

A better ride: new evidence on travel and the quality of roads in England and Wales, 1660-1820

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Abstract⁴

Travel improved dramatically over time, even before railways. This paper uses comments from travellers' diaries to measure road quality in England and Wales from the mid-1600s to 1820. Using GIS, we digitise journeys made by various travel modes along 15,722 miles and show the reported quality of many main roads went from 'poor' to 'adequate' or 'good' by the early 19th century. Improvements in safety and comfort were crucial as travellers switched from saddlehorses to wheeled vehicles. We also show that turnpike trusts, a novel organization for road funding, contributed to significantly better quality and were favoured by travellers.

Key words: travel, roads, safety, turnpike trusts, mobility, Industrial Revolution.

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1. Introduction

Travel becomes increasingly common as economies develop. Rising incomes make travel more affordable and new technologies and infrastructure investments make travel cheaper, faster, and more comfortable. New forms of travel are especially important as they generate substantial increases in consumption and welfare. History provides a lens through which to examine the evolution of travel and those who use it.⁵ The previous literature is especially informative on two attributes of travel which changed over time: price and speed. For example, in the case of England and Wales, it has been documented that passenger fares declined modestly on public stagecoaches during the 18th and early 19th century, while stagecoach travel times between the same originations and destinations fell significantly (Pawson, 1977; Gerhold 2012, 2014). The increase in speed was valuable to the time-sensitive traveller, namely those conducting business during the Industrial Revolution.

In this paper, we focus on other attributes of travel, namely safety and comfort. These characteristics may not improve as travel time drops; all else being equal riding in a coach at high speed is likely to make passengers more bruised and scared. Moreover, safety and comfort might increase using a more costly mode of travel, but the same might be achieved through significant infrastructural or technological change that also allowed higher speeds. Therefore, safety and comfort have their own evolution. We also give focus to the changing quality of roads, which in the pre-railway era, was crucial in determining safety and comfort as well as travel time. Changes in road quality necessarily involve the actions of government and other entities, whose role is to provide infrastructure. Thus, this paper combines a history of travel and institutions.

England and Wales in the long 18th century (1660-1815) provides an interesting context to study travel and road quality. Travel boomed in this period, including leisure travel (Rosevear et al., 2019). The landed gentry and clergy famously toured by road for pleasure, joining those who travelled for business or politics. The speed of travel also improved. As mentioned above, public stagecoach services became faster, resulting in reductions in travel times. Yet, while speeds were increasing, it is unclear whether they came at the expense of comfort and safety. Nor is it clear whether the substantial number of independent travellers who did not use public stagecoaches saw similar changes.

⁵ See Weiss and Dupont (2024) for an overview of economic history research on tourism and travel.

The 18th century English context is also interesting because of turnpike trusts, a novel organization for the maintenance and improvement of main roads. Highways across England and Wales were generally of poor quality during the late 17th century. This failure arguably lay with the management of roads, which was the responsibility of each local parish. One key constraint was the lack of *sponsorship* for financing and implementation of any changes that might benefit travel beyond the parish. In response, turnpike trusts were created through Acts of Parliament. Trustees were generally members of the local gentry and other notables. They were given powers to levy tolls and borrow against toll revenues. Trusts were further required to reinvest all surplus revenues, effectively making them non-profit. Each trust managed a small mileage, but collectively they became responsible for most of the inter-urban road network by the late 1700s. As we explain below, there is a debate concerning the effects of turnpike trusts on road quality, which in part is driven by data limitations which we address.

Our analysis makes new use of personal diaries, both to document the changing experiences of travellers and to study the impact of turnpike trusts on road quality. Keeping diaries and journals had become common amongst literate people in 18th century England, recording the minutiae of their daily lives, including journeys they made. Gentleman and ladies commented on their social and leisure trips, businessmen recorded their regular calls, and farmers the markets they attended. Although not representing the whole population, these people were a cross section of the population that travelled frequently. Diarists travelled independently by saddle horse, by private carriage, by hired carriage (postchaise), or by stagecoach, the latter being the focus of most previous studies. Thus, diaries cover a greater range of travel experiences. Diaries also contain comments on road quality in various ways. From these we have derived a new, much enlarged dataset of measurable changes in the quality of the main inter-urban highways and adjoining rural roads. Text from 1,504 relevant comments of 69 travellers have been analysed. The diaries were chosen to cover almost all years between 1660 and 1820, most regions of England and Wales, and a range of social classes. All diarist comments on the nature of the road, positive and negative, have been included and converted into a quality index, ranging from 1 (very bad) to 6 (very good). We also link diary comments to a new and comprehensive digital mapping of the roads used by

travellers in this period.⁶ In addition, we calculate speeds of journeys, drawn from diarists, to benchmark our sample against other studies.

The new data indicate that the quality of the main roads changed from poor to adequate between the late 17th century and the mid-18th century. There was further change by the late 1700s with many roads judged to be good by travellers. We also provide maps showing where roads were classified as bad, adequate, or good over the period. For example, roads leading to London are shown to have been bad in the early 1700s, but by 1725 a few of these had been improved by turnpike trusts. By the late 1700s London was connected to its hinterland by long stretches of acceptable or good roads. A similar improvement is found for other major towns. By the early 1800s there were good quality roads to new leisure resorts and between the booming industrial areas of provincial England. Using the diarist data, we also document a mid-18th century shift in the dominant travel mode. Initially, most diarists travelled by saddlehorse, but after 1760 the wheeled vehicle was dominant, including private carriages, hired carriages, and stagecoaches.

Benchmarking the diary data against previous assessments based on advertised speed of stagecoaches, indicates these two datasets are congruent. However, the systematic analysis of data from diary comments allows us to quantify and analyse quality change more thoroughly than before and to compare the outcome on turnpike and non-turnpike roads. It highlights that safety and reliability were primary concerns of the early 18th century traveller. Failure to take account of these priorities results in an underestimate of the improvements made in the early 1700s.

We also perform an econometric analysis of quality at an individual road segment level in cross section and over time. First, we find that road segments under non-turnpike management were lower in quality on average than those under turnpike trust management in the same time periods. Second, we use quality observations on the same road segments over time to estimate how switching to turnpike management changed quality relative to roads that remained under parishes. A panel data differences-in-differences (DID) estimate implies that the probability of a road being at least acceptable (a quality score of 4, 5, or 6) increased by 33 percent when a road came under turnpike management versus when it did not. The effect is large considering 40% of roads in our estimating sample met the “at least acceptable” standard. A similar DID estimate shows that the probability of a road being generally good (a quality score of 5 or 6) increased by 24

⁶ Our mapping of the roads is documented in the Appendix.

percent. Furthermore, event studies show no significant change in quality in the decades before the switch to turnpike management, but significant change in the decades after. We also estimate heterogeneous effects DID models and find similar results.

Our paper relates to several literatures. First, it draws on a large body of previously unused, written records to provide new historical perspectives. Recent examples include the use of autobiographies to shed light on child labour and living standards during the Industrial Revolution and Victorian eras (Humphries, 2010; Griffin 2013, 2020). Also related are studies using textual analysis on parliamentary records (Guldi, 2019; Hanlon, 2022). To our knowledge, we are the first to study a consistent set of many observations from travellers across England and Wales. We are also the first to employ Geographic Information System (GIS) tools to systematically analyse such data.

Second, the paper relates to the social and economic history of transport users and mobility.⁷ One theme in this literature concerns the evolving identities of travellers and their purposes. Our study is novel in demonstrating that better safety and comfort were relevant motivations for increased travel, particularly into and between urban centres connected by good turnpike roads. The diaries suggest women, the landed gentry, and clergy particularly valued the improvements we document here and were more likely to travel as a result.

Third, we contribute to a literature studying the evolution of cost, speed, frequency, and other features in the transport sector. Speed has been emphasized in studies on shipping (Solar, 2014; Kelly and O'Grada, 2019; Ronnback, 2012; Solar and Hens, 2016; Solar and de Zwart, 2017; de Jong, 2020, Bogart et al., 2021). For inland transport, cost and speed have been compared for canals, road freight, stagecoach services, and railways (Bogart, Lefors, and Satchell, 2019; Gerhold, 2014; Leunig, 2006). Yet generally, comfort and safety have been ignored in the literature. We contribute by demonstrating their relevance in a historical context. Our new data also allow for comparison with the attributes of travel in other contexts, like the railway era, where travel became cheaper and faster (e.g., Leunig, 2006).

Fourth, this paper adds to the literature on the operation of turnpike trusts and their effect on quality.⁸ The limited evidence for the 17th century suggests some pre-turnpike roads were

⁷ For survey of mobility in urban areas see Zenobi (2021).

⁸ For a foundational work on turnpike trusts see Albert (1972).

sufficient to carry wheeled traffic, but wear and tear was an increasing problem (Brayshay, 2014). It is well established that the volume of wheeled traffic grew significantly during the 18th century at a time when turnpiking increased, but there has been insufficient comparative data to judge whether this was because of changes in the quality of the main roads.⁹ This lacunae has been addressed by studying road spending and indirect quality outcomes like travel speeds, seasonality, freight rates, and fares for public services (Pawson, 1977; Gerhold, 1996, 2005, 2014; Bogart, 2005a, 2005b). Most of these studies argue that turnpikes led to improvements, but data limitations have made it difficult to systematically compare most outcomes on turnpike roads versus the alternative, parish roads. Hence, one could reasonably question what improvements were seen as important and how much of this was the result of turnpike management, especially before major engineering innovations by McAdam and his cohort during the 1810s.¹⁰ Gerhold (2014) has also argued that since the number of stagecoach services did not increase before 1760, the roads had not improved significantly before then. The timing is relevant because an increasing number of new turnpike trusts were being created in the decades before and thus it is difficult to reconcile this enthusiasm to incur costs and effort if there were no observable benefits.

We contribute to the literature on the effects of turnpike trusts in several ways. We use diaries which contain more data for the period before 1750, include the comments of private travellers as well as those in public stagecoaches, have reduced sampling error (with a larger, more diverse source) and reduced measurement error (through ranked scoring). Our coding of diaries also increases sensitivity by using shorter road segments. We also use an empirical strategy which directly compares outcomes for turnpike trust and parish roads, thereby addressing a key limitation in many previous studies. Moreover, through a check for parallel trends, we address typical endogeneity concerns in difference-in-differences estimation. Broadly, our findings accord with the view that turnpike trusts contributed to improvement, but with a more precise definition of the distribution and limitations of the magnitude of quality change, pushing evidence of improvement back to before 1750. We also resolve the binary view of earlier studies and emphasise that going from bad to acceptable was a measure of improvement, not recognised in simple bad to good outcomes.

