1) on a partition of London into 15,351 hexagons of 5,000 m^2 (Figure C.19) leaves the findings qualitatively unchanged (Figure C.20); adding parish-by-decade fixed effects preserves the patterns for instrument shops while reducing the magnitude and significance of the effect on practitioners, plausibly because church-level addresses absorb much of the relevant variation. Because observations are densely clustered in space, we also compute Conley (1999) standard errors at cutoffs of 0.25, 0.5, 1, and 2 kilometers; the results are robust (Figure C.31).

C.8. Control Groups and Estimators

Equation (1) uses never-treated parishes as controls. The event study design of Callaway and Sant'Anna (2021), which also draws on not-yet-treated parishes, leaves the main results unchanged (Figure C.24). The results are likewise robust to an inverse hyperbolic sine transformation of the outcome (Figure C.30). The Poisson specification in equation (3) reproduces the shape of the response for both outcomes with wider confidence intervals: effects on mathematical practitioners reach the ten percent level throughout the post-treatment window, and effects on instrument shops the five percent level two and three decades after entry (Figure C.29). Estimation is restricted to event times within fifty years of first opening, since cohort-decade cells containing no shops otherwise separate the likelihood. The exponential model is estimated by pooled quasi-maximum likelihood with cohort rather than parish effects, because unit fixed effects in a nonlinear model raise an incidental parameters problem.

C.9. Trends and Influence

Following Goodman-Bacon (2021), we detrend outcomes within treatment cohorts using only pre-treatment observations, removing differential linear pre-trends; the results remain similar in magnitude and significance, with wider confidence intervals (Figure C.27). Re-estimating equation (1) 162 times, excluding one parish at a time, shows that no single parish drives the findings, though the four-decade effect loses significance under some exclusions (Figure C.28).

C.10. Pubs over the Full Period

Section 5 restricts the pub placebo to the 1550s–1640s because pub and coffeehouse openings are correlated once coffeehouses appear (Table C.2). Over the full 1550s–1690s sample, strong pre-trends in mathematical practitioners indicate that the placebo design is invalid there (Figure C.33). Controlling for group-specific linear trends removes these pre-trends and yields negative effects on practitioners (Figure C.32); estimated effects on instrument shops are positive over the full sample but small and insignificant before the 1650s.

C.11. Figures

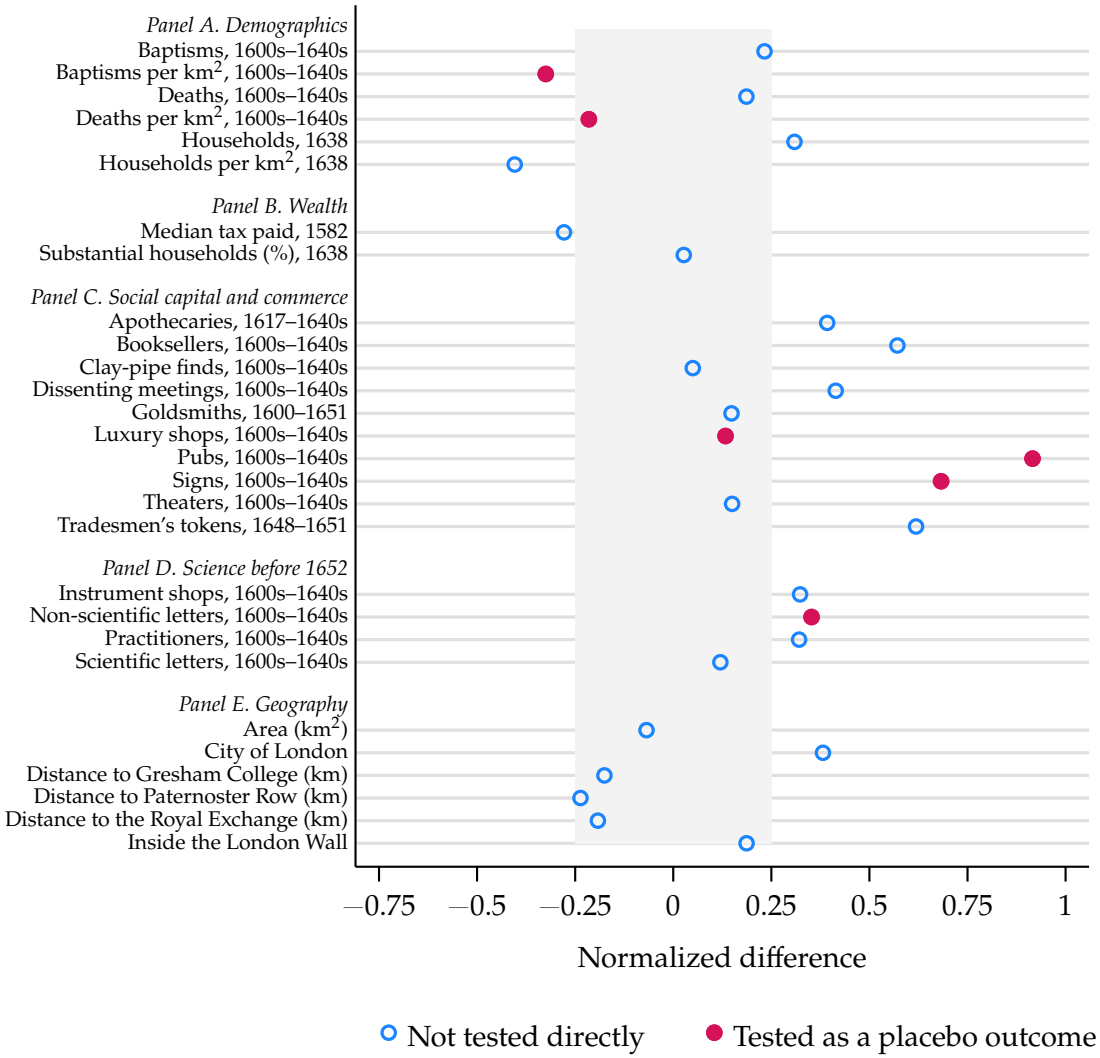
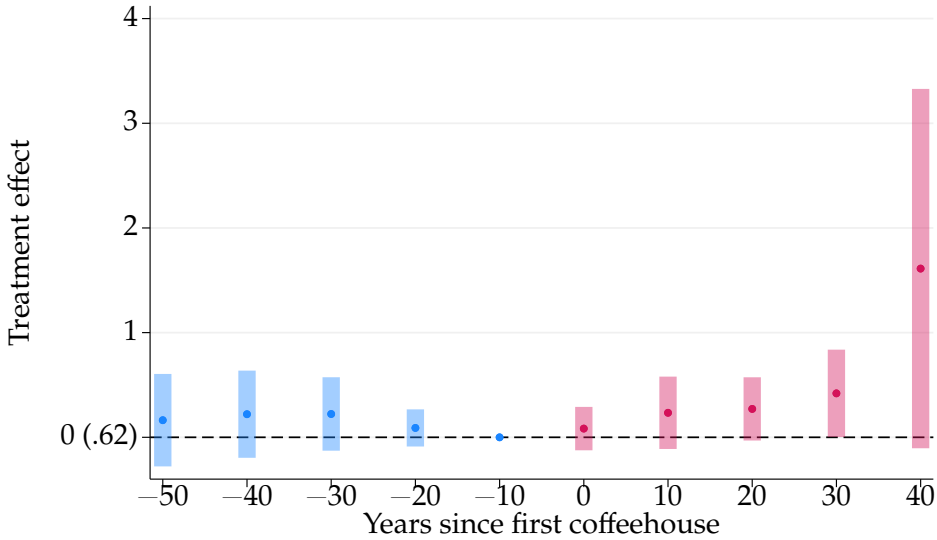


Figure C.1. Normalized differences in baseline characteristics

Notes: Figure plots the normalized differences in a set of pre-treatment characteristics between ever-treated and never-treated parishes, where treatment is defined as the decade of first coffeehouse opening in seventeenth-century London. The normalized difference for a covariate x is $\frac{\overline{x}_t - \overline{x}_c}{\sqrt{(s_t^2 + s_c^2)/2}}$, where $\overline{x}_t$ and s_t^2 denote the sample mean and variance of x in the ever-treated group, and $\overline{x}_c$ and s_c^2 the corresponding quantities in the never-treated group. The shaded region marks absolute differences below 0.25, the threshold suggested by Imbens and Rubin (2015, p. 277). Filled markers indicate covariates that also appear as placebo outcomes in Appendix Figures C.7, C.8, C.6, C.9, and C.10. Rows and their measurement follow Table 1. [Return to page 47]

(A) Mathematical practitioners



(B) Scientific instrument shops

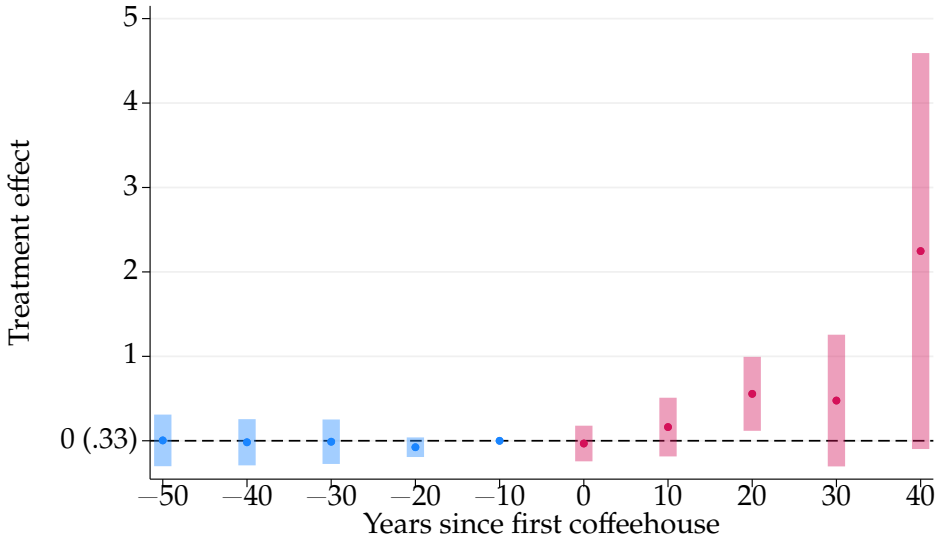
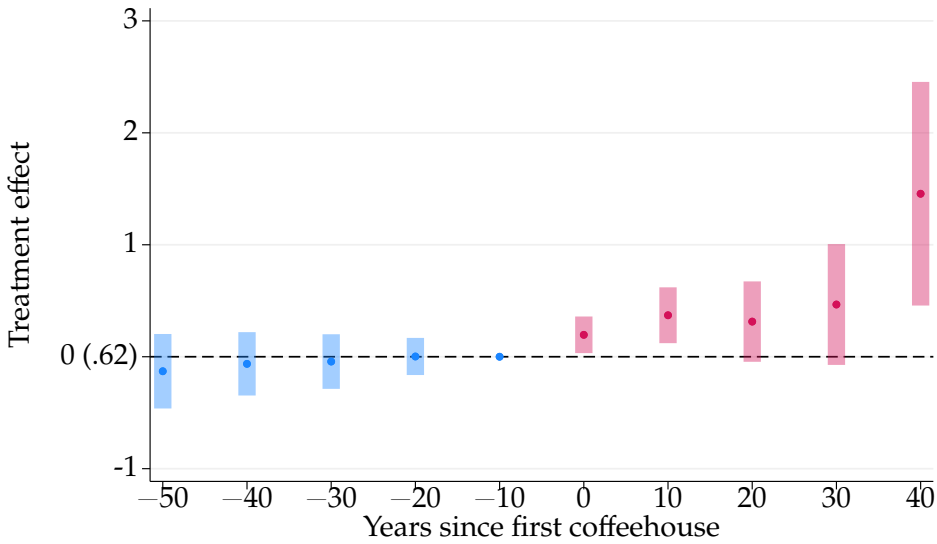


Figure C.2. Effects on scientific activity: IPW adjustment

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1), weighted with inverse-probability weights (IPWs), of the effect of first coffeehouse opening on scientific activity. The IPWs are based on a probit-estimated propensity score for ever being treated, using pre-1652 pubs, tradesmen's tokens (1648–1651), and booksellers, together with an indicator for the City of London. Weights are stabilized and trimmed at the first and ninety-ninth percentiles. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 47]

(A) Mathematical practitioners



(B) Scientific instrument shops

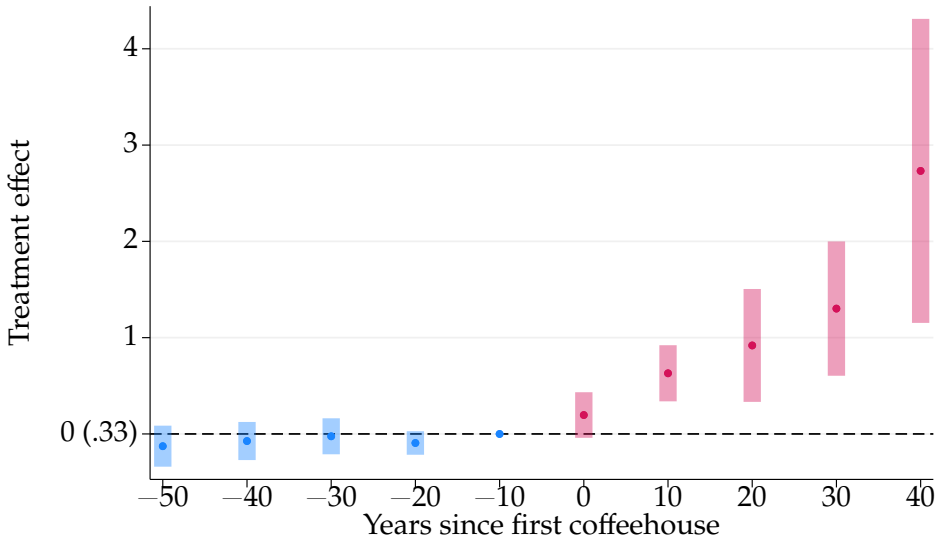


Figure C.3. Effects on scientific activity: regression adjustment

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity, including covariates. The specification includes pre-1652 pubs, tradesmen's tokens (1648–1651), and booksellers, together with an indicator for the City of London, each interacted with decade fixed effects. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 47]