⁹ Some preliminary inquiries into quality are made by Jackman (1912), pp.101, 301. Pawson (1977), pp. 268-269, 288-292.

¹⁰ Rosevear et. al. (2023) compares quality by turnpike trusts and Government in the early nineteenth century.

The paper is organized as follows. Section 2 gives more background. Section 3 deals with the criteria used to measure quality changes in roads and presents new facts concerning change over time. Section 4 reports evidence on the effects of turnpike trusts, including difference-in-differences estimates. Section 5 concludes with a broader discussion of the economic implications.

2. Roads, turnpike trusts, and travel

Until the late 17th century, all roads in England and Wales were maintained by civil authorities, generally the parish, using property taxes (Highway Rates levied on top of Poor Rate assessments) and compulsory work by the parishioners (Statute Labour).¹¹ Each parish could have many miles of road with little differentiation between the network of local roads and the small mileage of great highways or post roads that might pass through the parish.¹²

The number and character of parish roads varied across regions. Carts had been used in lowland England since Medieval times (Brayshay, 2014). However, few of the roads in the upland areas of the north-west and south-west were suitable for wheeled traffic.¹³ Carrier services to London from the north-west and south-west continued to rely on pack horses in the early 18th century. Parishes in these and other regions had neither the power nor finances for investment in better road building and maintenance to deal with increasing traffic as the economy grew. Until the early 19th century, it also appears that Governments in London lacked the capacity or political desire to finance change directly¹⁴. Roads, like other infrastructure, were a local issue to be addressed by the Justices of Peace, relying on parish resources.¹⁵

Basic maintenance methods such as laying a broken stone surface, draining the roadbed, building culverts, regularly fixing holes and removing obstructions were used in some parishes. Signposts were supposed to mark uncertain paths, and it was clear that widening lanes, dealing with hollow ways or gradients and addressing dangerous features would be useful. The enduring

¹¹ This had been codified in the Tudor period, initially by a Statute of 1555 which set out the responsibilities placed on parishes for road maintenance (Brayshay, 2014)

¹² Although the crossing of small streams over fords or culverts fell within the road administration, larger rivers were crossed by ferries or bridges. Negotiating these could be time consuming and sometimes hazardous. Ferries were generally leased to a private operator, but medieval bridges were maintained by the County using taxes. New bridges were generally built and maintained by a bridge trust and would normally charge tolls.

¹³ Jackman (1977, p.87), Sheldon (1928, p. 72), Croft (1967, pp. 2-8).

¹⁴ Government concerns about poor roads grew in the early 1800s, see Rosevear et al., (2023).

¹⁵ See Webb and Webb (1913, ch. 3).

problem was how to coordinate, finance, and provide powers to implement improvements across all parishes along the road.

Turnpike trusts emerged to rectify this problem. The first was made in Hertfordshire by a Parliamentary Act in 1663, but the next was not until 1695. In this initial period, turnpike roads were operated by Justices of the Peace. However, by the early 1700s, trustees were given operational control. These bodies generally comprised local landowners, merchants, and the clergy, which became the norm in turnpike road trusts as in some other business activities.¹⁶ The 'turnpike trust system' subsequently grew in the 1720s and more rapidly in the 1750s and 60s. By 1836 there were more than 1,000 trusts managing over 20,000 miles of road. The roads managed by parishes were around 106,000 miles in the 1830s, but they were far less used than turnpike roads.

The novel powers of trusts were laid out in their Act of Parliament. Each was unique, but 'turnpike acts' had three common powers: 1) to take a portion of statute labour to concentrate on these major highways, (2) to levy tolls to cover maintenance and against which to borrow to finance improvements, and (3) to acquire land and materials at a fair rate to maintain and change the road. The power to levy a toll had existed since Medieval times as "pavage" or "pontage". Yet levying a schedule of tolls on different types of traffic (wagons, coaches, livestock) was generally new. A local authority borrowing against the revenues of tolls was also novel. Finally, most acts specified a term limit of 21 years, but trustees could apply for a renewal or continuation act before then, if the trust had an outstanding debt or proposed an extension to its powers. Continuation acts were very common so that many turnpikes operated into the mid-19th century under a sequence of acts.

The preamble to each turnpike act included a statement of what the trust was to do and a justification for why the powers were needed. Most stated that the trustees would repair, maintain and amend an existing road and some also were to widen this road. The applicants said that these powers were needed because the road was in a poor state and could not be amended under the existing Parish Statute Labour system. The deterioration of the road was often attributed to "the many carriages frequently passing through" and the "nature of the soil". Most acts prior to 1750 said that the highway was "ruinous" and "dangerous to travellers", and that problems were greatest in the winter season. Many said the road was impassable some of the time and was

¹⁶ For more on the model of giving legal powers to a 'trust', see Harris (1994).

narrow and bad. As we will see later, most of these terms reoccur in the diaries of travellers and presumably reflect the criteria used at the time to informally assess road quality.

Public pressure to maintain adequate roads varied across the class spectrum. The poor generally walked and had few reasons to travel regularly. The middling groups (farmers, tradesmen) may have owned a saddle horse for regular travel. In rural areas, many people would have a farm horse that could occasionally draw a 2-wheel gig and in urban areas there were posting inns which would hire out both saddle horses and 4-wheel postchaises with a postillion for short journeys. As the 18th century progressed, the middling traveller might increasingly choose public transport such as a scheduled stagecoach. The upper class (professionals, the gentry, aristocrats) used all these modes but also had their private carriages which could be drawn by their own coach horses or by hired post horses. It was the users of wheeled vehicles who needed better roads, and it was largely the upper classes who pressed for turnpiking rather than leaving roads to parish care (Webb and Webb, 1913).

3. Traveller diaries and journals as a source

3.1 The diarists in our sample

This study uses a new dataset drawing on 90 travel diaries and journals, 69 of which contain specific comments on road quality. Around half were published in the last 70 years and a similar number are digital copies of older transcripts (details in Appendix II). A small proportion were transcribed from County Archives. They range in scale from multi-volume sets (e.g., Pepys, Witts) to small booklets describing a short tour; the least edited or summarised edition available was used.

Table 1 lists individuals making road quality comments on at least 100 miles of their travel. These travellers were often comfortably off, being clergy, men in trade, gentry or aristocrats. In our data 57% of the miles with comment were travelled by gentry, 35% by middling people. The mode of travel used by both male and female diarists ranged from saddle horse, private carriage, hired carriage (postchaise) to stagecoach and a few were pedestrians. Of those journeys for which a comment was made on road quality, 36% were by horse riders, and of those in wheeled vehicles only 3% were in stagecoaches, the great majority being in the diarist's own carriage or a hired vehicle. A quarter of the journeys with road quality comments were by female diarists, though of all the journeys recorded in the diaries only 9% were written by females. The data were divided into three time periods ("eras") to help reveal change over time. Era 1 before 1760 covers a period

when turnpiking was just beginning and most journeys were on un-turnpiked roads. During era 2 (1760-1789) the turnpike network was expanding rapidly, and in era 3 (1790 to 1820) the turnpike network was reaching maturity but was yet to experience the dramatic road improvements by Telford and Macadam (Rosevear et al., 2024).

With notable exceptions (Ogilby, Defoe and Young) the diarists did not expect their writings to be published. Their comments on the road were a minor part of their diary entries, though several commented on more than a tenth of the miles they travelled. Thus, in general they do not appear to have had a particular prejudice or agenda. The table demonstrates the relative diversity of sources within each era.

Table 1: Main diaries and from which road quality comments were taken for England and Wales

Diarist (*clergy; **middling; ***gentry; ****aristocrat; ~ journalist)	Distance with comments pre- 1760 (miles)	Distance with comments 1760- 1789 (miles)	Distance with comments 1790- 1820 (miles)	Total miles of journeys recorded in diary	% Journey miles with comments
Celia Fiennes ***	1663			5511	30%
Daniel Defoe ** ~	1011			nk	
John Ogilby (Britannia)	932			7690	12%
Lord Harley ****	303			2284	13%
Samuel Pepys **	303			4199	7%
Richard Pococke *	272			7243	4%
Joseph Taylor **	213			914	23%
Cornish judge ***	202	23		734	31%
Ralph Thoresby **	116			8004	1%
Joseph Taylor (poet)**	114			2150	5%
Caroline Powys ***	19	68	44	5147	3%
Arthur Young *** ~		2179		2406	91%
Samuel Curwen **		853		4567	19%
La Rochefoucauld ***		648		2501	26%
Agnes Witts **		484	888	12391	11%
John Byng ***		412	709	6534	17%
Jabez M Fisher **		359		4500	8%
Stebbing Shaw *		210		1175	18%
Sylas Neville***		127		6794	2%
Chas Hatchett **			751	1678	45%
Gent on tour ***			718	887	81%
Louis Simond **			186	2306	8%
John Cary (road book)			155	nk	
John Skinner *			129	6033	2%
Peter Hawker **			113	10828	1%
Benjamin Silliman **			101	1605	6%
Others	578	370	594		
Total in each Era	5726	5733	4388	#	

Notes: 369,000 miles of travel have been analysed from 90 diaries, journals and collections; 69 of these have road quality comments; only diaries with comments on more than 100 miles listed here. See Appendix I for references to diaries and collections.

The diaries describe well specified journeys made over many decades, from which we extract three classes of data (i) direct comments on the quality of the road (from 69 diaries), (ii) the average speed of individual journeys based on start and finish times (from 90 diaries), and (iii) the mode of travel: horseback, wheeled vehicle, or undetermined.

3.2 Words used to comment on road quality

Textual analysis was employed to examine the words diarists used to describe the road quality. The frequency of particular words used in 1,500 individual entries covering turnpikes and parish roads for all dates, were counted using textual analysis tools.¹⁷ From the 932 unique words, a subset of 106 words relating directly to road quality was selected by us. The word use is tabulated in more detail in Appendix I. Relevant words used most frequently were **good** (235), **bad** (220), **excellent** (87), **stoney** (84) and **narrow** (81). Less frequently used were **tedious** (23), **execrable** (17) or **impassable** (8). Hence the two extreme categories of good and bad road (A and C below) were usually identified unambiguously from these simple terms.

Speed was rarely mentioned directly. Witts used the word **slow** once in 1792 and both Byng and Lister used it in 1792 and 1824 respectively; fast was not used. Tedious may be synonymous with slow but has a low incidence and the one instance of the phrase “longer than expected” probably relates to speed. Thus, it appears that speed was not uppermost in the mind of these travellers, once they had begun a journey. Nevertheless, the likely speed of a journey (as advertised) and the suitability and cost of the vehicle for safe travel at a high speed were surely relevant, so both speed measurements and direct comments are valuable tools in judging change.

Using the target words derived from diaries, we have devised a road quality grading system that allows comparisons and relative change to be assessed. As shown in Table 2, the words and

¹⁷ We use a macro in Microsoft WORD
https://wordribbon.tips.net/T010761_Generating_a_Count_of_Word_Occurrences.htm

phrases¹⁸ of the diarist are assigned a quality score (1 to 6) to place them into one of three quality categories: C - generally poor, B - adequate, and A - generally good.¹⁹

Table 2: Data entry criteria used to classify road quality comments.

Road Quality Category	Examples of terms in text used to give a quality score
C – Generally poor <i>Significant barriers to easy travel</i>	1. Very bad/dangerous ; worst; terrible; execrable; insufferable; vile, unsuitable for carriages; very steep; hazardous; detestable; had to walk horses; break-neck, tide covers sands; flooded; totally impassable
	2. Bad ; rough; large stones; full of ruts; very dirty; very stony; very narrow; steep, rough for coaches; too bad for postchaise; poor, under indictment; rough, heavy, deep, unpassable at times, ruinous, ill, unpleasant, wet; splashy, terrible.
B – Adequate <i>Usable but some inconvenience</i>	3. Not good ; sandy hard going; hilly, steep, stony; uneven; rough; narrow; lanes; dirty, Summer road only; indifferent, winding, uneasy, no very good way, mountainous, hilly; overhung; shady.
	4. Acceptable ; not best, not very ill, rather sandy; uneven but free from ruts or stones; tolerable; tolerably good; fair; adequate, good at this season {not before}, in repair, indifferent good, middling, good over mountains.
A – Generally good <i>Easy travel</i>	5. Good ; level; as garden gravel; delightful; pleasant; fine, firm; clean; straight, paved pebbles; very agreeable, improved; mended.
	6. Very good ; excellent; very fine, well-pitched

Notes: The terms should relate to the road not the surrounding countryside, weather or social experience. A combination of adverse terms drops the score by one point. Where comparison is made of winter and summer quality, the score is averaged. In a few instances, personal judgement was used to match a word or phrase to a synonym in this list.

The frequency of individual words associated with each of the three levels of quality are shown by word clouds in Figure 1. Notice that roads in the generally poor category (score 1 and 2) were often described by words that are less positive, e.g., bad, deep, dirty, steep, rough. Roads in the adequate category (scores 3 and 4) were characterised by more positive words, like good and level, but these may be qualified by the word “not” and may include negative words, like narrow and stoney. Roads in the generally good category (scores 5 and 6) have the most positive words, like excellent, pleasant, and hard. These plots illustrate how our quality score differentiates roads based on diarist descriptions.

¹⁸ It is important to consider the context as well as the frequency with which the individual words were used in a phrase or sentence; e.g. good and bad may be used alone or qualified as “not good”, or “very bad”. It is these phrases that determine the quality score.

¹⁹ The terms used in the preamble to the turnpike Acts also appear here, all at the poorer end of this categorization.

The journeys and comments have been linked to a historical GIS road dataset (1680-1825). The latter includes mapping of (i) all roads that were turnpiked and in which year, (ii) principal roads in 1680, and (iii) all main roads, “other roads,” and some parish roads mapped by Cary around 1825. Altogether 80,000 miles of road are represented as polylines (Appendices III to V provide details). The most probable path of each journey was plotted using the spatial information in the diary (start, end, intermediate towns, or features) and relevant polylines in the historical GIS roads dataset. Where a traveller made a comment on the state of the road, this section was copied into a “road quality” file which contained fields for the quality score (1 to 6) and the ranked quality category (A to C). Where comments related to roads that could not definitely be classified as public roads (e.g., through parks, over bridges and ferries), these were not analysed. Where a journey was made over different classes of road, the class of the longer section was used, unless the parts were similar length, when it was split. This gave 1,504 sections totalling 15,772 miles for analysis. Crucially for our panel analysis later, 683 of these sections have significant overlap along 270 stretches of road, giving quality scores over time, based on at least two diary comments.²⁰

The GIS file with turnpike roads, (i) above, is used to characterise sections as either under turnpike management at the observation date, never under turnpike management, or turnpiked after the date. Going forward we refer to a road section as ‘turnpiked’ from the year in which the act was passed; typically tolls would apply immediately though improvement may not have begun. Parishes were responsible on that segment before the Act or if the trust relinquished control or Justices of the Peace made a determination to dis-turnpike.

3.3 Perception, bias, and environmental factors

Analysis of traveller diaries is well suited to revealing change in quality over time and attributable to turnpike management. They were usually written on, or close to, the day of a trip and provide precise dates and locational details of journeys undertaken. Diarists were also in the social classes that were regular users of the long-distance turnpike roads and so most motivated to comment knowledgeably on how these might vary in quality.

Yet there are some limitations of this source which we have tried to address. Perceptions of quality are subjective, depending on the circumstances of the traveller, their recent experience, and the prevailing standards. Most of the recorded journeys in the 17th and early 18th centuries were

²⁰ Overlap of ca.30% was allowed if other factors were consistent, though most pairings had far higher congruence.

made by horse riders. For them, road quality depended on avoiding wet or confined areas and having a yielding surface for the hooves of horses. Natural, unmade roads and turf, particularly along ridgeways, could often provide this. For the coaches that became common during the 18th century, a quality road was (i) wide enough for two vehicles to pass, (ii) firm, so that the surface was not cut into deep ruts by the wheels, (iii) smooth, to minimise jolts, and (iv) free from steep inclines to allow a steady pace. Thus, the transition from hoof to wheel might lead to a changing definition of what was a good or bad road. Nevertheless, both saddle horses and coach horses worked best on surfaces free of sharp stones or smooth, slippery slabs, while both would rate deep sloughs as dangerous or impassable. These factors may reduce any divergence in the judgement of overall road quality.

Differences in income and experience could also frame perceptions. As stated in the *Gentleman's Magazine* of November 1752, "farmers, innkeepers and peasants who never travel far from home, may give execrable roads (and tell no lie) the nomination of very safe and good ones." The judgement of commentators was also referenced against their own, wider travel experience. Hence, pedestrians or riders felt quite competent to classify a road as good or bad, using their recollection of journeys made by wheeled modes. Individuals may change their reference points slowly, so any upward change in standards might drift on a generational time frame rather than a step change.

To address how the drift in perceptions affects the way roads are described, we used textual analysis for two prolific commentators, Celia Fiennes and Agnes Witts. These female diarists made journeys several generations apart. Both thought themselves of a similar social class, travelled widely and both recorded travel over several years and seasons (from 1682-1706 and 1788-93 respectively). As shown in Appendix I, there is surprising similarity in the words they use most frequently in criticism or praise of road quality. Fiennes was more specific in what she regarded as bad, often using the same terms that appear in early turnpike Acts to describe parish roads, such as hazardous, narrow, deep and heavy. Fiennes had several accidents on flooded roads so her words relating to poor drainage reflect real concerns over safety. Witts used more emotional terms for positive and negative features, such as enchanting or excellent and wretched or execrable. This does represent some shift in perception of what is bad and good, though its direction is towards a more demanding standard but not to a completely different frame of reference.

Diarists made choices about the routes they took. In a small road network, travellers were obliged to take the only route available, and comment upon a very bad road. However, in a well-developed network with multiple options, a traveller would choose what they perceive to be the best route, based on more than just road quality. In our context, aristocratic travellers in vehicles capable of high speeds might favour, and comment on, a different route from those using a mode with a lower optimum speed, e.g., horse riders, freight carriers or farmers. This effect will not unduly bias our attempt to measure quality on the most travelled roads.

The diarist comments generally only apply to parts of the journey; for instance, on stagecoach journeys the comments relate to 467 miles of sections on the 1,313 miles of the full journeys (36%). Diarists may comment on stretches of poor-quality road and good-quality road, interspaced with sections without comment on a particular route. Hence, diarists focus judgement on road quality at specific places not just on the whole journey.

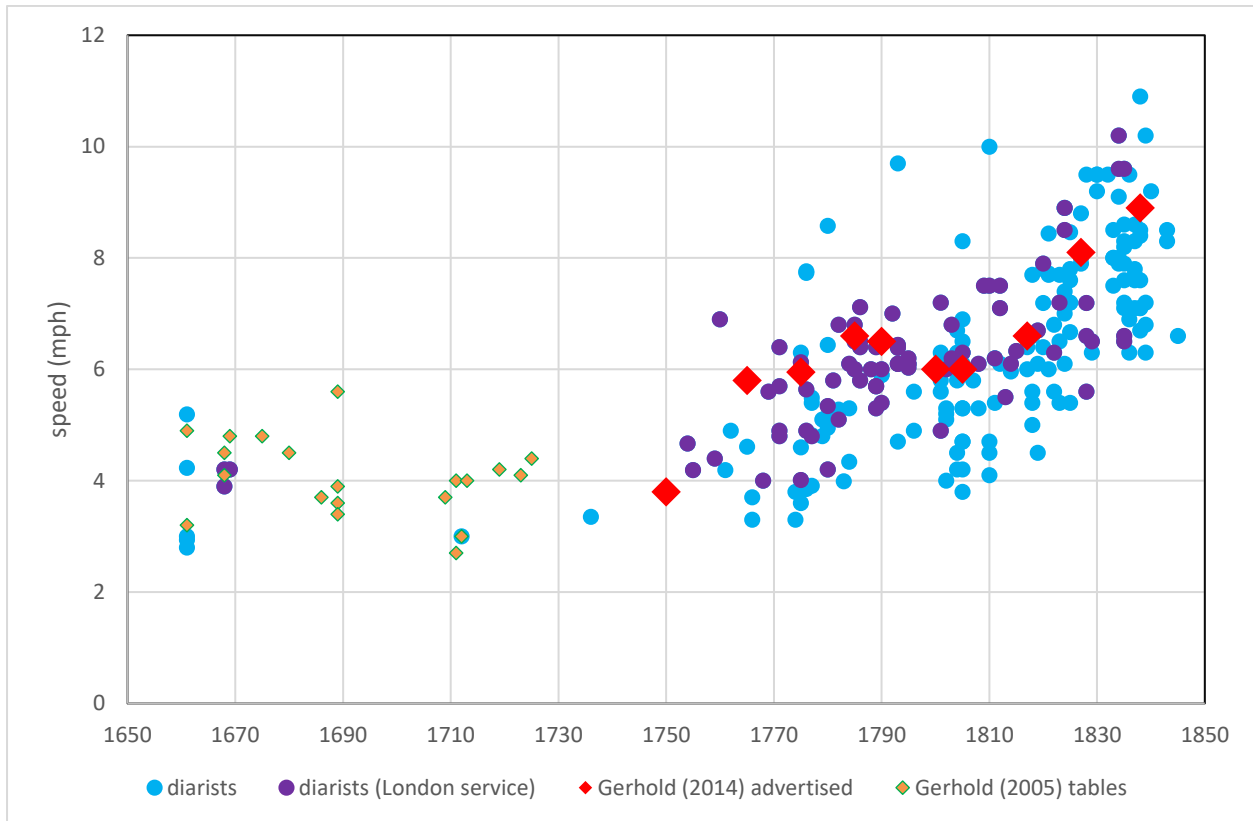
Environmental factors also mattered. It was easier to maintain a satisfactory road across some soils (clay was bad) and some topography (steep hills and flood plains were bad). Thus, not all roads would need the same input to make them adequate but, all else being equal, more traffic meant more damage and lower quality. Furthermore, if a road was very bad, making it adequate would be a positive achievement.