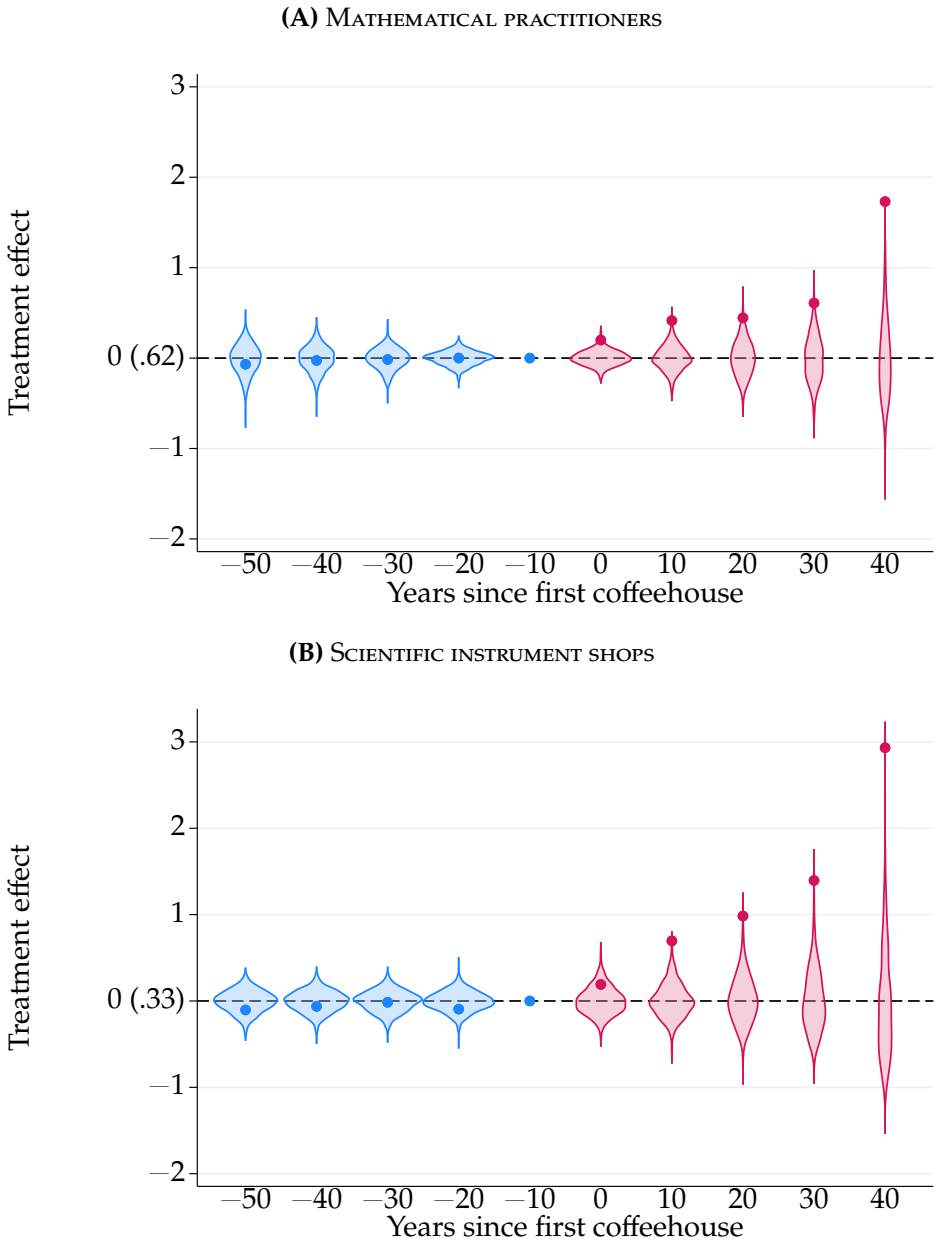


Figure C.4. Effects on scientific activity: randomization inference

Notes: Figure shows violin plots of event study estimates from a series of 1,000 placebo estimates of equation (1) of the effect of the first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. In each placebo dataset, we randomly assign the timing of the first coffeehouse opening to one of the decades from the 1650s to the 1690s for 61 of the 162 parishes, preserving the size of the treated group in the main sample. Violin plots show the distribution of placebo treatment effects by event time, with dots indicating the actual event study estimates from the true dataset. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. [Return to page 48]

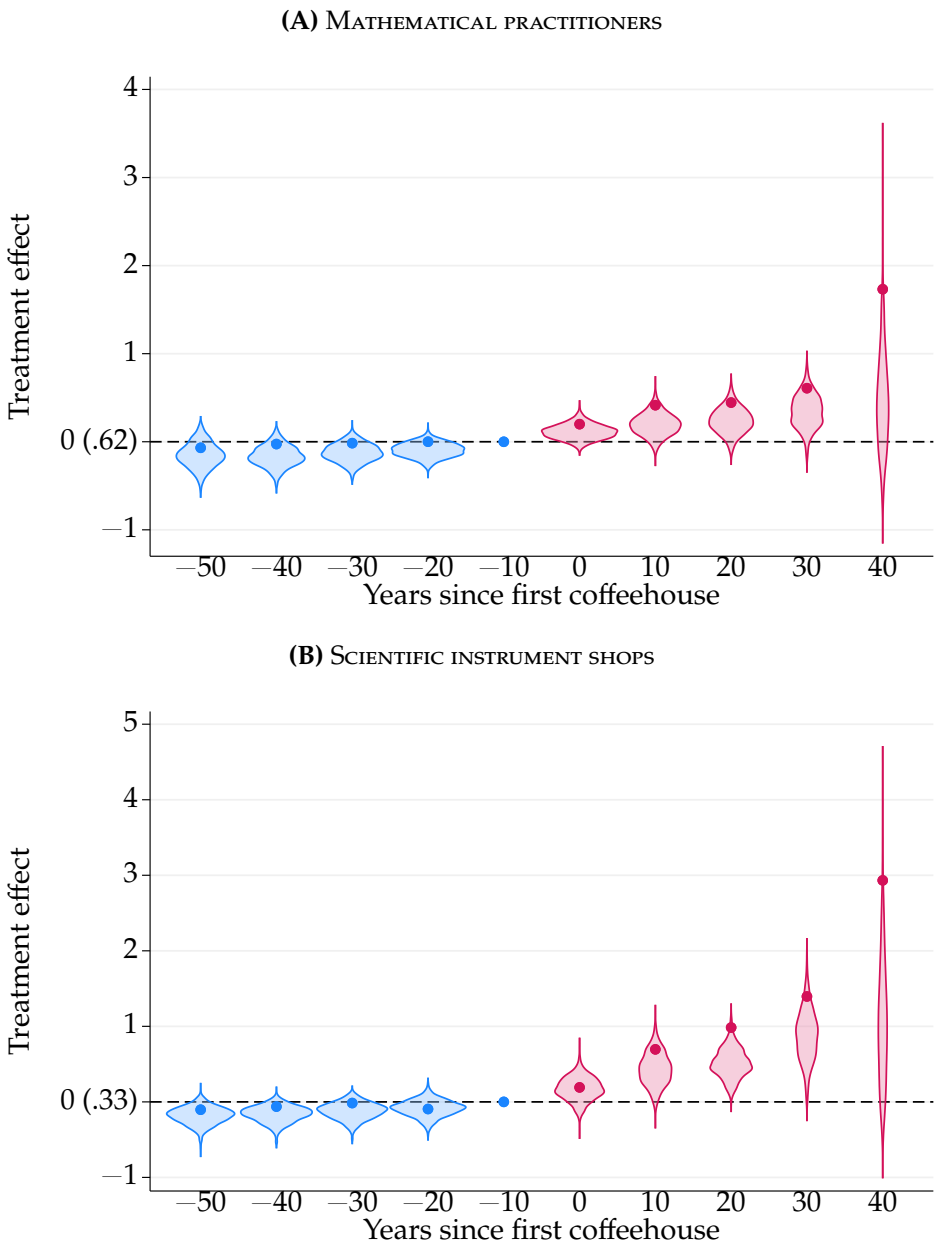


Figure C.5. Effects on scientific activity: conditional randomization inference

Notes: Figure shows violin plots of event study estimates from 1,000 placebo estimates of equation (1) of the effect of the first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. In each placebo dataset, treated parishes are drawn without replacement within quintiles of the propensity score of ever receiving a coffeehouse, estimated by probit on pre-1652 pubs, tradesmen's tokens, and booksellers, together with an indicator for the City of London, preserving the number treated in each quintile, and the observed decades of first entry are then assigned at random among the drawn parishes, so that both the commercial geography of entry and the number of parishes observed at each event time match the historical rollout. Violin plots show the distribution of placebo treatment effects by event time, with dots indicating the actual event study estimates from the true dataset. Randomization p-values report the share of placebo draws at least as large as the observed estimate, counting the observed assignment in the reference set. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. [Return to page 48]

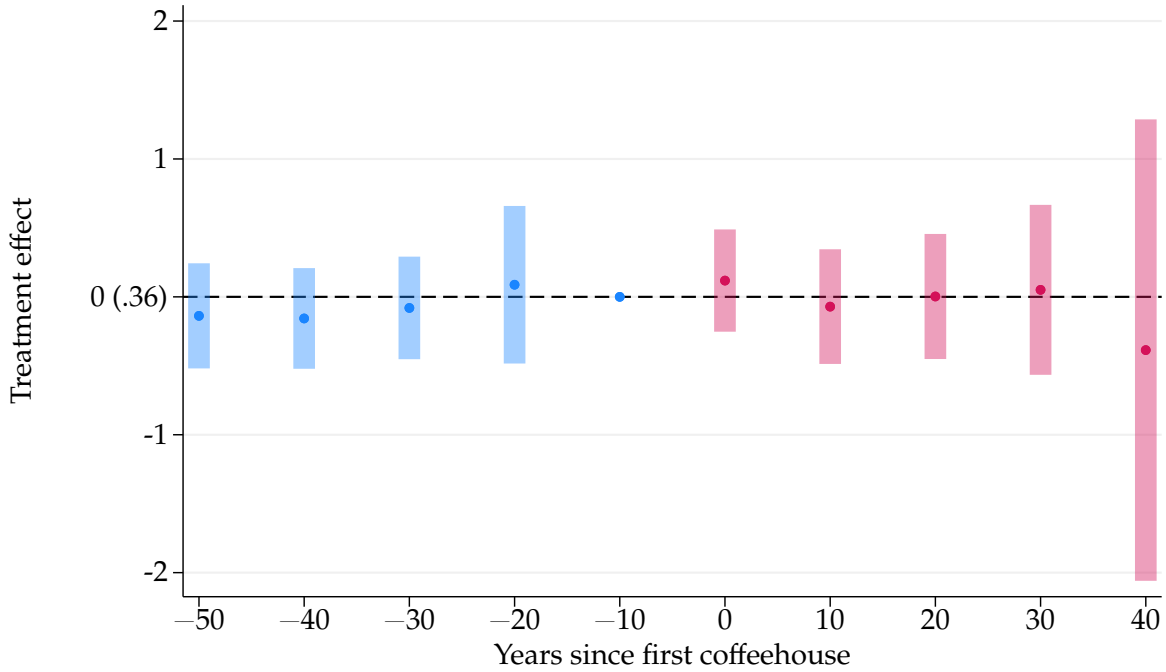


Figure C.6. Effects on luxury shops

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on the decadal number of luxury shops in a parish. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to pages 48, 53]

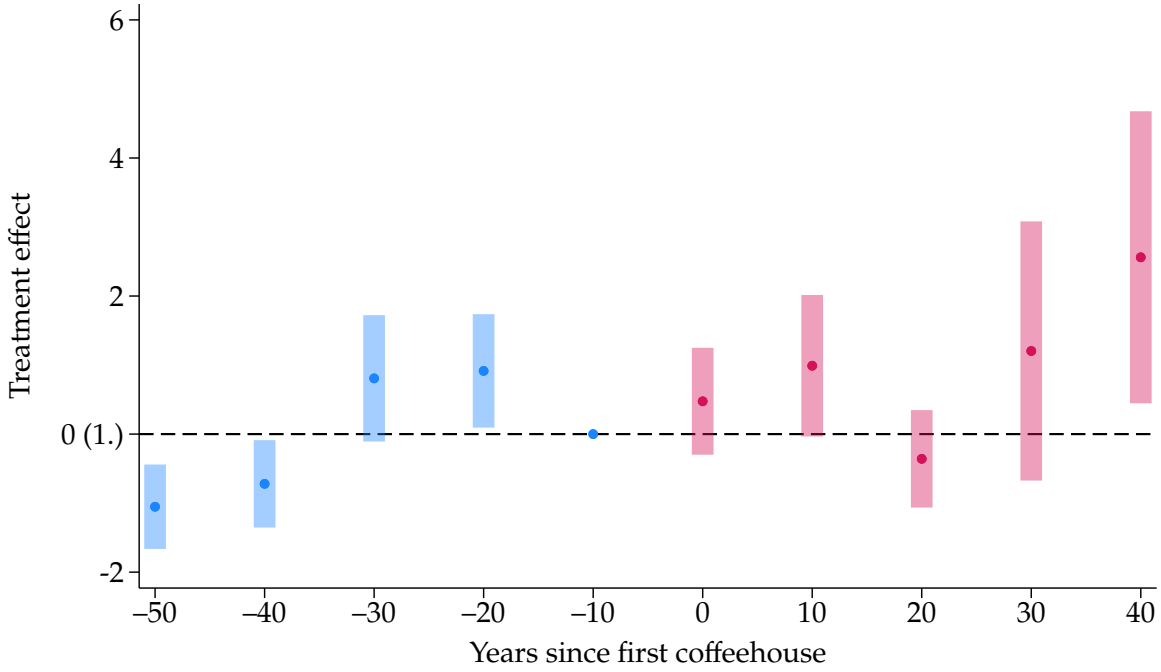


Figure C.7. Effects on pubs

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on the decadal number of public houses in a parish, meaning taverns, inns, alehouses, wine houses, victuallers, and mum houses. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to pages 47, 48, 53]

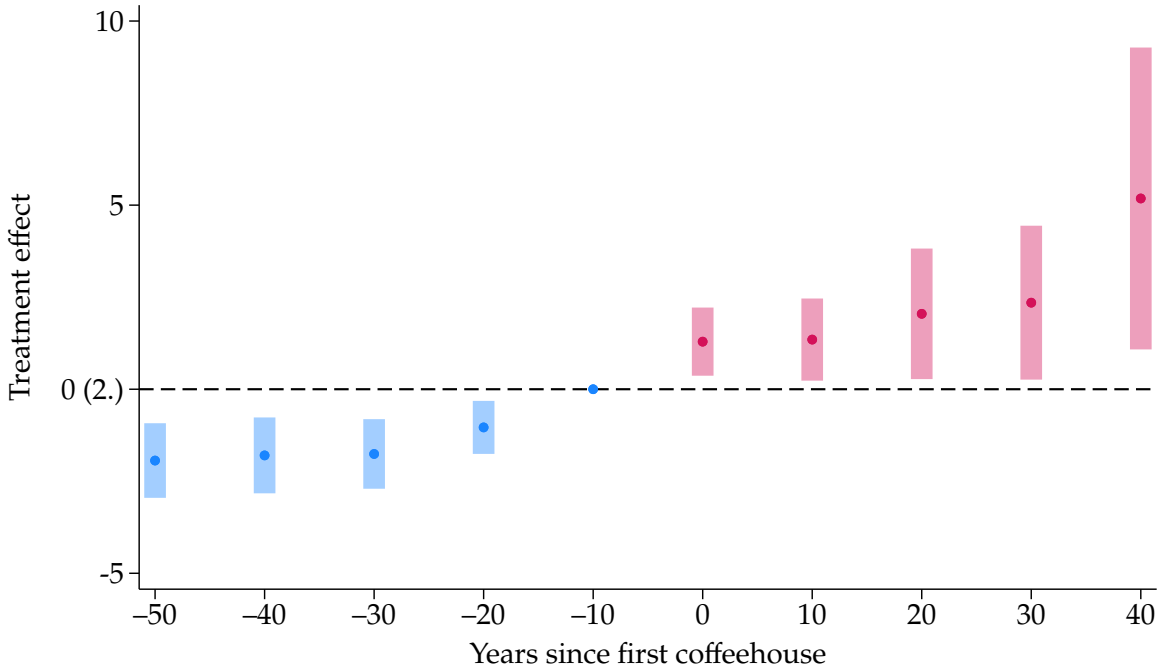


Figure C.8. Effects on signs

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening. Outcome of interest is the decadal number of signs in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to pages 47, 48, 53]