3.4 Benchmarking

To check for any fundamental difference or bias between diarist experience and earlier studies we have benchmarked the data from all 90 diaries using a metric that they share with the other studies, the average speed of stagecoach journeys (Figure 2). These journeys were normally along main roads that were progressively turnpiked.

We find that the trend in the speed of those stagecoach journeys reported by diarists is consistent with the pattern reported previously by Gerhold (2005, 2014), particularly for London services. This would suggest that actual journeys made by these diarists correspond with the advertised information used by others. If it were assumed that coach speed was sensitive to the quality of the road, then Figure 2 suggests that roads deteriorated slightly in the late 17th century, remained unchanged during the initial period of turnpiking from 1700 to 1750 and only began to improve significantly in the 1760s. Our additional quality metrics will modify this conclusion as discussed in the next section.

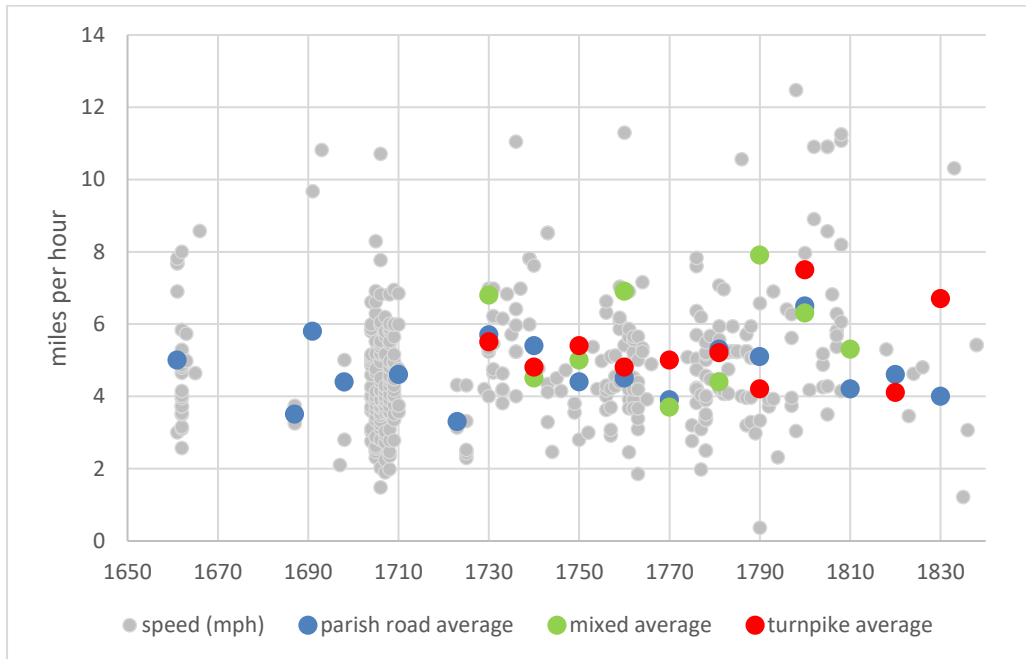
Figure 2: Speed of stagecoach services derived from the diaries compared to previous studies



Notes: We distinguish trips to and from a London terminus and those between other terminals. We also distinguish speeds in Gerhold (2005, 2014) drawn from advertised London coaches and early records.

From the journeys recorded in all 90 diaries we can also derive a dataset on speed for other modes of travel. This gives the first comparison between common modes of private and public transport. The speed of hired carriages (e.g., the postchaise) and private carriages follows a similar pattern as that of public stagecoaches, typically being around 4 mph until the latter part of the 18th century. Some postchaises achieve similar speeds to the stagecoach in the early 19th century, but private carriages were slightly slower on average at 8mph. However, travel on a saddle horse shows a different pattern than the wheeled vehicles. In Figure 3 the speed of journeys made on a saddle horse is plotted, along with the decadal average speeds, distinguishing journeys made mainly on parish roads, mainly on turnpikes and those that involve sections of both (mixed).

Figure 3: Speed of journeys made by diarists on a saddle horse.



Notes: We distinguish decadal average speeds along either mainly parish roads, mainly turnpike roads or a mixture of both. There are 420 journeys total, excluding those of less than an hour.

The average speed of journeys made by diarists on a saddle horse did not change significantly between the 1660s and the 1830s, remaining around 5mph. Nor is there any substantial difference in the speed of trips made on turnpike roads or parish roads. There is a very wide spread of data, some of it arising from the way the horse was ridden; walking, trotting or galloping. Trips made at more than 8mph are assumed to be on a galloping horse and this was not sustainable regularly or for a long period. High overall journey speeds could be achieved using hired post horses when the rider might gallop for an hour and then take a fresh mount. The proportion of these high-speed journeys does increase slightly over the period, but this occurs on both turnpikes and non-turnpike routes.

The relatively small dataset of journeys on foot shows a similar pattern to that on the saddle horse, remaining at around 3mph over the period. This overall pattern suggests that road improvements to increase coach speed were of little benefit to riders of saddle horses or pedestrians. Horses were already able to reach the maximum speed of which they were capable even in the 1600s before any turnpiking and so were not able to benefit from road improvement.

3.5 Changes in mode of travel

Table 3 documents how the modes of travel of the selected diarists changed over time. Importantly, this dataset records the experience of the private traveller by saddle horse or carriage, as well as the stagecoach passenger, the focus of previous studies.

Table 3: Mode of travel of diarists commenting on road quality

Era	% saddle horse	% private carriage	% hired carriage	% stagecoach	% foot	% Uncertain
<u>1. pre-1760</u>	68%	13%	1%	1%	0%	16%
<u>2. 1760-1789</u>	16%	51%	28%	4%	1%	0%
<u>3. 1790-1820</u>	20%	41%	28%	4%	3%	4%
total miles by mode	5690	8804	2921	466	179	1124

Notes: Authors' calculations from diarist dataset.

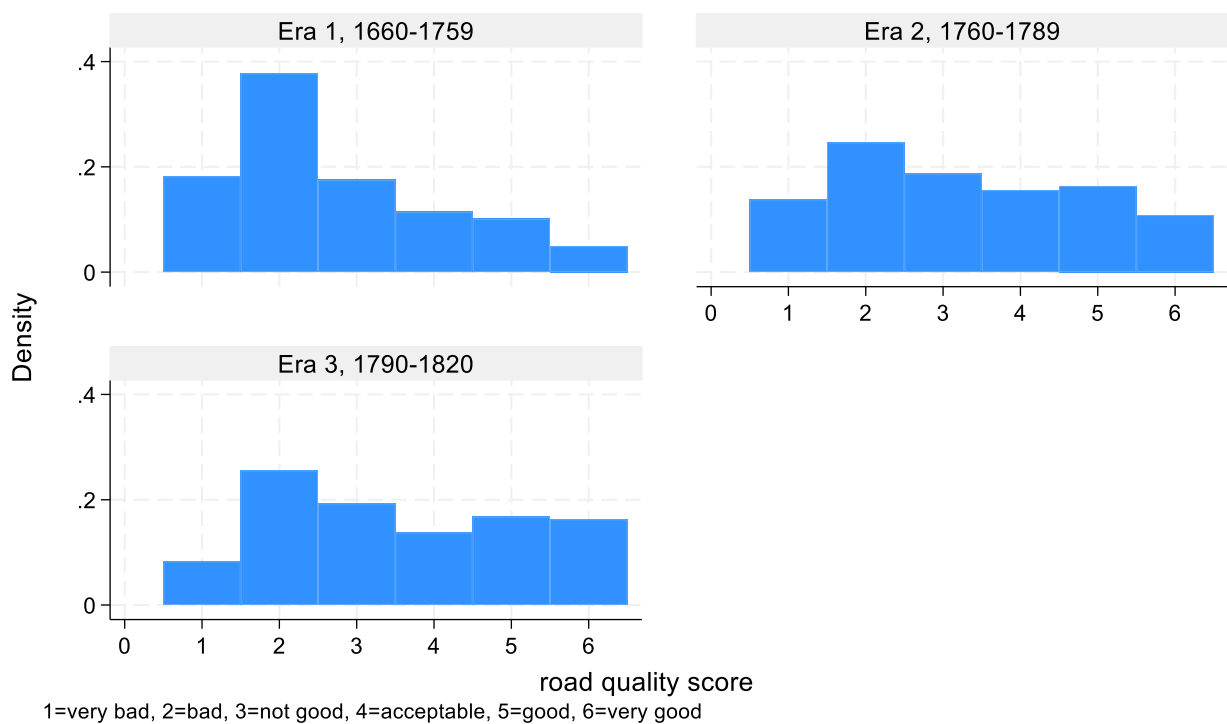
In era 1, prior to 1760, almost 70% of reported journeys were on a saddle horse and only 15% of the mileage assessed by travellers was in a wheeled vehicle. The proportions were reversed in eras 2 and 3 with over 70% being passengers rather than riders. These passengers were more likely to be in private carriages than postchaises (hired carriages) or stagecoaches. There was little difference in the speed of travel on a saddle horse and in a coach until the latter quarter of the 18th century (see Figs 2 and 3), so it seems unlikely that speed was a dominant factor in the choice of mode. Improved carriage design and the availability of posting houses at which fresh posthorses might be hired would obviously have contributed to this favouring of travel in a carriage or coach rather than on a saddle. However, these wheeled vehicles could not have operated unless the ruinous roads had been improved to allow them to carry passengers rapidly, safely and in comfort. Importantly, diarists seemed to favour using wheeled transport when on a turnpike; in era 1, 22% of the travel on turnpikes was in a vehicle compared with only 15% of the travel on non-turnpikes. By era 3, the increased use of carriages meant that about 80% of travel on turnpikes was as a passenger in a vehicle, but on non-turnpikes only about half the travel was on wheels. This may be interpreted as a change in behaviour by those in a vehicle, choosing a route that minimised use of poorer quality, and slower parish roads. Changes in mode may have raised expectations of average quality and would tend to reduce road quality score without any change in actual quality. Hence, increased use of lighter swifter vehicles, rather than saddle horses, would have changed what turnpikes were expected to provide, a more comfortable and convenient highway for travel. The relatively high proportion of reporting by independent travellers may reflect differences in greater

weight and stability of the stagecoach making it less likely that the passenger would experience small changes in road quality.²¹

4. Changes in road quality and the impact of turnpikes

We now document changes in road quality derived from our dataset of comments in 69 diaries. Figure 3 shows the distribution of quality scores across the three eras and for all observations. There is a notable relative decline in the reporting of quality scores 1 and 2 (very bad or bad) relative to scores 5 and 6 (good and very good) progressing through era 1 to era 3. In short, quality improved in our sample, despite various biases that should dampen the degree of change.

Figure 3: Distribution of road quality scores across eras.



Source: Authors’ calculations from diarist dataset.

4.1 Assessment of quality scores on turnpike and non-turnpike roads

From the diarists and our GIS datasets, we have assessments for quality on turnpike and non-turnpike roads. This allows us to estimate the direct effects of turnpikes on road quality, which has not been possible in previous studies.

²¹ In the dataset of all journeys (90 diaries) public coaches accounted for 5%, 13% and 22% of the mileage in the three periods and private carriages 11%, 24% and 31% respectively, i.e., stagecoach travellers commented on a lower proportion of their journeys whereas private travellers commented more. Hired carriages reported slightly more and horse riders slightly less

We first compare the proportion of road types in the different periods that have diarist comments indicating a road quality category of A, B or C. First, as observed in Table 4, more than half the non-turnpiked road mileage is in the generally poor category (C) in all eras. Meanwhile, the percentage of turnpike mileage in the generally good category (A) rises over the three periods from 30% in era 1 to 44% in era 3. Second, within each era, the percent of turnpike roads that were generally good was always higher than that for non-turnpike roads. Nevertheless, about a fifth of the turnpike mileage was still judged poor in all eras. Turnpiking was not a guarantee that roads would improve to meet the expectations of travellers.

Table 4: Road quality category on sections of turnpike and non-turnpike roads from diary comments

Era	sections of road in each category			Total sections	Total miles	% miles in each category		
	A	B	C			A	B	C
<u>1. pre-1760</u>								
Turnpike	12	17	6	35	558	30%	51%	19%
Not turnpiked	61	118	250	429	5,133	17%	28%	55%
<u>2. 1760-1789</u>								
Turnpike	125	132	99	356	4,163	38%	39%	23%
Not turnpiked	17	47	99	163	1,501	11%	32%	57%
<u>3. 1790-1820</u>								
Turnpike	122	102	66	290	3,426	44%	35%	21%
Not turnpiked	13	31	74	118	939	10%	28%	62%

Notes: Authors' calculations from diarist dataset. A is generally good, B is adequate, and C is generally poor. We exclude streets, estates roads, and bridges.

These data also illustrate that journeys made by diarists were increasingly along turnpikes. Only 10% of the comments were related to turnpikes in era 1, while 73% in era 2 and 78% in era 3 related to turnpike roads. This trend is perhaps unsurprising since turnpike mileage rose from 1,360 in 1725, to 8,660 in 1760 and to 16,050 in 1790, but the magnitude is marked since available parish mileage had only shrunk by 12% from ca 120,000 miles to ca 106,000 miles. Around three quarters of the non-turnpiked roads with comments in era 1 were later turnpiked, irrespective of quality at the time of the journey, suggesting that neither inherently good, nor particularly bad roads, were favoured as future turnpikes. However, in eras 2 and 3, only a tenth of the non-turnpiked roads

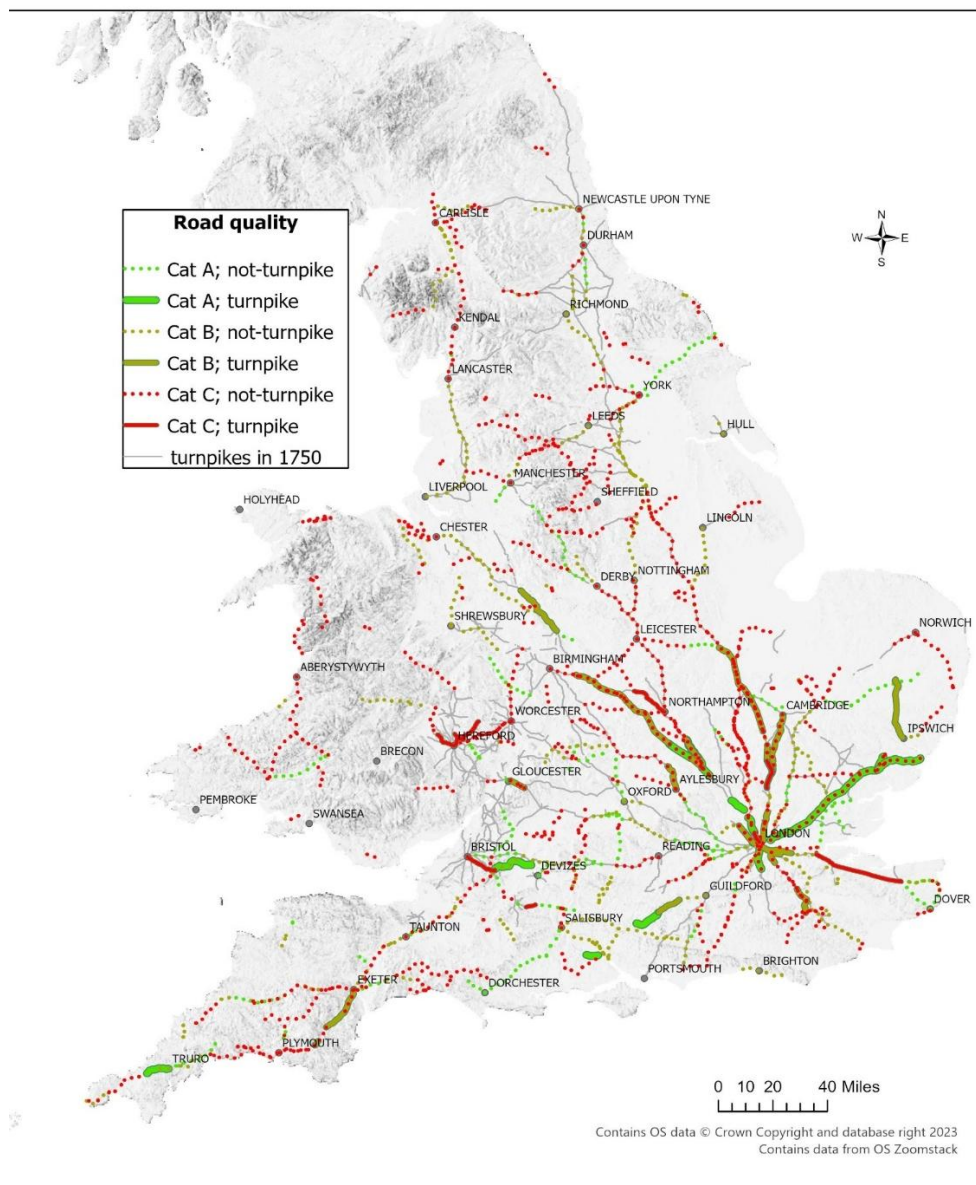
would be turnpiked in the future, but some of the poorer roads seem to have been selected for turnpiking.

To illustrate the location and progression of road quality, we map each class of road over time in Figures 4.1 to 4.3.²² In Figure 4.1 (before 1760), the mileage with quality comments were dominated by non-turnpike roads.²³ One take-away is that the non-turnpiked main roads radiating from London were rarely categorised as “at least adequate” (A or B). For example, Baldock Lane on the main highway north of London, scored 1, on five occasions between 1661 and 1710. Also, there was a higher concentration of poor parish roads in upland areas northwest of a line from Dorchester to the Wash (north of Cambridge). The relatively small mileage of turnpikes includes both good and bad roads. Notably, there were significant unbroken sections of good turnpike close to London. On some, the red dots indicating a poor pre-turnpike road overlay the later assessment of the good turnpiked road in solid green. To further illustrate, we identified 115 sections within 50 miles of London in era 1. Of these, 19 were managed by turnpike trusts at the time with an average quality score of 3.94. The other 96 sections of non-turnpike road had an average quality score of 2.65, which is statistically different from 3.94. Thus, there is some evidence before 1760 that turnpike trusts had a positive impact on road quality along the busy routes near London.

²² Note that where there are multiple comments by a diarist on a section of road, the last record for a particular road type will be on top and so determine the colour seen.