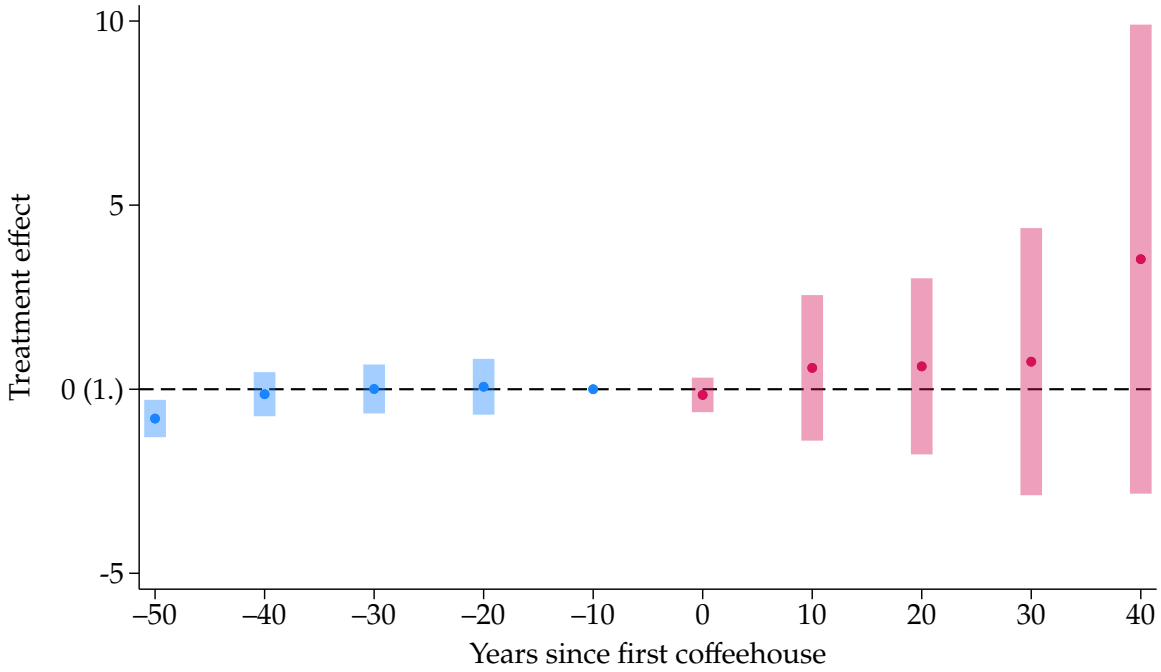
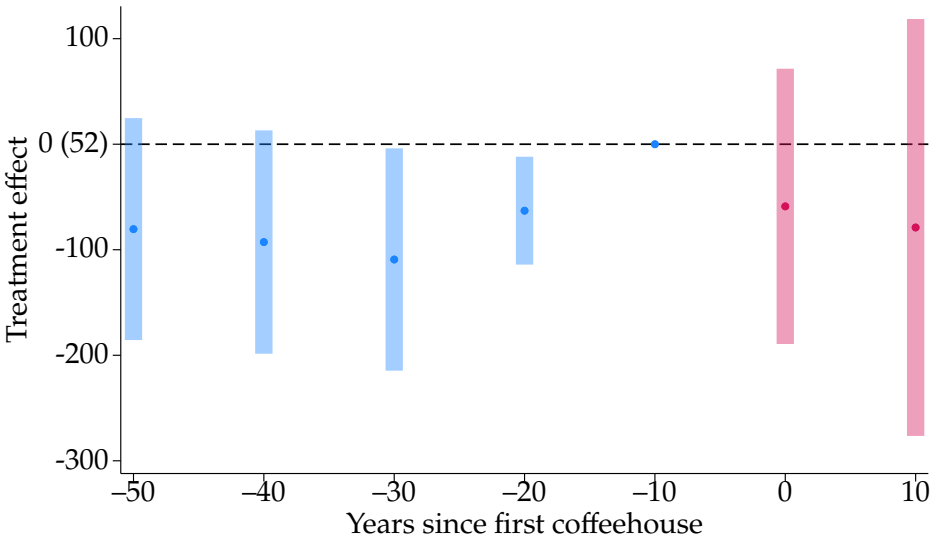


Figure C.9. Effects on non-scientific letters

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening. Outcome of interest is the decadal number of non-scientific letters in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to pages 48, 53]

(A) Baptisms density



(B) Deaths density

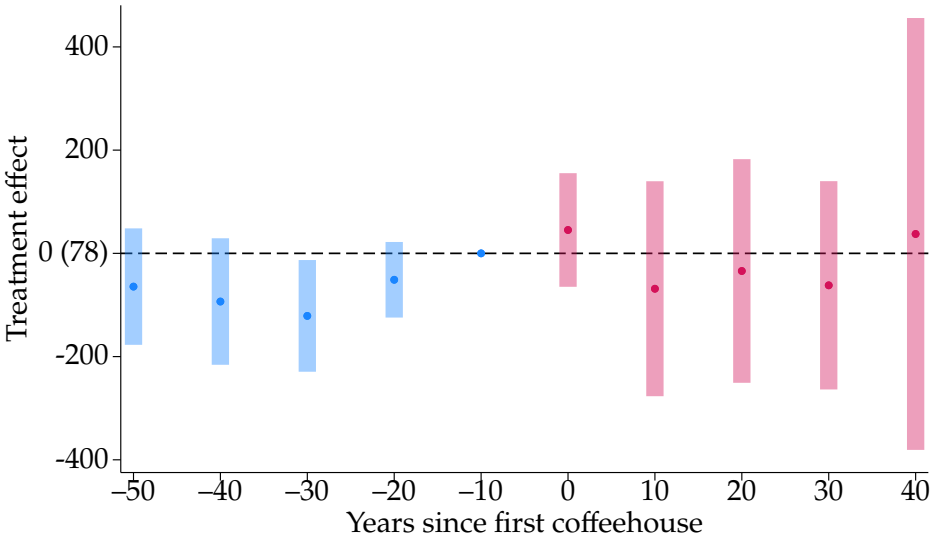


Figure C.10. Effects on population density

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on placebo outcomes. Outcomes are the decadal number of baptisms and deaths per square kilometer in a parish. Sample includes 130 of 162 parishes for baptisms from the 1600s to the 1660s and 119 of 162 parishes for deaths from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to pages 48, 53]

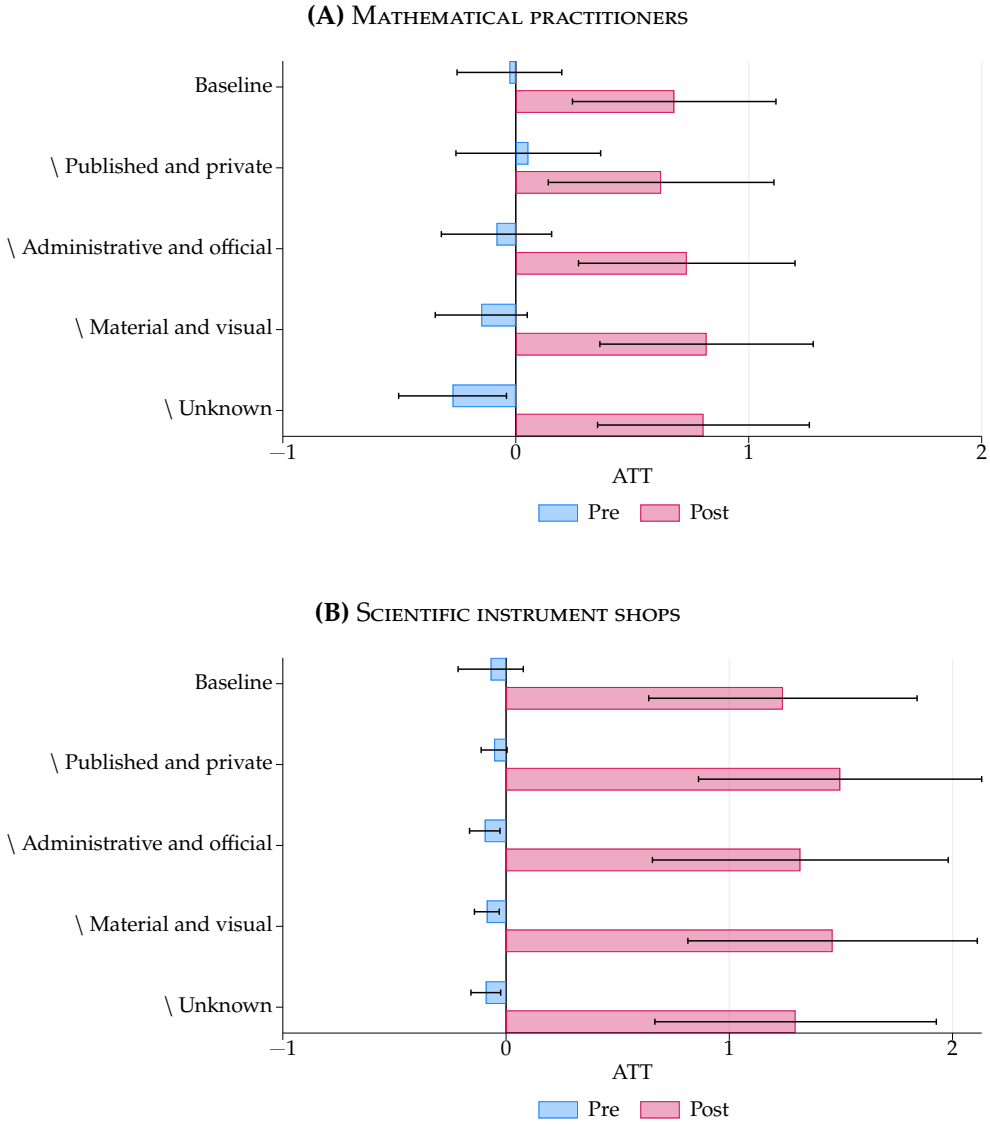


Figure C.11. Effects on scientific activity: dropping coffeehouse source categories

Notes: Figure reports average pre-treatment and post-treatment effects, with 95 percent confidence intervals, from equation (1). In each alternative specification, we exclude coffeehouses first recorded in the indicated source category: published or private, administrative or official, material or visual, or unknown. The baseline uses all coffeehouse sources. Pre-treatment effects are averages of event study estimates from 50 to 20 years before opening; post-treatment effects are averages from opening through 50 years after. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to page 49]

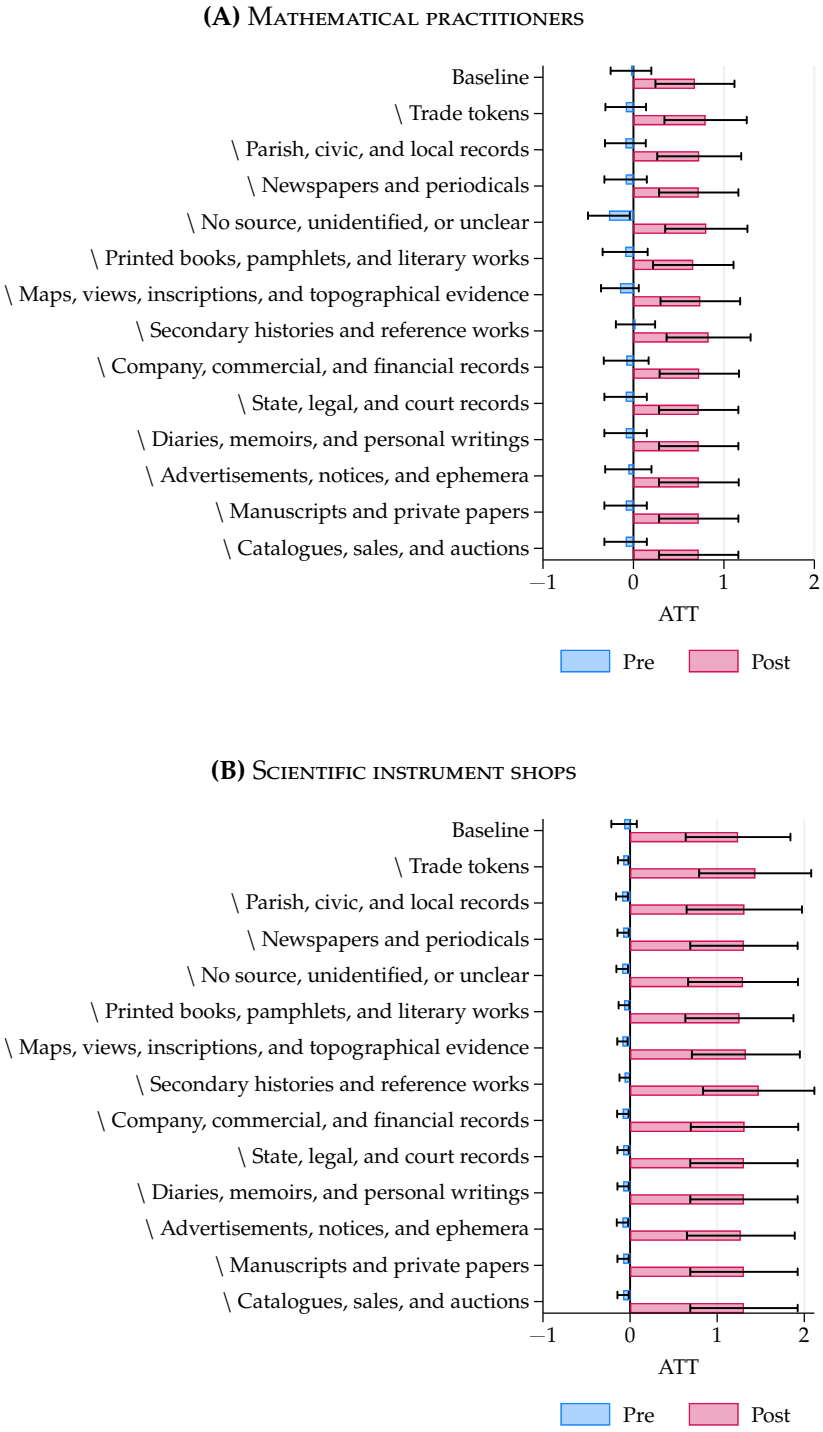
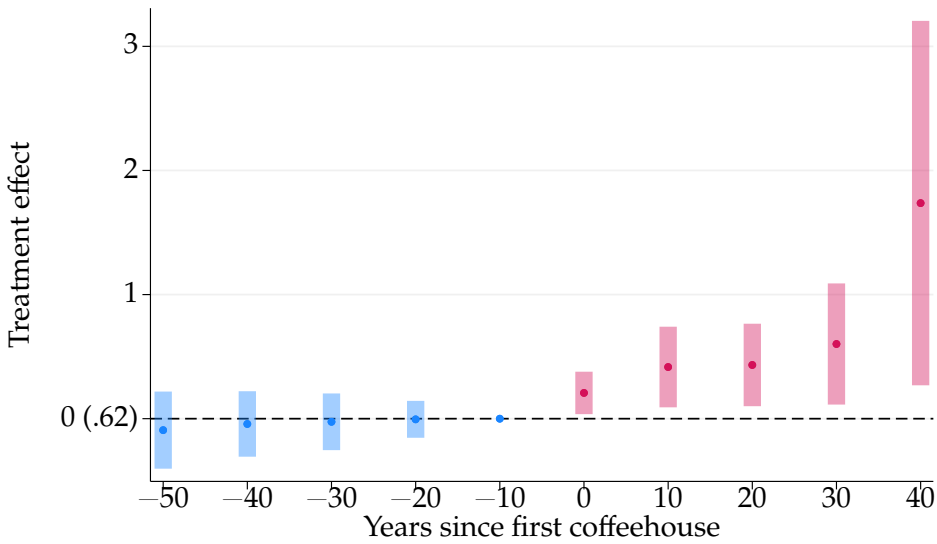