²³ The turnpike network, 10 years before the end date of each era is plotted to allow for building and bedding down of any improvements

Figure 4.1: Road quality reported by diarists on roads in era 1, before 1760

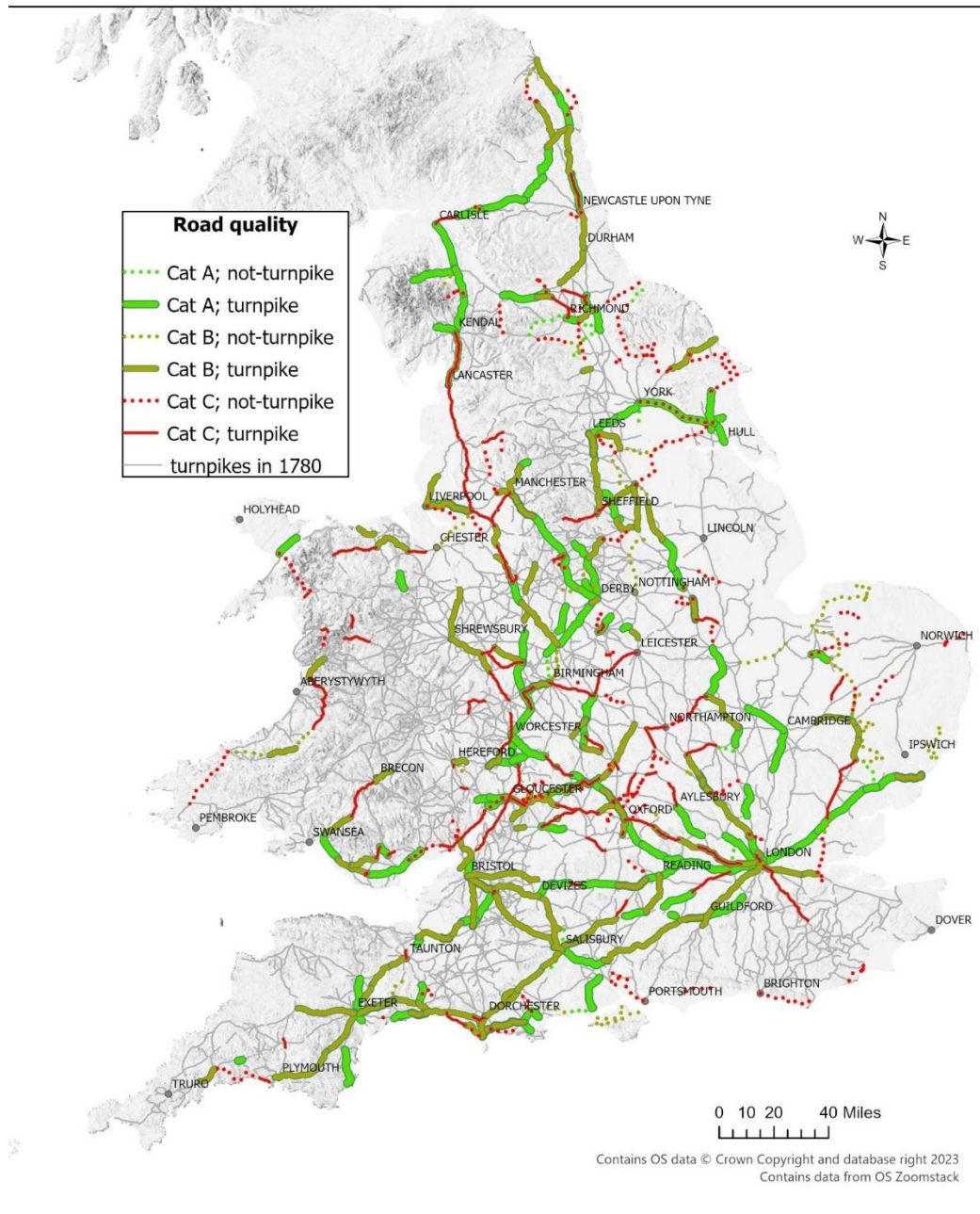


Source: See text for details. Note: The map displays 5,133 miles non-turnpiked, 558 miles of turnpike.

In Figure 4.2, from 1760 to 1789, more of the mileage with quality comments were for turnpike roads across England (fewer observations are for Wales, outside of the southern coast). Only a minority of these turnpikes are categorised as generally poor (red). Moreover, there were long, unbroken runs of good turnpike radiating northwards from London, also over the deep claylands of lowland England, and northwards between Derby and Manchester. Long stretches of adequate turnpikes also radiated from cities in the southwest, such as Exeter and Bristol. In contrast, there are no good roads reported southeast of London through the notoriously bad ground in the Weald, nor in the upland areas of the north and west. Within 50 miles of London, most sections in era 2 were turnpike roads (49 vs. 16), and the average quality score for the

turnpikes was one point higher (4.04 vs 3). However, not all non-turnpike roads were bad. The road from Honiton towards Exeter in Devon for instance had a very good quality score (6) by three commentators on horseback prior to turnpiking in 1753 and scores of 6, 5 and 6 by commentators in vehicles after turnpiking.²⁴

Figure 4.2: Road quality reported by diarists on roads in era 2, 1760-1789



Source: See text for details. Note: The figure displays 1,501 miles non-turnpiked, 4,163 miles of turnpike.

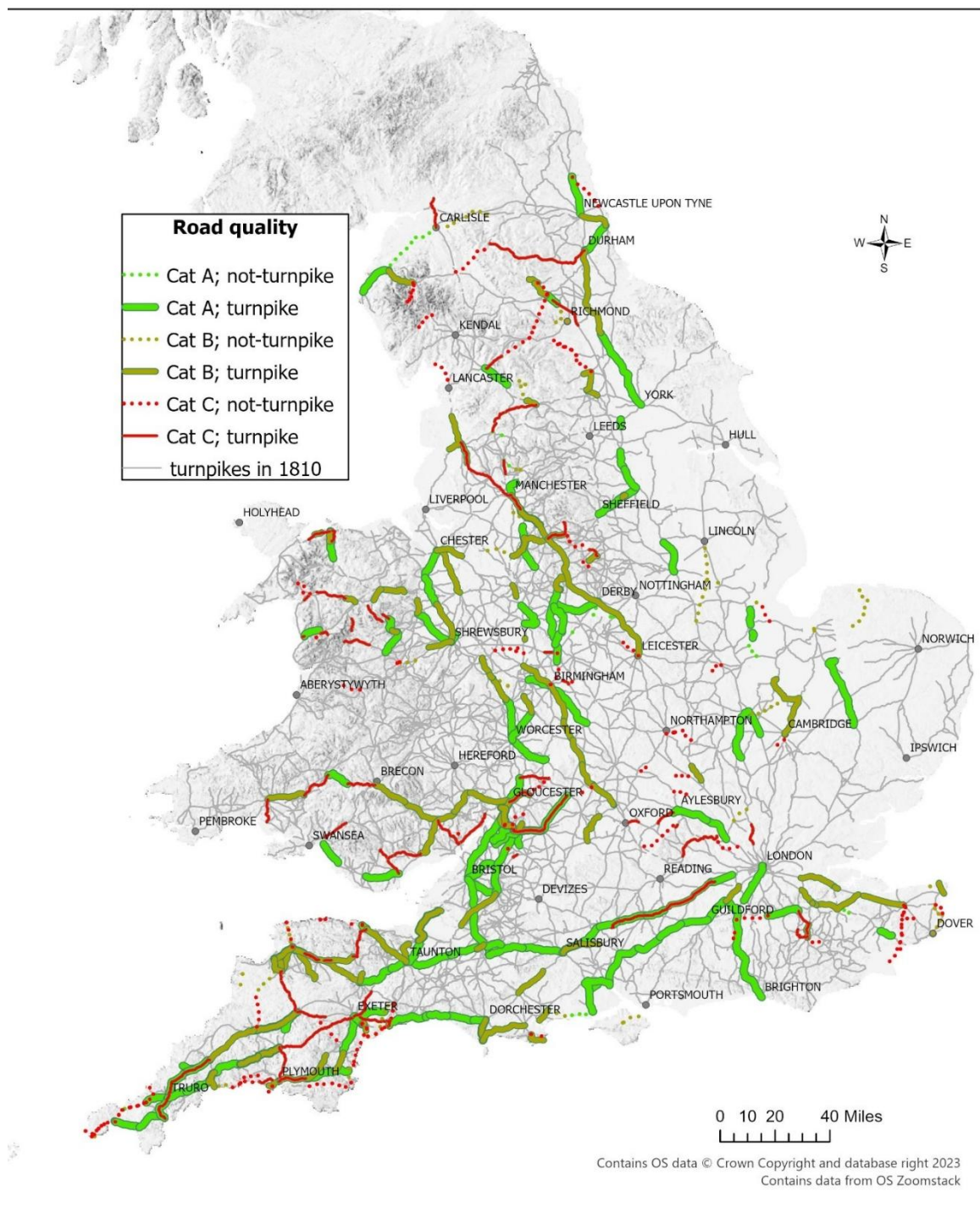
²⁴ Even this road had a poor section at Fenny Bridges where the river could overflow its banks (diary 1669); a fault that was not rectified until a new County bridge was built in 1808 by James Green.

In Figure 4.3, after 1790, there are relatively few sections of bad turnpike on the main routes radiating from London to the South Coast. The good quality road from London to the seaside resort of Brighton had become the busiest coach route in England. There were now better provincial roads between the commercially important city of Bristol and the booming industrial towns of Birmingham and Manchester. Many of these were 'Mail Roads,' used by the Post Office. In our sample, the average quality score of Mail Roads in era 3 was 4.3, meaning they were generally amongst the best turnpikes. However, sections of bad turnpike are found along the western fringes beyond Exeter and into Wales beyond Gloucester and Shrewsbury. Once again, turnpikes were not universally successful in raising quality according to diarists, but the busiest roads were often better quality.

4.2 Turnpikes and Quality change: two-way fixed effects estimates

In this sub-section, we use two-way fixed effects estimators (TWFE) to examine whether turnpikes led to significant changes in road quality. We first excluded imprecise or ambiguous diarist observations from the analysis. These exclusions were (1) comments that related to roads and streets in urban areas – our focus is on inter-urban travel and, though nominally turnpiked, routes through towns were often managed locally, (2) roads through parkland where the landowner may make an input, (3) roads over bridges where the County may have responsibility, (4) long sections of road (typically more than 40 miles in length) where the comment is too general to be used for comparisons, and (5) reports after 1820 when turnpike trusts built substantial mileage of totally new road. This reduced the usable dataset from 1,500 to 1,270 comments, covering 13,404 miles.

Figure 4.3: Road quality reported by diarists on roads in era 3, 1790-1820.



Source:

See text for details. Note: displays 939 miles non-turnpiked, 3,426 miles of turnpike.

We focus on observations that form an approximate panel of road sections. There were 603 road quality comments where we can match at least two diarists to 247 sections of road. Matching is based on different diarists commenting on the same or overlapping road sections during their journey. For example, Celia Fiennes commented on roads during her journey from Nantwich to

Chester in 1698. Reverend Edmund Butcher commented on similar roads during his journey from Chester to Tarporley in 1803. The two were matched as the diarists shared a large portion of the same route (Tarporley is a stop between Chester and Nantwich). In the data, the average number of matched observations is 2.6 and the median is 2. At least 25% of quality observations have 3 or more matches and at least 10% have 4 or more.