Figure C.12. Effects on scientific activity: dropping detailed coffeehouse source categories

Notes: Figure reports average pre-treatment and post-treatment effects, with 95 percent confidence intervals, from equation (1). In each alternative specification, we exclude coffeehouses first recorded in the indicated detailed source category. The baseline uses all coffeehouse sources. Pre-treatment effects are averages of event study estimates from 50 to 20 years before opening; post-treatment effects are averages from opening through 50 years after. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to page 49]

(A) Mathematical practitioners



(B) Scientific instrument shops

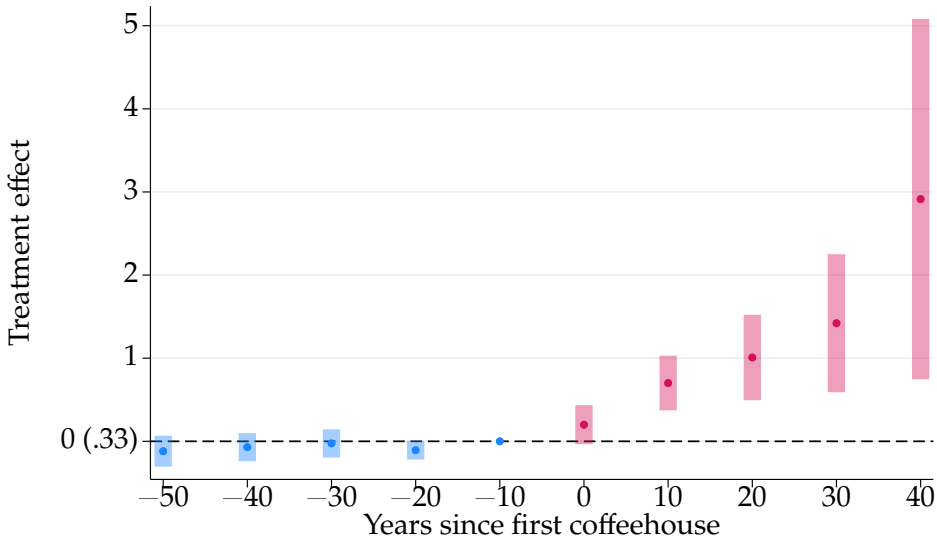
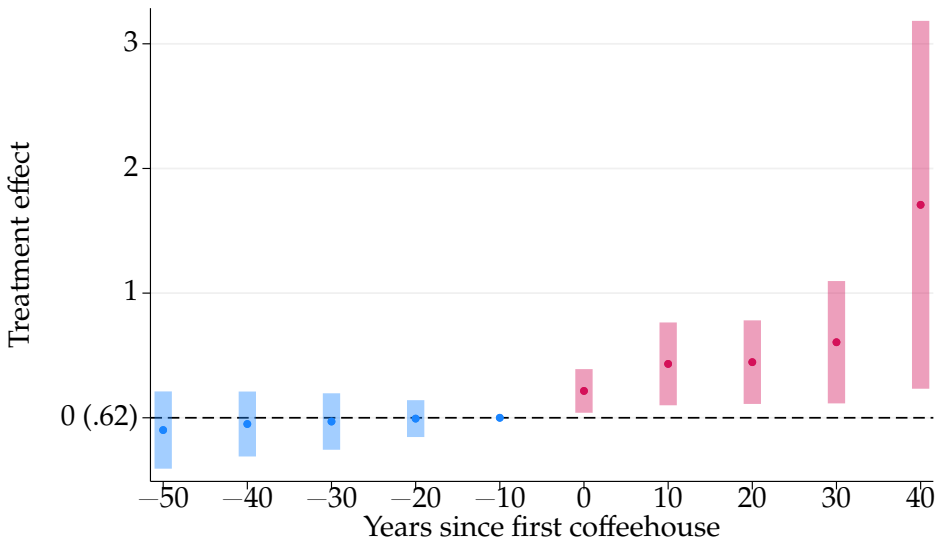


Figure C.13. Effects on scientific activity: control for exposure to the Great Fire

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1), including fixed effects for the interaction between an indicator for exposure to the Great Fire and each decade, of the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 49]

(A) Mathematical practitioners



(B) Scientific instrument shops

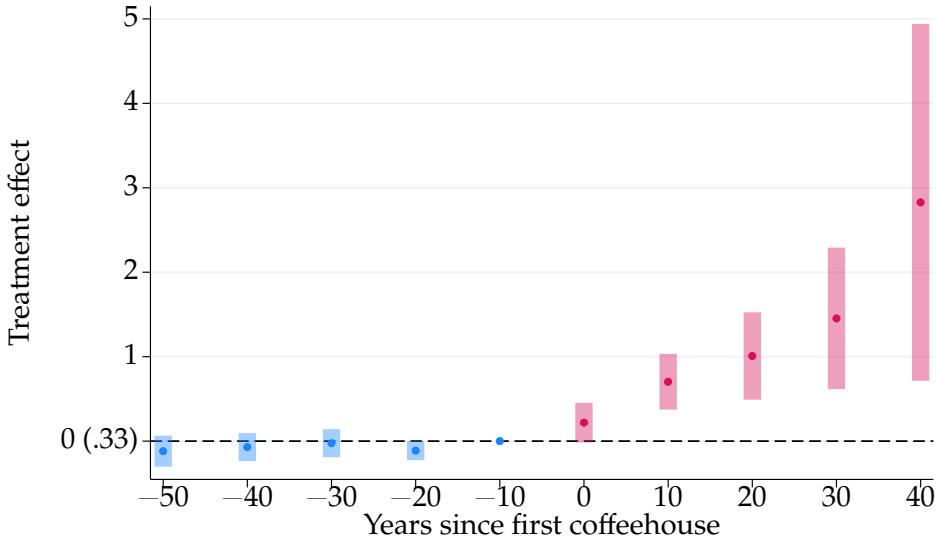
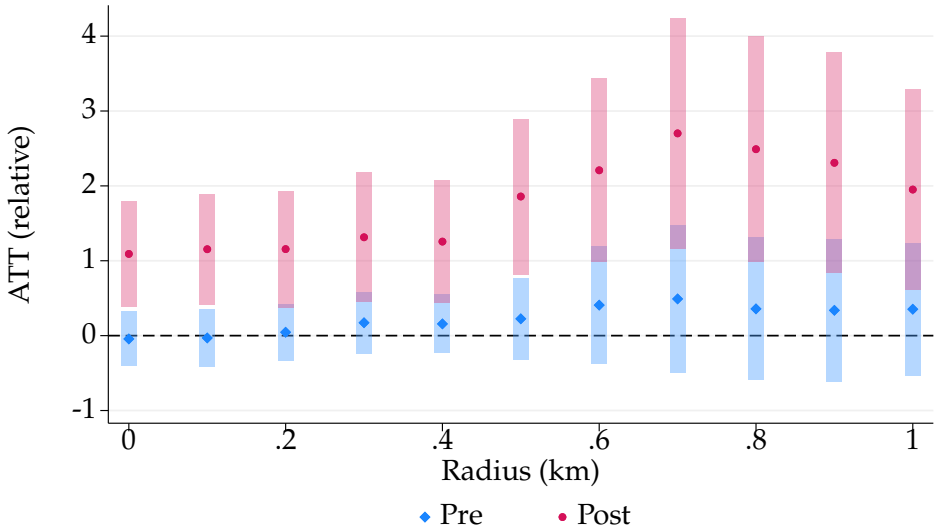


Figure C.14. Effects on scientific activity: control for within London Wall

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1), including fixed effects for the interaction between an indicator for whether a parish lies within the London Wall and each decade, of the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 49]

(A) Mathematical practitioners



(B) Scientific instrument shops

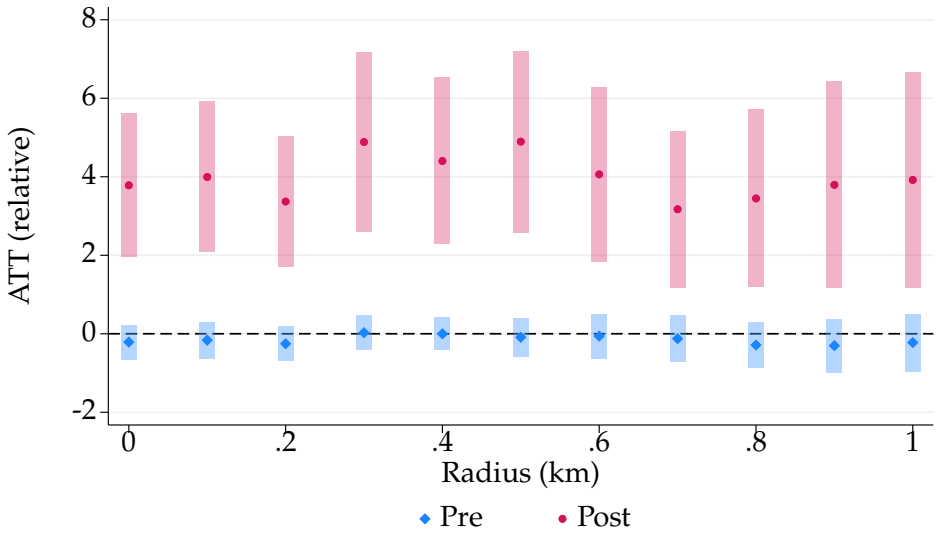


Figure C.15. Effects on scientific activity by spillover radius

Notes: Figure shows pre- and post-averages of event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity, but where first coffeehouse opening in parish i in decade t is defined by a given spillover radius r: (i) the first coffeehouse within i was established in t, and (ii) no coffeehouse was established before t within an r-kilometer radius of the centroid of i. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Each outcome is divided by its reference mean, i.e., the sample mean of the outcome one decade before the first coffeehouse opened. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. Standard errors clustered by parish. [Return to page 24]

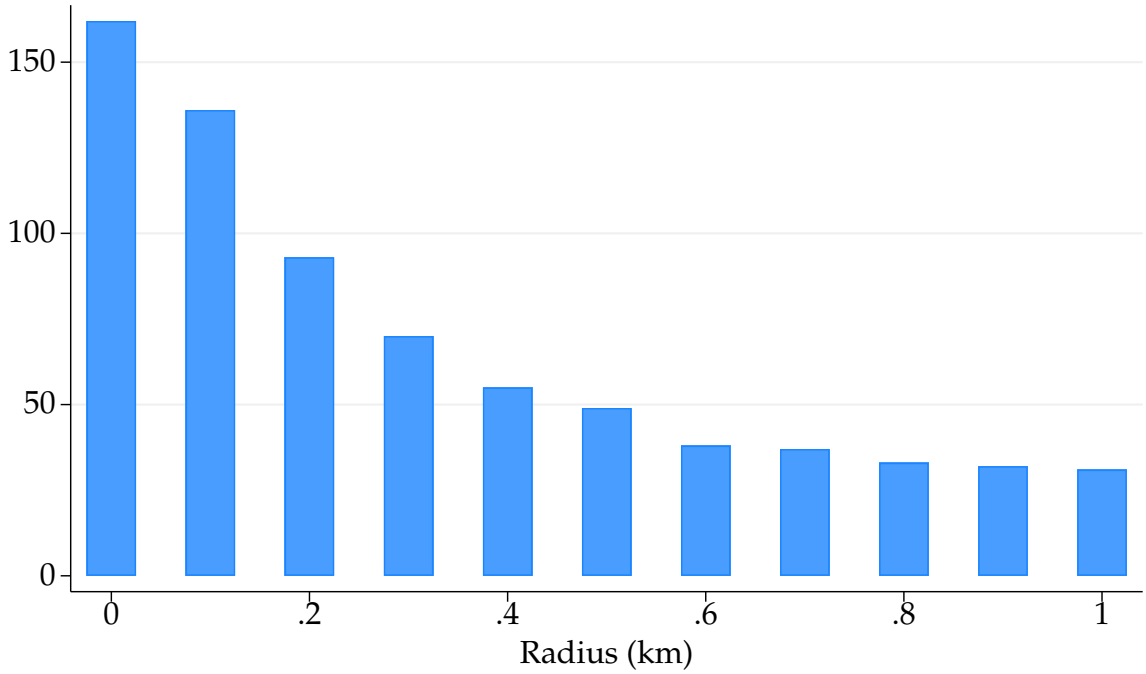


Figure C.16. Number of parishes by spillover radius

Notes: Figure plots the number of parishes in the sample by spillover radius r when first coffeehouse opening in parish i in decade t is defined by a fixed spillover radius r: (i) the first coffeehouse within i was established in t, and (ii) no coffeehouse was established before t within an r-kilometer radius of the centroid of i. This implicitly drops parishes that had a coffeehouse established prior to decade t within the specified radius r of their centroid, so the number of parishes declines as r increases.

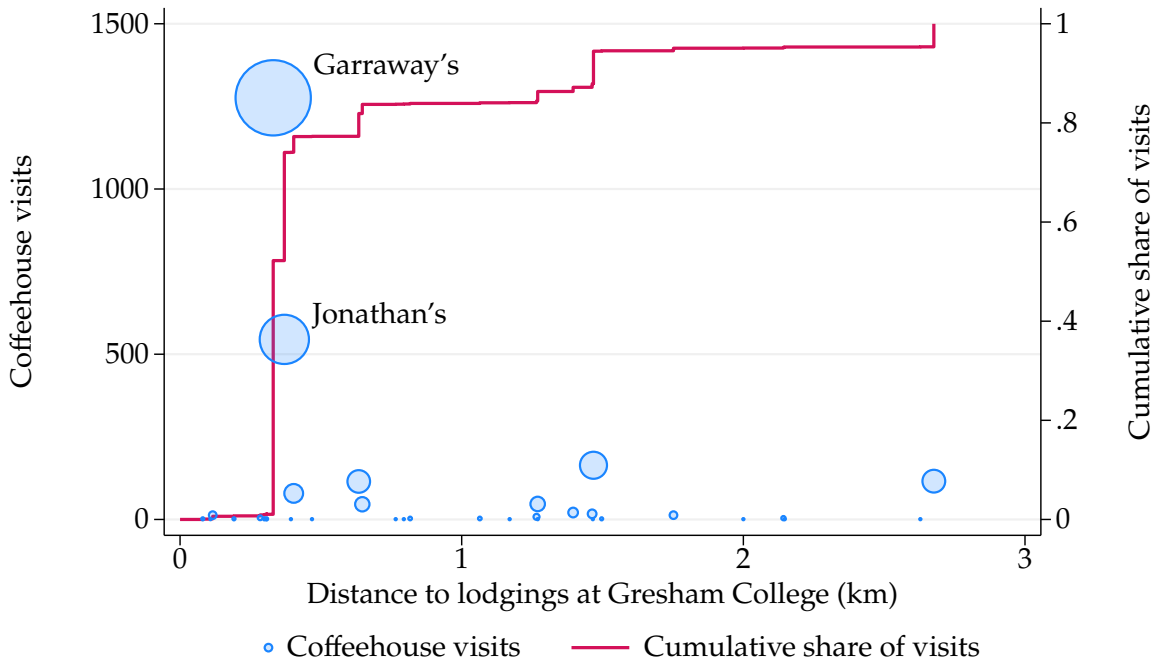
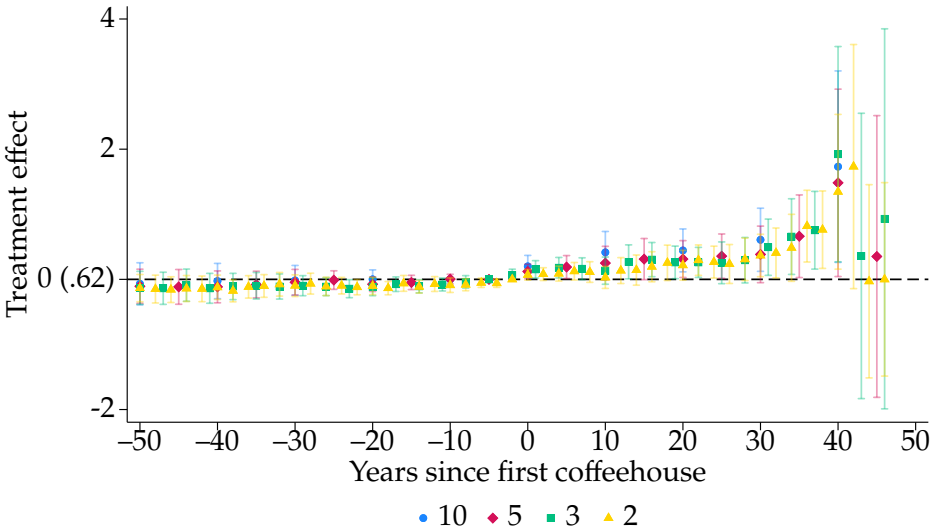