Our dataset of matched quality observations is unbalanced across time. Twenty five percent of observations apply to years before 1710 and 25% apply to years after 1791. The median year is 1776. There are several years with no comments being observed. The reason for imbalance is that diarist comments were scattered across time and not all roads can be matched. The panel becomes more balanced across time if we group observations into sixteen ten-year periods, starting with 1660 to 1669, then 1670 to 1679, and continuing up to 1810 to 1819. Every period has at least 1% of the observations and the most, 21%, is found in period 14, 1790 to 1799. As our panel analysis will implement two-way fixed effects, one for time and one for roads commonly matched, we restrict the sample to one matched observation per ten-year period. This is done by selecting observations with the latest year if there are multiple matches in any ten-year period.²⁵ We are left with 525 matched observations on road quality occurring no more than once within any of the sixteen time periods.

For each road section i in period t , we create an indicator variable $turnpike_{it}$, which equals 1 if the road section was turnpiked and zero if not. In this sample, 21.3% of the observed road sections were never turnpiked. In the language of TWFE, this group consists of the never treated road sections. For the rest, the road to which they apply had a turnpike at various dates between 1695 and 1832. 75% of observations had a turnpike established on the road before 1760, the year which starts period 11 of 16.

Our quality score ranges from 1 to 6 and is an ordinal variable based on diarist using various categories of words (Table 2 gives quality score definitions). The change in quality moving from a score of 1 to 2 versus moving from a score of 3 to 4 may not be the same. Therefore, our dependent variable, y_{ijt} , is one of three indicator variables based on thresholds of the quality score. The first takes the value 1 if diarist j on road section i in period t reports a quality score of 3, 4, 5, or 6 and it takes the value 0 if scored 1 or 2. A value of $y_{ijt} = 1$ says the road was judged to be

²⁵ There are 36 matched observations with the same year. For our panel analysis we arbitrarily selected 18 of these.

not bad. The second dependent variable takes the value 1 if diarist j on road section i in period t reports a quality score 4, 5, or 6, and takes the value 0 if scored 1, 2, or 3. Here a value of $y_{ijt} = 1$ says the road was judged to be at least acceptable. The third dependent variable takes the value 1 if diarist j on road section i in period t reports a quality score 5 or 6 and equals 0 if scored 1, 2, 3, or 4. A value of $y_{ijt} = 1$ implies the road was generally good.

In our baseline, we estimate the following TWFE specification:

$$y_{ijt} = \beta \text{turnpike}_{it} + \alpha_i + \delta_t + \varepsilon_{ijt} \quad (1)$$

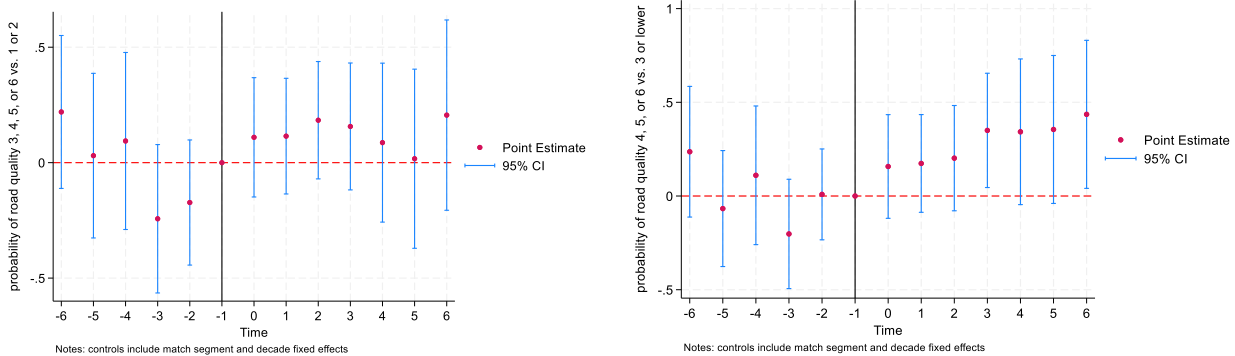
where y_{ijt} is one of our dependent variables for road quality, α_i is a fixed effect (FE) for each match among road segments i , δ_t is a fixed effect for one of sixteen ten-year periods t , and ε_{ijt} is the error term, which can also vary by diarist j .²⁶ Inclusion of mode fixed effects, like the use of wheeled vehicles, does not affect the estimates and so we omit such variables. Our specification (1) helps address various forms of bias associated with using diaries. First, there is likely to be an upward drift in quality expectations. As a result, there would be a downward bias with respect to measured quality over time so any improvement associated with turnpikes will be less than actual change. Second, there is potential for differential reporting of success on novel turnpikes in the early 1700s and selective reporting of failure once turnpikes were common after 1750. This issue is addressed later by studying heterogeneous effects of turnpikes across several periods. Third, there may have been changes in relative popularity of routes. In our analysis, we can match specific sections of turnpike and make like-for-like comparisons on the routes that were used repeatedly.

The identification assumption in specification (1) is that in the absence of treatment, roads coming under the control of turnpike trusts would have followed similar trends in quality as roads that did not (i.e., the parallel trends assumption). In this case, we test for ‘pre-trends’ using a panel event study, which if absent would support the parallel trends assumption. We observe quality scores up to eight decades before a turnpike and up to eight decades after. The event study estimates are shown in Figure 5 for six lags and six leads. The omitted time period, -1, is one full decade before turnpiking. The point estimates to the left of -1 show no significant or precisely estimated change in the probability of a not bad road (scores 3, 4, 5, or 6) at least five decades before turnpiking. The same for the probability of at least an acceptable road (scores 4, 5, or 6).

²⁶ In this regression analysis we are looking at differences in the difference in road quality recorded over time when the road was not a turnpike and when it was turnpiked

Thus, the absence of significant pre-trends is consistent with satisfying the parallel trends assumption. Notice that to the right of -1, the point estimates imply that the probability of at least an acceptable road increased after turnpiking.

Figure 5: Event study point estimates for impact of turnpike trusts on probability of road being not bad (left) and at least acceptable (right)



Notes: Time indicates decades before or after a road segment was managed by turnpike trusts. Date -1, the reference period, is one decade before turnpike management. The specifications include segment and decade fixed effects.

The baseline specification (1) does not consider heterogeneous treatment effects, meaning the effect of turnpike trusts could change with duration of exposure and/or could differ across adoption cohorts. We estimate heterogeneous effects using the ‘extended two-way fixed effects’ estimator proposed by Wooldridge (2021). It addresses heterogeneity by including interactions between treatment-period cohorts and periods.²⁷

Estimates for the standard TWFE and the average treatment effect using extended TWFE based on Wooldridge (2021) are presented in Table 5. We cluster the standard errors on road sections throughout. The dependent variable is the indicator for not a bad road in columns 1 and 2. The coefficient in 1 implies that when a road section switched to turnpike management, the probability of a road being classified not bad increased by 0.373, which is large relative to the mean probability of 0.604. The average treatment effect using TWFE, EXT is similar. Those estimates also show broadly similar effects across treatment cohorts, meaning roads that got their turnpikes in the 1720s had similar effects as roads getting their turnpikes in later decades. Treatment effects are also broadly similar across time, meaning having a turnpike in the 1760s had similar effects as turnpikes in later decades. In columns 3 and 4, the dependent variable is 1 if the road is at least

²⁷ We obtain similar results using the Callaway and Sant’Anna (2020) procedure, with the never treated road sections serve as our control group. But the unbalanced nature of our data meant that estimation is based only on 50 observations.

acceptable. Once again turnpike management is found to increase the probability. The coefficient is large in magnitude given the mean of the dependent variable, implying that turnpikes were especially successful in switching a road from bad to at least acceptable. The extended two way fixed effects estimate in 4 is similar and does not point to significant heterogeneity across treatment cohorts and time. In columns 5 and 6 the estimates imply that turnpikes increased the probability of a road being generally good. The magnitude of the coefficient is again quite large.

Table 5: Two way fixed effects estimates for effect of turnpike management on road quality

	1	2	3	4	5	6
Estimator	TWFE	TWFE, EXT	TWFE	TWFE, EXT	TWFE	TWFE, EXT
Dependent variable, y_{it}	"Not bad" 1 if score is 3, 4, 5, or 6 and 0 otherwise		"At least acceptable" 1 if score is 4, 5, or 6 and 0 otherwise		"Generally good" 1 if score is 5 or 6 and 0 otherwise	
Variable	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.
Turnpike dummy	0.373 (0.162)**	0.417 (0.121)***	0.338 (0.162)**	0.407 (0.124)**	0.243 (0.124)*	0.323 (0.096)***
Period FE	Y	Y	Y	Y	Y	Y
Match FE	Y	Y	Y	Y	Y	Y
Mean of dep. Var.		0.604		0.403		0.249
N	525	525	525	525	525	525
R-square, within	0.714		0.693		0.368	

Note: The dependent variable is the indicators for road quality. All specifications include period and match fixed effects. TWFE refers to the two-way fixed effects estimator. TWFE, EXT refers to the extended two way fixed effects estimator of Wooldridge (2021). Standard errors are clustered on matched ID variables for road sections *, **, *** indicate statistical significance at the 1, 5, and 10% levels.

The following calculations illustrate how much of the change in quality score is accounted for by turnpiking. If the turnpike indicator is excluded from the specification in column 1 of Table 5, then the decade-period fixed effects imply that the probability of a not bad road increased by 0.6 approximately from the first decade to the 1790s. If the turnpike indicator is included, then the decade-period fixed effects imply that the probability of a not bad road increased to 0.22 from the first decade to the 1790s. Thus, the turnpike variable appears to account for most of the increased probability. One caveat is that we cannot control for other improvements or changes in perception that might be bound up with turnpiking. But other factors would need to be very large to account for all the effects attributed here to turnpikes. Importantly, changes in perception would generally

depress reported quality score over time, so they should not result in over-estimation of improvement in actual quality.