Figure C.17. Robert Hooke's coffeehouse visits, 1672–1683

Notes: Figure shows the number of visits Robert Hooke (1635–1703) made to different coffeehouses between March 1672 and May 1683, grouped by their distance from his lodgings at Gresham College. Circle size is proportional to the share of his 2,497 recorded coffeehouse visits that a house received, and the step function read against the right axis gives the cumulative share of those visits made within a given distance. Of the 2,497 visits, 2,096 occurred within 1 km of his lodgings. Garraway's Coffee House was the most frequently visited, with 1,276 visits, followed by Jonathan's Coffee House with 545 visits, both located within 1 km. Data from Brown et al. (2021) and drawn from Hooke's diary. [Return to page 24]

(A) Mathematical practitioners



(B) Scientific instrument shops

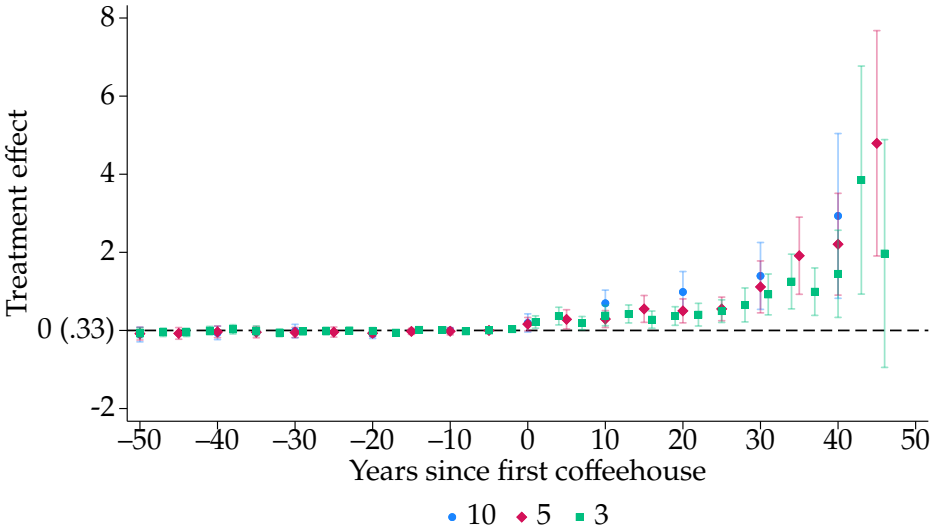


Figure C.18. Effects on scientific activity by time-frame length

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity. Outcomes are the number of mathematical practitioners and scientific instrument shops in a parish, estimated across varying time-frame lengths. The unit of observation is a parish-by-time-frame-length cell (decadal, quinquennial, triennial, or biennial). The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 49]

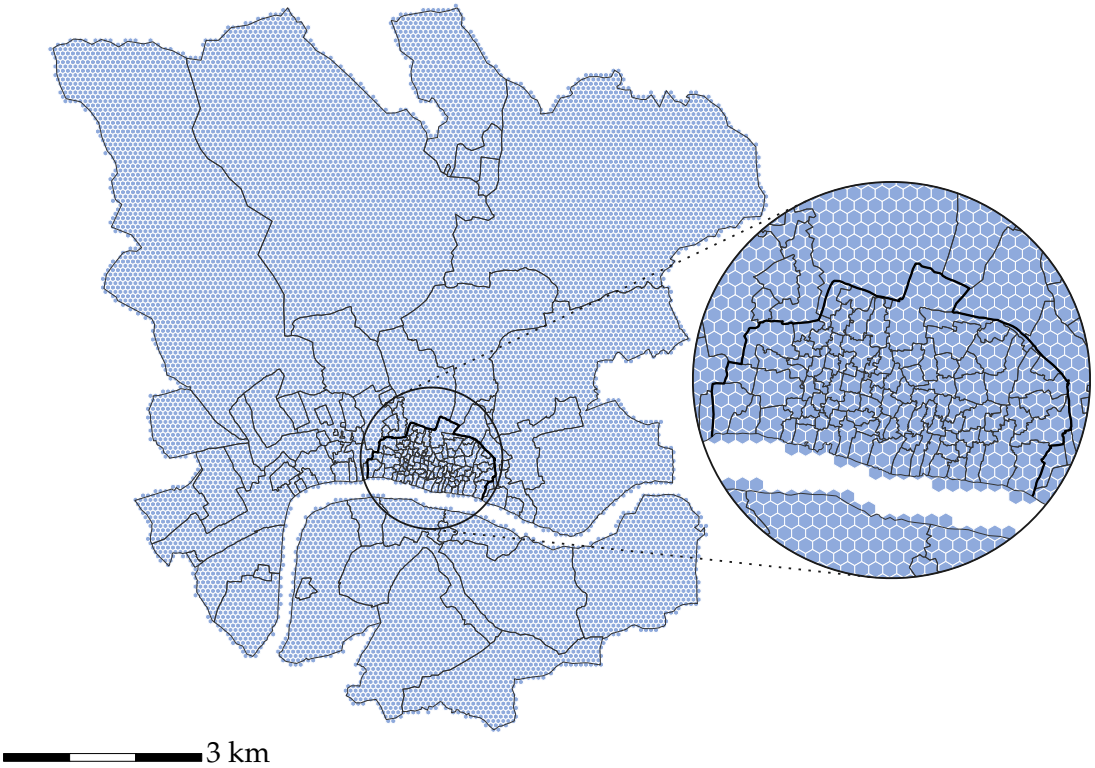
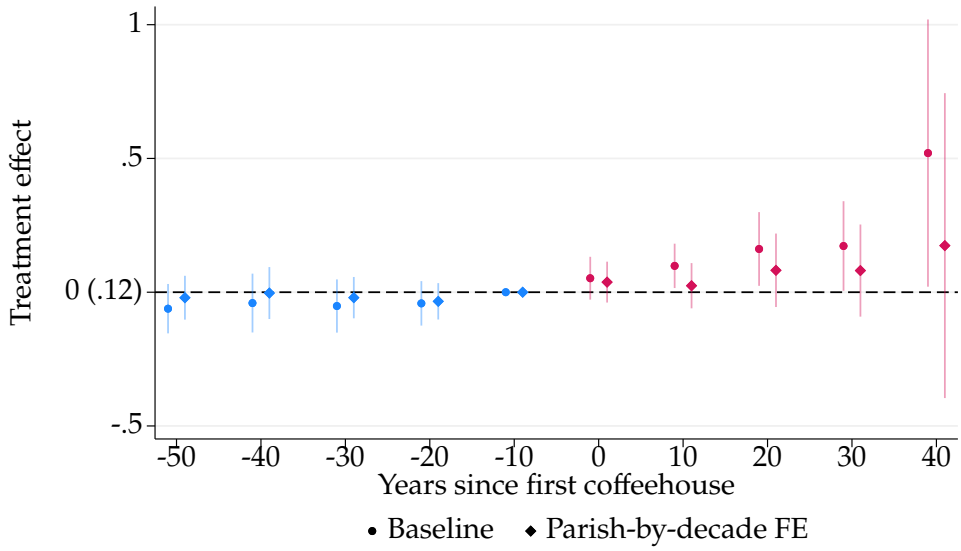


Figure C.19. Hexagonal partition of London

Notes: Map of London divided into 15,351 hexagons of 5,000 m^2 each, with white lines for hexagon boundaries and black lines for the 162 parish boundaries. [Return to pages 50, 72]

(A) Mathematical practitioners



(B) Scientific instrument shops

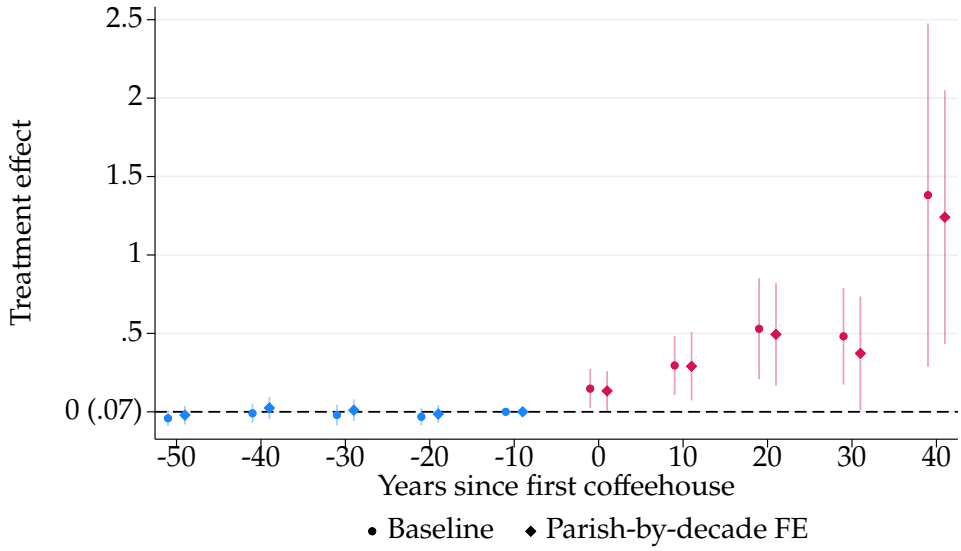


Figure C.20. Effects on scientific activity: grid cell level

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity, without and with parish-by-decade fixed effects. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a 5,000 m^2 hexagon. Sample includes all 15,351 hexagons of size 5,000 m^2 (see Appendix Figure C.19) and all 162 parishes from the 1600s to the 1690s. Unit of observation is hexagon-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

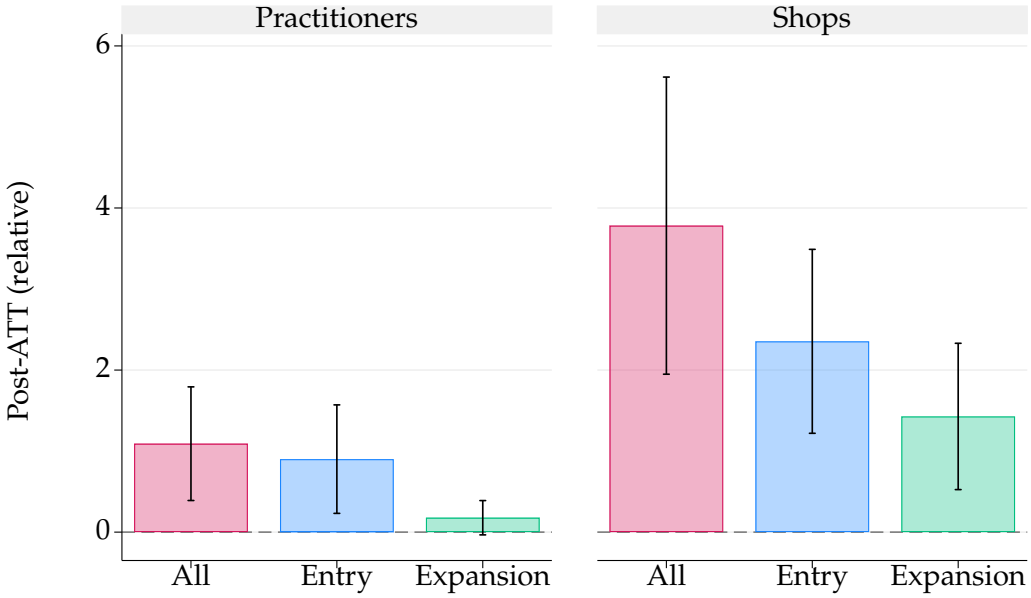


Figure C.21. Effects on scientific activity: entry and expansion

Notes: Figure reports average post-treatment effects and 95 percent confidence intervals from equation (1), relative to the outcome mean one decade before first coffeehouse opening. It separates overall effects into entry and expansion components for mathematical practitioners and scientific instrument shops. For practitioners, entry counts active person-location spells at a person's first recorded London location and expansion counts spells at later recorded London locations. For shops, entry counts establishments beginning in a maker's first recorded shop year and expansion counts establishments beginning later. Post-treatment effects average event study estimates from opening through 50 years after. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to page 25]

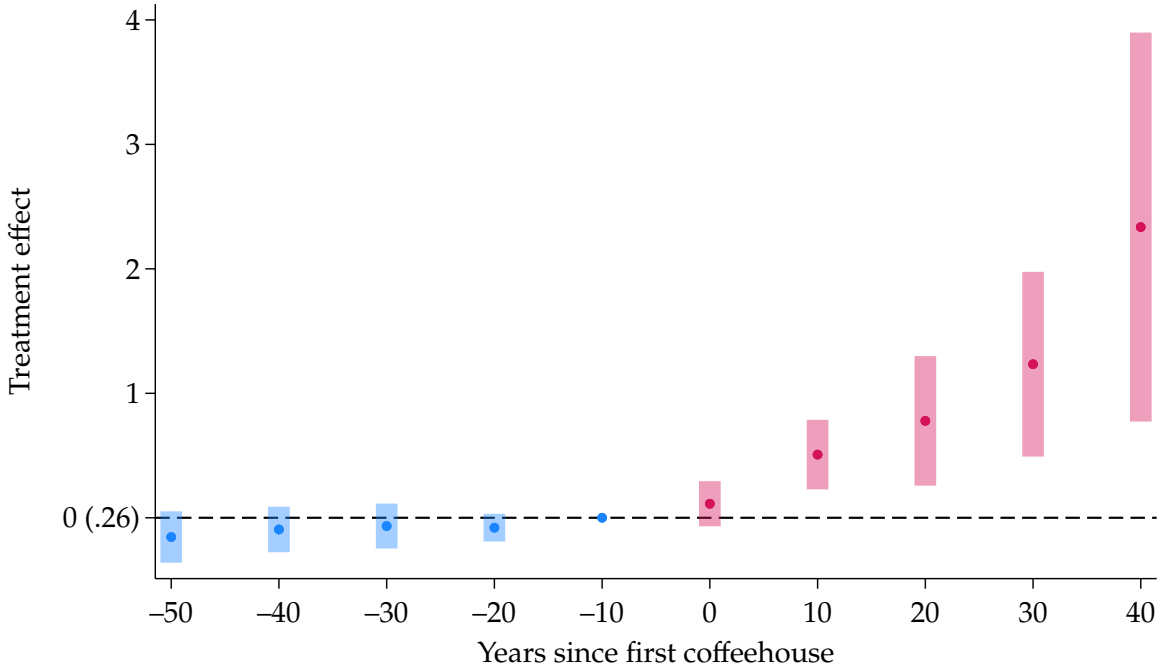


Figure C.22. Effects on scientific instrument shops in guild

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity. Outcome of interest is the decadal number of scientific instrument shops operated by instrument makers for whom a guild is recorded, the subset of makers whose records are best preserved. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 49]

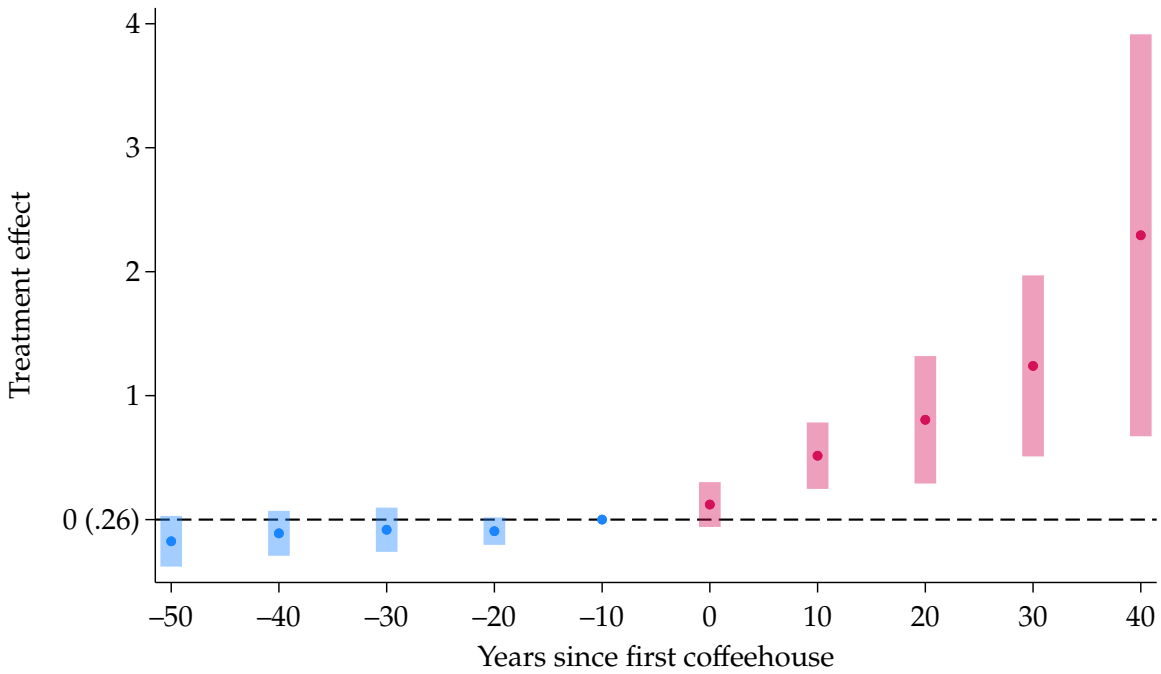
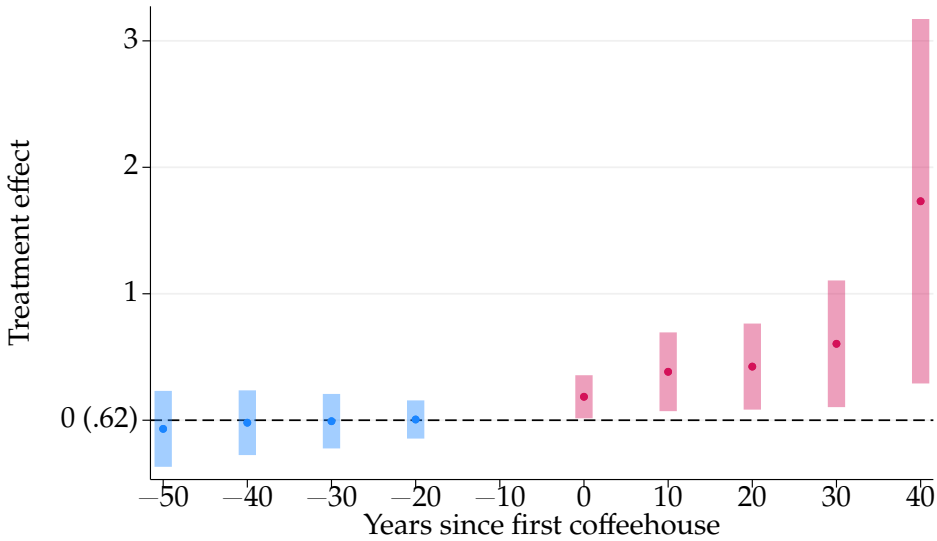


Figure C.23. Effects on scientific instrument shops in guild: control for the Great Fire

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1), including fixed effects for the interaction between an indicator for exposure to the Great Fire and each decade, of the effect of first coffeehouse opening on scientific activity. Outcome of interest is the decadal number of scientific instrument shops operated by instrument makers for whom a guild is recorded, the subset of makers whose records are best preserved. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 49]

(A) Mathematical practitioners



(B) Scientific instrument shops

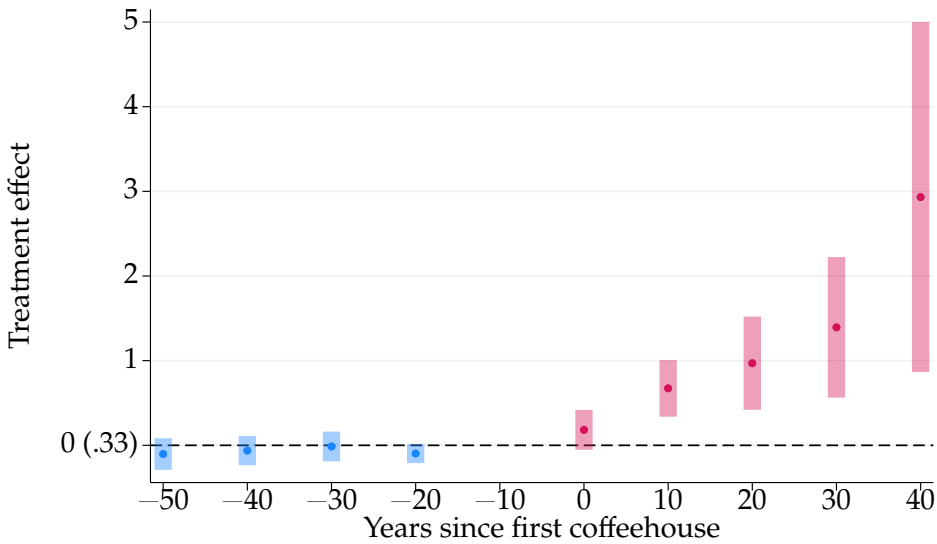
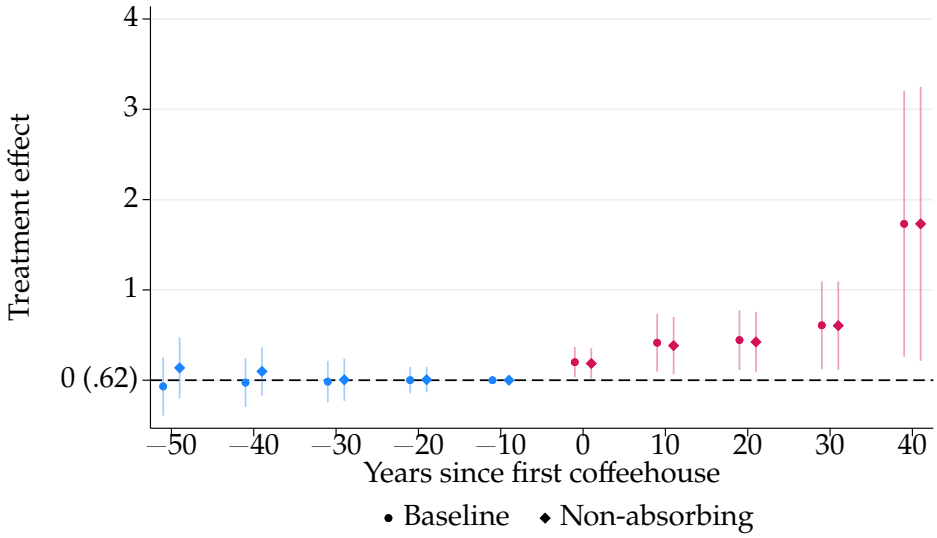


Figure C.24. Effects on scientific activity: never- and not-yet-treated controls

Notes: Figure shows event study estimates and 95 percent confidence intervals from our baseline specification and the estimator of Callaway and Sant'Anna (2021), where the control group consists of both never- and not-yet-treated parishes. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

(A) Mathematical practitioners



(B) Scientific instrument shops

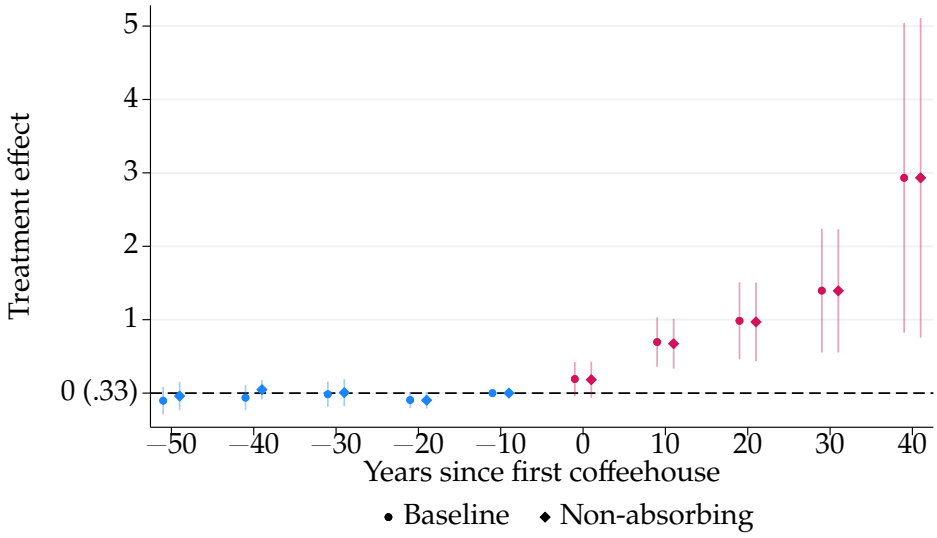


Figure C.25. Effects on scientific activity: non-absorbing treatment

Notes: Figure shows event study estimates and 95 percent confidence intervals from our baseline specification and the estimator of de Chaisemartin and d'Haultfoeuille (2024) for the effect of coffeehouse presence on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 49]

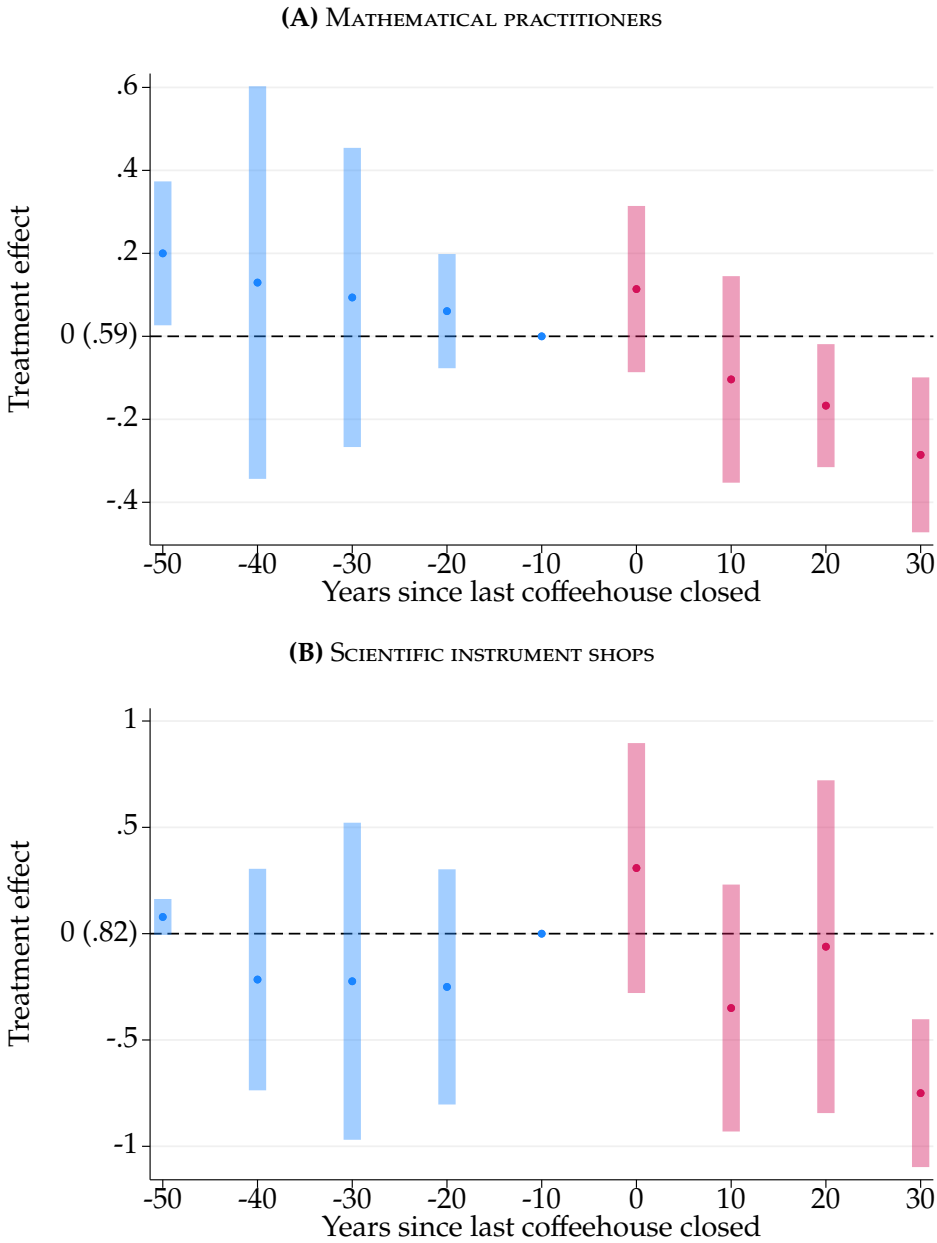
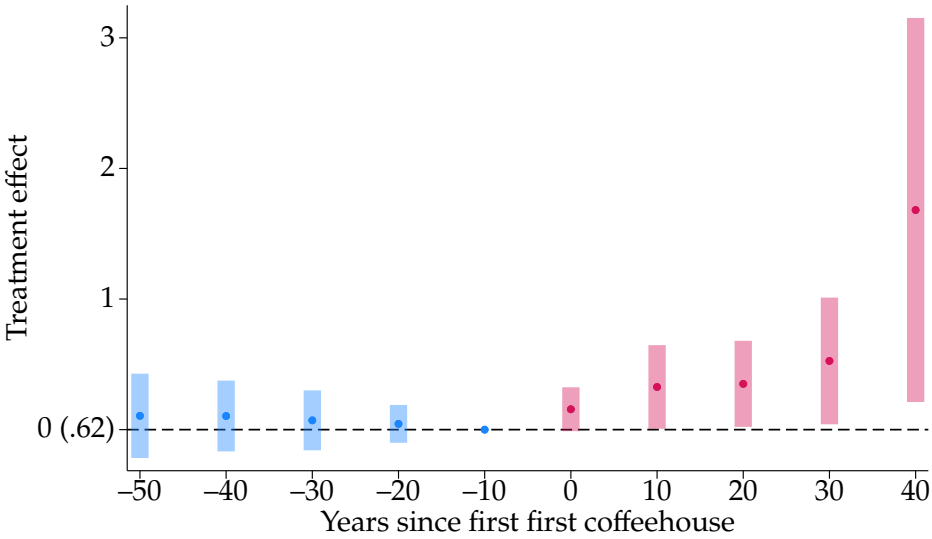


Figure C.26. Effects on scientific activity: closing down the last coffeehouse

Notes: Figure shows event study estimates and 95 percent confidence intervals based on de Chaisemartin and d'Haultfoeuille (2024) for the effect of closing the last coffeehouse on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

(A) Mathematical practitioners



(B) Scientific instrument shops

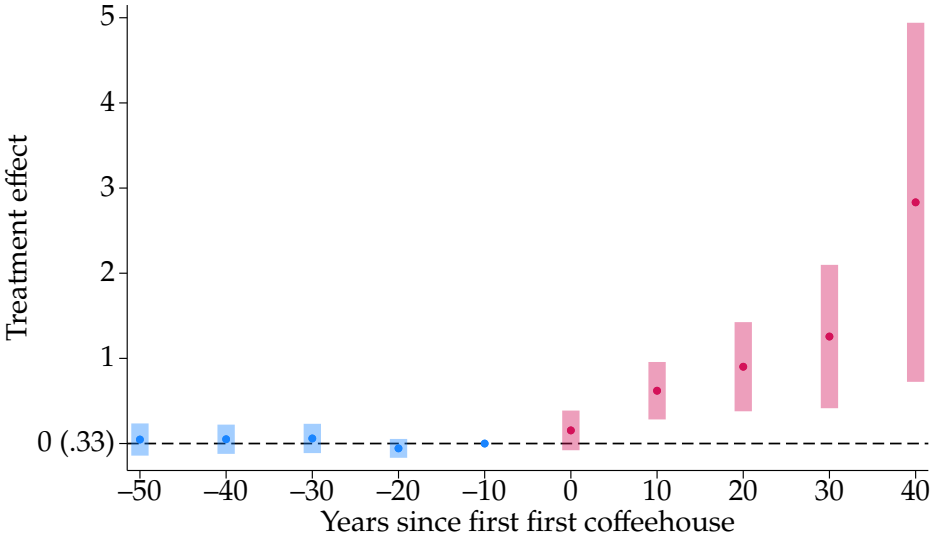


Figure C.27. Effects on scientific activity: group-specific trends

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity after adjusting for group-specific trends. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Following Goodman-Bacon (2021), we estimate a linear outcome trend by treatment cohort using only pre-treatment observations and then subtract the estimated trend from the outcome. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

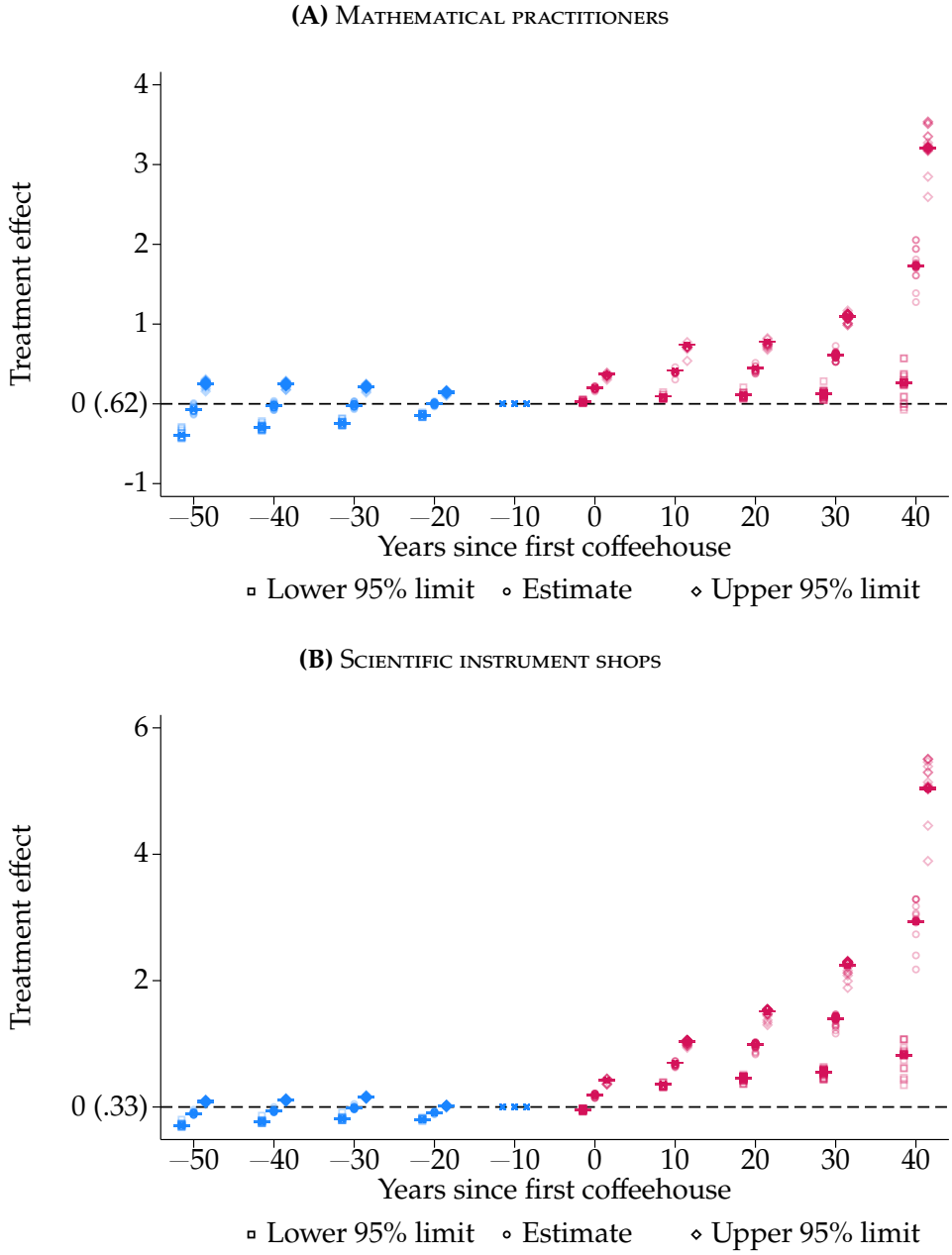
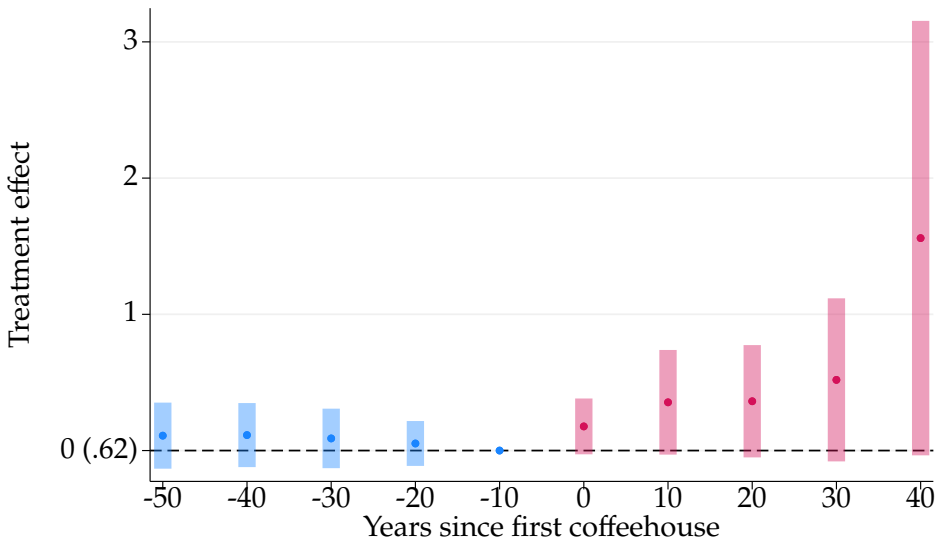


Figure C.28. Effects on scientific activity: leave-one-out sensitivity check

Notes: Figure shows boxplots, including outliers, of event study estimates and their 95 percent confidence limits from equation (1) for the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. The boxplots use 162 leave-one-out samples from the 1600s to the 1690s, with each parish omitted once. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

(A) Mathematical practitioners



(B) Scientific instrument shops

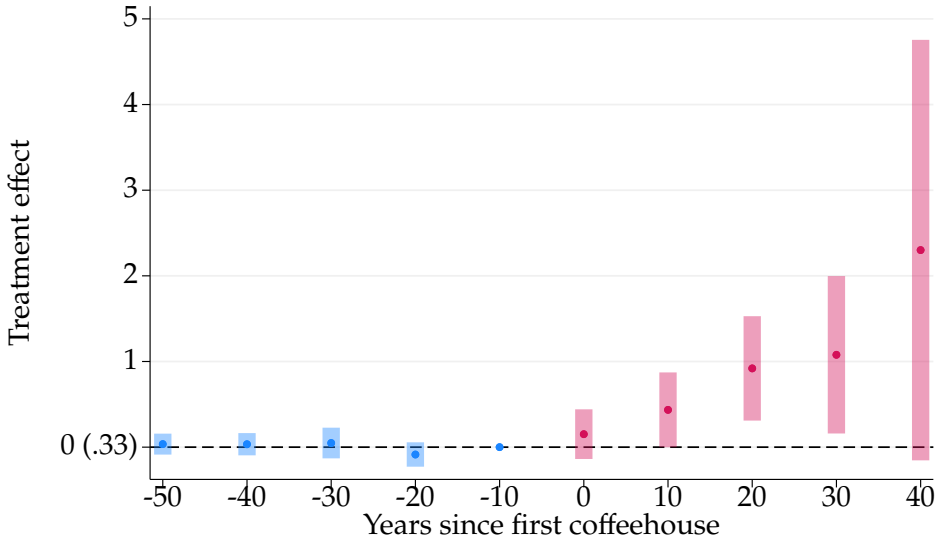
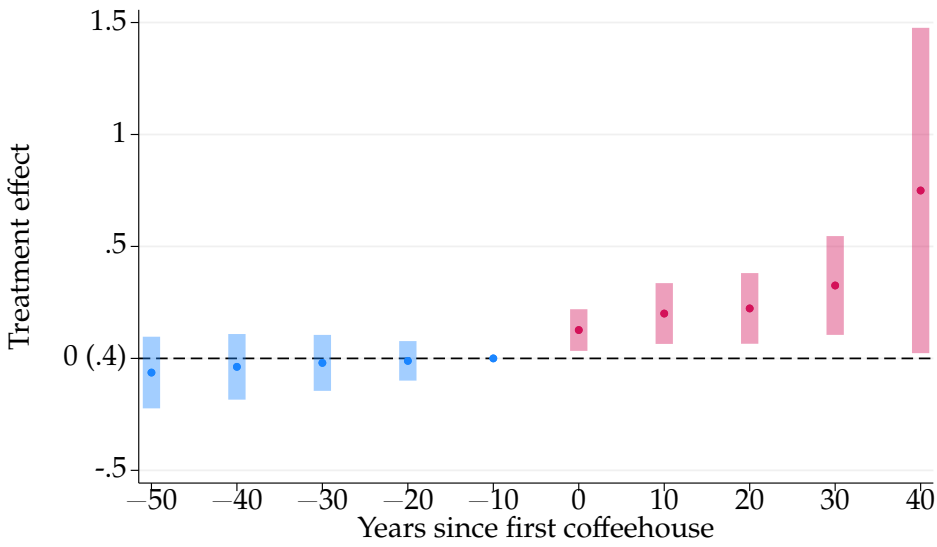


Figure C.29. Effects on scientific activity: Poisson specification

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (3) of the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Estimation is restricted to event times from 50 years before to 50 years after first opening, retaining all never-treated parishes. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

(A) Mathematical practitioners



(B) Scientific instrument shops

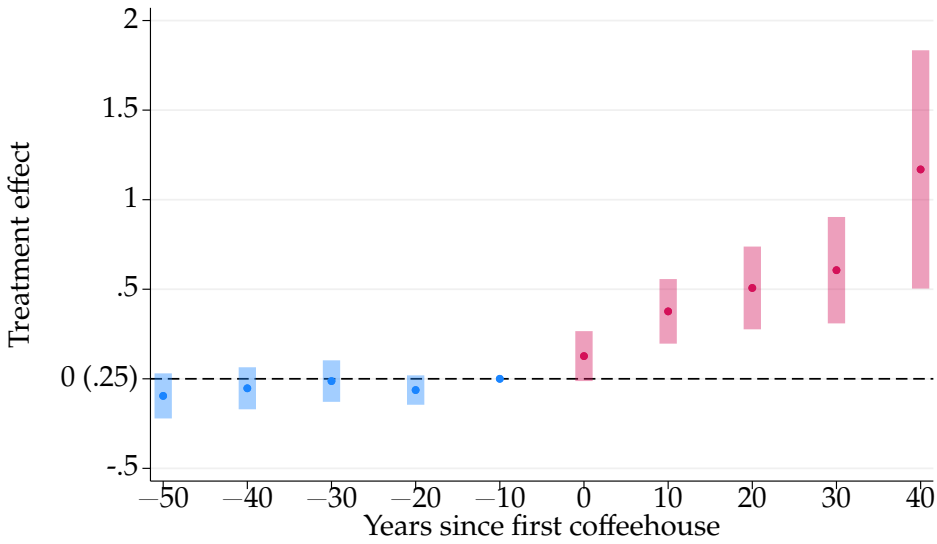


Figure C.30. Effects on scientific activity: inverse hyperbolic sine

Notes: Figure shows event study estimates and 95 percent confidence intervals for the effect of first coffeehouse opening on scientific activity, obtained by estimating equation (1) with the inverse hyperbolic sine of the outcome: $\text{IHS}(y_{it}) = \alpha + \sum_{g=1650}^{1690} \sum_{\substack{s=1600 \\ s \neq g-10}}^{1690} \beta_{gs} \mathbb{1}[s = t] \mathbb{1}[g = E_i] + \gamma_i + \delta_t + \epsilon_{it}$. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors clustered by parish. [Return to page 50]

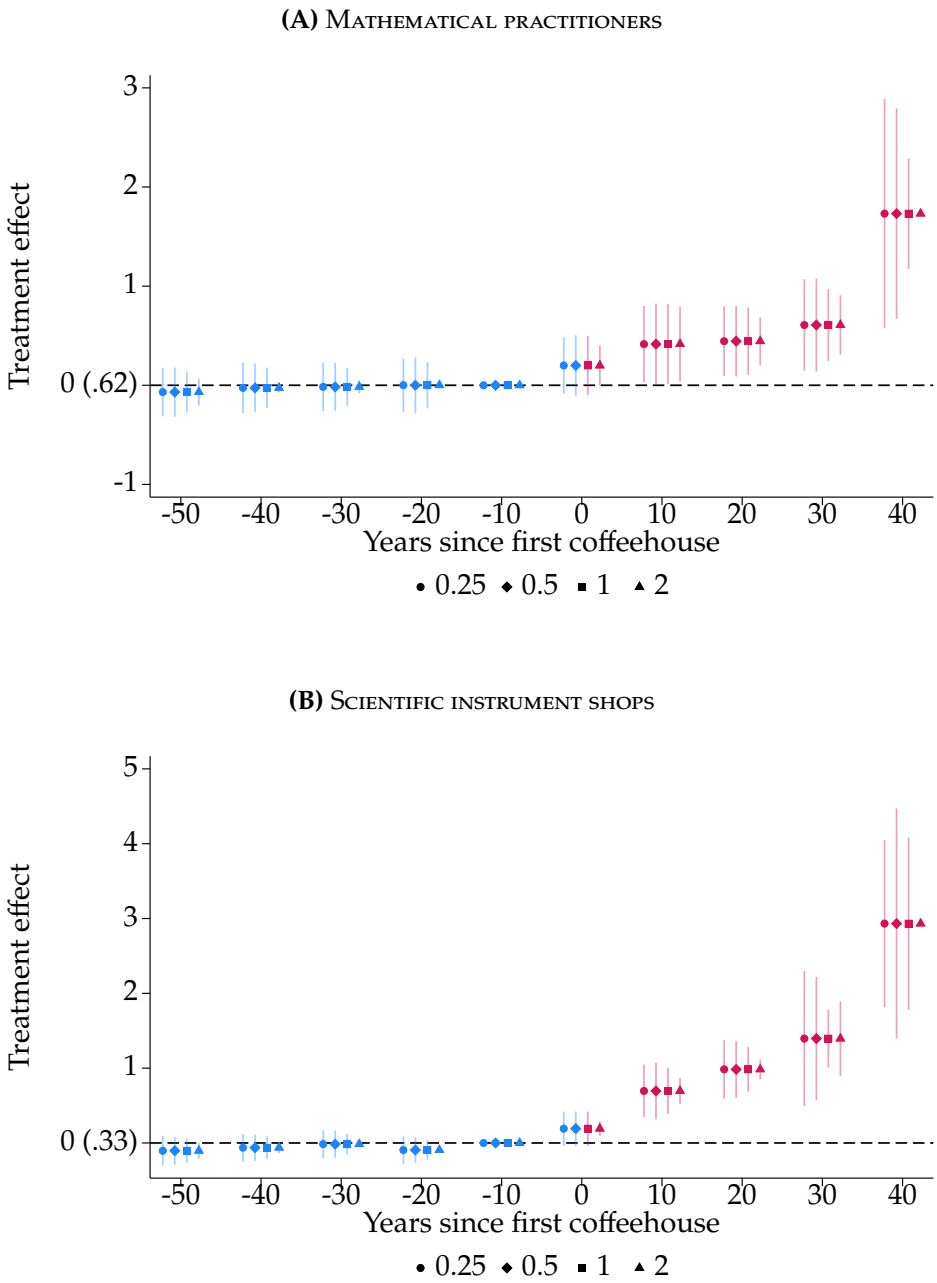


Figure C.31. Effects on scientific activity: Conley (1999) standard errors

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first coffeehouse opening on scientific activity. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Sample includes all 162 parishes from the 1600s to the 1690s. Unit of observation is parish-decade. The parenthetical beside 0 reports the sample outcome mean one decade before treatment. Standard errors are calculated following Conley (1999), corrected for heteroskedasticity, autocorrelation, and spatial correlation using a linear distance decay function with cutoffs of 0.25, 0.5, 1, and 2 kilometers. [Return to page 50]

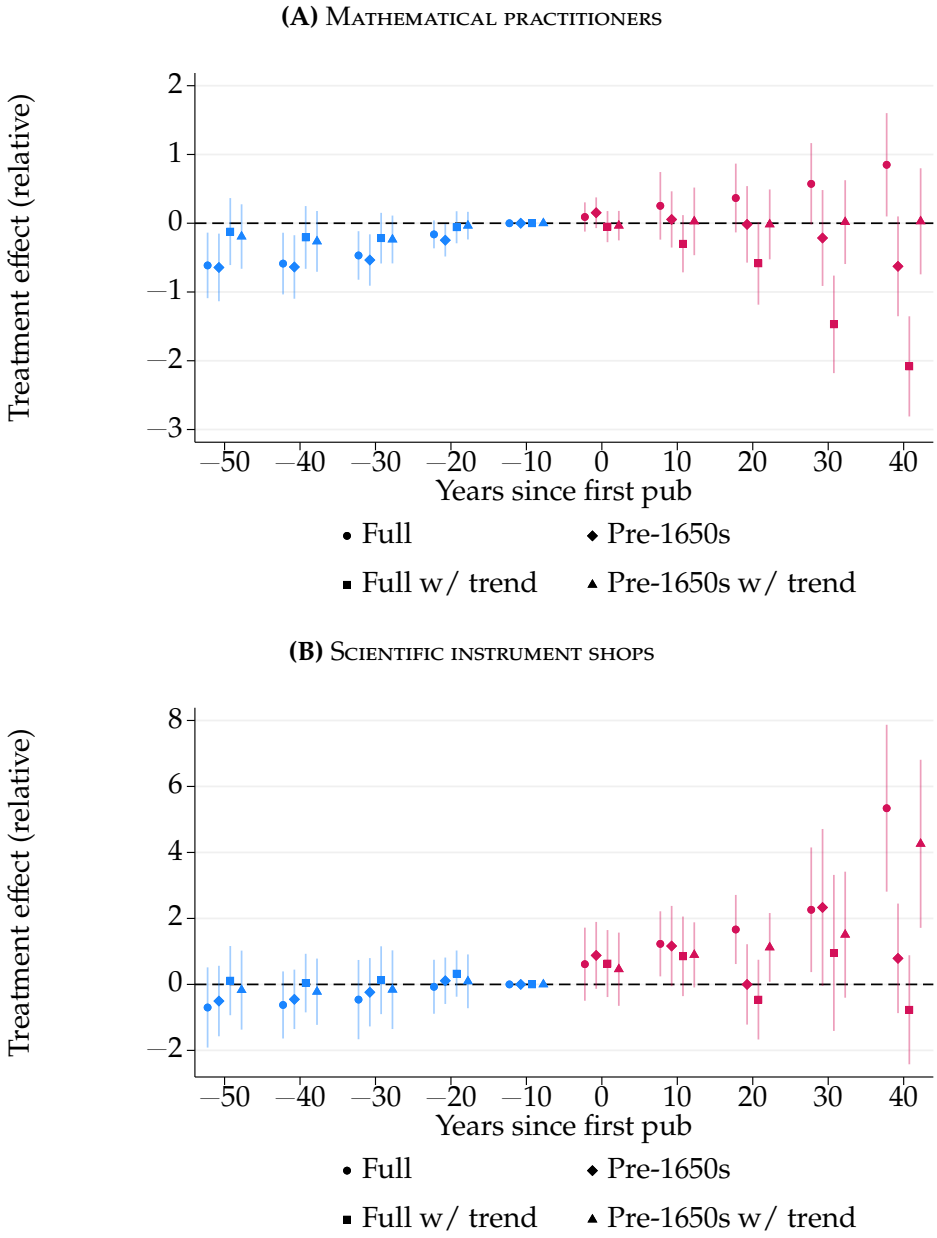


Figure C.32. Pub effects on scientific activity: group-specific trends

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first pub opening in the 1600s on scientific activity. Public houses comprise taverns, inns, alehouses, wine houses, victuallers, and mum houses. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Each outcome is divided by its reference mean, i.e., the sample mean of the outcome one decade before the first pub opened. Sample includes all 162 parishes from the 1550s to the 1690s (full) or the 1550s to the 1640s (before the 1650s). Results "w/ trend" first adjust for group-specific linear trends, following a suggestion in Goodman-Bacon (2021): we estimate a linear outcome trend by treatment cohort using only pre-treatment observations and then subtract the estimated trend from the outcome. Unit of observation is parish-decade. Standard errors clustered by parish. [Return to page 51]

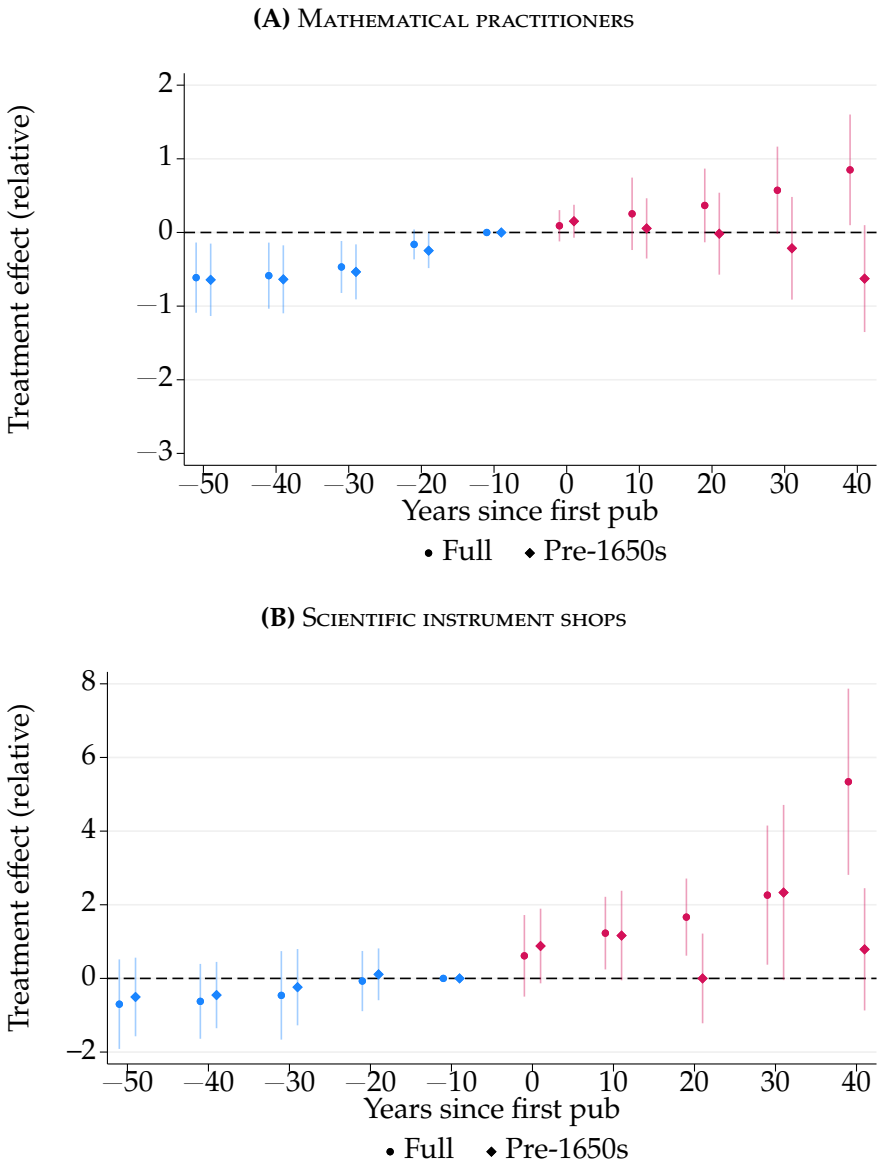


Figure C.33. Pub effects on scientific activity over the full period

Notes: Figure shows event study estimates and 95 percent confidence intervals from equation (1) of the effect of first pub opening in the 1600s on scientific activity. Public houses comprise taverns, inns, alehouses, wine houses, victuallers, and mum houses. Outcomes are the decadal number of mathematical practitioners and scientific instrument shops in a parish. Each outcome is divided by its reference mean, i.e., the sample mean of the outcome one decade before the first pub opened. Sample includes all 162 parishes from the 1550s to the 1690s (full) or the 1550s to the 1640s (before the 1650s). Unit of observation is parish-decade. Standard errors clustered by parish. [Return to page 51]

C.12. Tables

Table C.1—Balance of pre-treatment changes

	Observed parishes	Treatment parishes	Control parishes	Normalized difference
Panel A. Demographics				
Baptisms	130	31.49 (73.83)	17.93 (76.60)	0.18
Baptisms per km^2	130	104.57 (196.59)	107.73 (239.48)	−0.01
Deaths	91	26.44 (100.91)	7.08 (83.22)	0.21
Deaths per km^2	91	10.61 (183.58)	37.26 (286.36)	−0.11
Panel B. Social capital and commerce				
Booksellers	162	−0.04 (2.15)	−0.01 (0.56)	−0.02
Clay-pipe finds	162	0.16 (0.91)	0.26 (1.28)	−0.09
Dissenting meetings	162	0.08 (0.41)	0.03 (0.17)	0.17
Luxury shops	162	0.11 (0.33)	0.09 (0.37)	0.06
Pubs	162	4.16 (4.67)	0.67 (1.63)	1.00
Signs	162	0.50 (1.02)	0.10 (0.37)	0.52
Theaters	162	0.02 (0.24)	−0.03 (0.16)	0.25
Panel C. Scientific activity before 1652				
Instrument shops	162	0.09 (0.32)	0.06 (0.36)	0.08
Non-scientific letters	162	0.68 (2.52)	0.24 (1.47)	0.21
Practitioners	162	0.07 (0.81)	0.10 (0.52)	−0.05
Scientific letters	162	0.03 (0.40)	−0.03 (0.68)	0.11
Parishes	162	61	101	

Notes: Table compares the change in each pre-treatment characteristic between the 1600s–1610s and the 1630s–1640s, for London parishes that received a coffeehouse and parishes that never did. Entries are mean changes with standard deviations in parentheses. Characteristics that are fixed or recorded once, reported in Table 1, have no change to measure. Apothecaries are omitted because the source begins in 1617. The normalized difference is $(\overline{\Delta x}_{\mathrm{T}} - \overline{\Delta x}_{\mathrm{C}})/\sqrt{(s_{\mathrm{T}}^2 + s_{\mathrm{C}}^2)/2}$. [Return to pages 18, 23, 13, 47]

Table C.2—Correlation between coffeehouses and pubs

	Coffeehouses (standardized)				Coffeehouses > 0			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pubs (standardized)	0.408	0.264	0.412	0.251				
	(0.067)	(0.094)	(0.068)	(0.103)				
Pubs > 0					0.169	0.073	0.154	0.017
					(0.025)	(0.035)	(0.024)	(0.032)
Mean dep. var.	0	0	0	0	0.107	0.107	0.107	0.107
Observations	1620	1620	1620	1620	1620	1620	1620	1620
Parish FE		✓		✓		✓		✓
Decade FE			✓	✓			✓	✓

Notes: Table shows the relationship between coffeehouses and pubs. Columns 1–4 show effect sizes from regressions of the number of coffeehouses on the number of pubs, standardized to mean 0 and standard deviation 1. Beginning with the raw correlation in Column 1, the specifications add parish fixed effects, decade fixed effects, and both parish and decade fixed effects. Columns 5–8 show the corresponding extensive-margin regressions of indicators for coffeehouses and pubs with the same sequence of fixed effects. The sample includes all 162 parishes from the 1600s to the 1690s. The unit of observation is the parish-decade. Standard errors clustered by parish. [Return to pages 30, 51]

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