5. Discussion and Conclusions

The comments by diarists suggest that prior to turnpiking only a fifth of the main roads that travellers used were thought to be good. Road quality was poor on certain important post roads and in some mining and industrial areas. These were routes carrying an increasing amount of heavy traffic, which probably overwhelmed the ability of civil parishes to maintain these highways. When these roads were turnpiked, how well did they improve quality? During the early 18th century, diary comments suggest that turnpiking of some main roads did have a positive effect on their quality. Our analysis shows that the proportion of road mileage judged adequate or generally good (category A and B) was significantly higher on roads that were turnpiked than on roads that were not prior to 1760. The proportion of turnpiked roads judged good (category A) continued to increase through eras 2 and 3 (1760 to 1820). Improvements in the first half of the 18th century were revealed by taking account of what travellers deemed important. This meant better safety and reliability on all parts of the network rather than simply higher speed along principal inter-urban routes. Similarly, in the second half of the 18th century it was greater comfort and convenience that were criteria for an acceptable journey. However, one cannot deny that in the second half of the century, the capability to travel faster in safety was an important factor in the much increased market for road travel.²⁸

The complaints from travellers before 1750 were primarily that bad roads were dangerous, impassable, and ruinous and that travel was more difficult in the winter. The diaries make it clear that danger to life and limb on bad roads was a reality of travel through flooded, broken highways. The journalist Defoe highlights the benefits of raised causeys, new bridges, and better drainage as much as improved surfaces in his praise of turnpike success. Resilience to the adverse effects of weather and safe travel were major achievements of the turnpikes in the first half of the 18th century. Shifting the quality category from generally bad (C) to adequate (B) was a mark of success against the criteria travellers judged important. We think the emphasis was on getting the basics right before matters of mere convenience.

²⁸ For growth of coaching traffic see Gerhold (2014) and Rosevear et al. (2019)

The relative importance of safety and speed when judging the quality of a turnpike road would vary with the class of traveller. For the middling farmer or tradesman, whose return journey to the local market was made within a day, a doubling of speed to say 5mph would improve their experience. But being able to do that reliably and without risk to themselves or their goods would be a more significant improvement. For the elite, say travelling the 100 miles from London to Bath, a doubling in speed could save whole days, so making roads on which lighter vehicles could travel faster became a significant factor.

The increased mileage of road under turnpike management (rising from 115 miles to 3,933 miles between 1700 and 1750) and the improvements that this brought laid the foundations for a change in the preferred mode of travel and increased coach traffic, particularly public transport. Better designed, faster carriages were a necessity for this transition but could not have achieved their full potential without a substantial improvement in the safety and reliability of the existing roads that had been turnpiked. Stagecoaches with a regular change of horses had the potential to travel more quickly, yet safely, and this provided coach service operators with a competitive opportunity, particularly over private modes with less potential for high speeds. The trend from individual riders to group travel in public stagecoaches would inevitably improve productivity. The preference for wheeled vehicles which performed best on turnpike roads would also bring more traffic to these, increasing toll income and hence their ability to fund further improvement.

These trends exemplify the way turnpiking and the improved infrastructure they embodied, impacted mobility. Turnpiking led to more differentiation within the road network. The earlier pattern of a tight network of parish roads with a few great roads radiating from London was transformed to a less intense inter-urban network of good roads, that were significantly better than the adjoining local parish roads. It was along these improved inter-urban roads that the new public transport services developed, enhancing further the importance of the town as the focus of mobility and opportunity. This divergence towards a more distinct two-tier system has wider implications over whether this may have been common to the management of other critical infrastructure in the 18th century.

Through the 1770s and 1790s there were new waves of turnpiking, particularly of cross roads. Some of these would be as busy and damaged as the early turnpikes but had sufficient traffic to generate funds for improvement. However, on some of these later turnpikes, traffic was sparse

and the radial, county-based turnpike trusts, had drawn some minor roads into the system. These inevitably limited the potential for improvement, and our observations show that a substantial proportion of the now much greater mileage of turnpikes remained stubbornly adequate (B) and some even bad (C) through the remainder of the century. Yet, on the routes that diarists chose to travel, the score on turnpikes remained a point higher than on roads that had not been turnpiked.

Diarists after 1760 began to mention how pleasant the road was; comfort and convenience were now important. The beneficial changes still did not reduce the proportion of turnpikes that were judged as poor and many were still of adequate quality (category B). This was disappointing, given the resources that were clearly being expended. There is evidence that coach travellers adapted their routes to maximise use of turnpikes, avoiding alternative parish roads which rated badly against their quality criteria. Nevertheless, the increase in efficiency and speed of public transport would imply more improvements were taking place, particularly on those major turnpikes used by stagecoaches. The well documented increase in capacity of the stagecoach industry after 1760 can be understood against these changes, particularly the greater comfort and convenience of travel on turnpikes. Wheeled vehicles were now slightly faster than saddle horses but crucially women and the gentry found the greater freedom in dress and better comfort more acceptable, greatly expanding the number of potential social travellers. This market continued to grow as coach speeds and convenience of travel on turnpikes increased.

By the late 18th century, good or excellent quality scores were concentrated on a set of principal roads connecting key hub towns, including London. It was along these roads that most public coach services ran, and speed and comfort became dominant criteria of success. The virtuous circle of more traffic generating more toll income and hence greater resources for better materials and management, likely fuelled this differentiation. Nevertheless, even on the principal highways there were still sections of poor road which can now be identified from diarist comments. Some of these may result from insuperable engineering challenges at this period, others could be attributed to poor local management or under-investment by particular turnpike trusts. This heterogeneity, inherent in a locally based regime, meant that turnpiking had yet to create a truly national network that could be described as universally good, though it was now “good in many parts”. Using diarist comments rather than other averaging metrics gives new insight into this mosaic of road types prior to 1800.

The detailed data from diaries provides evidence that by the 1790s a substantial mileage of road under turnpike management was the favoured path for travellers in both public and private vehicles. Sections of poor parish road had been selected and successfully re-purposed as turnpikes and maintained in an above average condition despite the increased weight of traffic that concentrated on the favoured turnpike routes. Holding the improved position was an achievement worthy of note, both for the roads turnpiked before and after 1750.

In general, the speed of stagecoach travel by diarists is consistent with previous studies (e.g., Gerhold 2014) that used increased speed of scheduled public transport to deduce quality change. However, we also demonstrate that the speed of non-elite modes of travel, such as the saddle horse, did not change, irrespective of improvement. This illustrates limitations in using speed alone as a quality indicator. Our new dataset of traveller's comments has extended the scope of assessment and for the first time helps to understand the character of the change in road quality and the mechanisms by which this might affect economic outcomes. Firstly, the quantity and breadth of geographic and temporal cover of comments is wider than that previously available and has given greater sensitivity and specificity to the analysis. Through diaries we have comments not only from travellers using public stagecoaches but also the many independent travellers in private and hired vehicles who used a greater proportion of the turnpike network. The granularity of the assessment is similar to that of individual turnpikes, covering typical journeys, not whole stagecoach routes. Crucially we can use statistical tools to quantify the probable improvement in road quality. With this we observe improvements in turnpiked roads before 1750 that had not been apparent in earlier studies using coach speed or a few selected observations.

The comments identify the factors that deterred early travellers and reveal the mechanisms that would lead to economic benefit. Travellers needed to be confident that they could move safely and predictably on the road; facilitating this was an important and previously unrecognised success of turnpikes. After 1750 the greater comfort and convenience of travel on better turnpike roads was important in creating a new market for leisure and social travel. Quantifying the economic benefit of these social changes is beyond this paper, but its qualitative value is clear.

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Appendix

Contents

- I. Word Frequency
- II. Documentation of GIS shapefile for road quality
- III. Historical GIS road dataset part 1. Ogilby's Strip Map
- IV. Historical GIS road dataset part 2. Turnpike Main roads
- V. Historical GIS road dataset part 3. Cary roads

I. Frequency of word use

Textual analysis was used to examine words diarists used to describe the road quality they experienced. The frequency of particular words used in 1,399 individual entries was counted using a macro in WORD.²⁹ From the 932 unique words, a subset of 106 words relating to road quality was selected (excluding common terms such as road, turnpike etc).

Table A.I.1 gives the incidence of these Words associated with particular time periods and individuals. The numbers have been normalised to take account of the difference in the number of lines of data in each division (e.g. there are approximately twice as many records post 1765 as there are pre 1765, so the latter are adjusted downwards; the number of records for the three individuals differ and have been normalised against the number of Agnes Witts records).

Table A.I.1: occurrence of relevant words

Word(s)	Frequency of occurrence				
	pre 1765	post 1765 (normalised)	C Fiennes (normalised)	J Byng (normalised)	A Witts (normalised)
agreeable	2	3			
bad/badness	67	65	2	18	30
basest	1				
beautiful		3		1	3
better		8			6
bleak				1	
bog	1	1		1	
broad	10	2	4		
causeway/causey	20	3			
causey	13		6		
chalky	1				
charming		2			4
clay	19	1	6	1	
comfortable	1	1		1	
complaint					1
dangerous/dangerously	8	4	1		1
deep	35	11	12	4	2
delicate	1				
delightful		3			1
descent	4	1	1		
dirty/dirt	16	13	4	3	5
disagreeable	1	2		2	
dreadful		3			5
enchancing					1
enclosed	4		2		
excellent	4	35		5	13
execrable/execrably		7			2
expected		3			5
fenny	1				

²⁹ https://wordribbon.tips.net/T010761_Generating_a_Count_of_Word_Occurrences.htm

fine/finest	6	9		1	
flags				1	
flat	1	4		1	
flooded	1				
good	53	77	15	17	18
gravel/gravelly	9	9	3	1	
handsome	1				
hard	6	5	2	1	
hazardous	6	1	3		
heath	3	1	1	1	
heavy	15	4	4		1
hill/hills/hilly	34	39	15	4	12
holes	2	5	1		2
holloways	2		1	1	
horrid	1	2			4
ill	2	4		4	
impassable/unpassable	6	1			1
impossible	1	1			
improved	2	1		1	
indifferent	5	8			2
insufferable	1				
intolerable/intolerably	1	3		1	1
intricate		2			
level	3	11	1	1	
loose	2	3	1		
made	5	3		2	
magnificent		1		1	
marshes/marshy	3		1		
mended	1	2		2	
middling/middlingly		5			
mirey	2				
miserable				1	
moor/moorish	5	1	1	1	
mossy				1	
mountainous/mountain	4	7			
muddy/mud	4	2		1	1
narrow	27	23	9	4	2
nasty				1	
new	1	10			4
odious					1
overflowed	1				
passable	2	1		1	
paved/pavement/paving	2	24		14	
pebbles/pebbly	2	3	1	4	
pitched	26		13		
pleasant	13	11	2	2	8

precipice	2		1		
pretty	16	4			3
quagmire	2		1		
quicksands	2		1		
rocks/rocky	4	2	1	1	
rooty	1				
rough	3	22		2	9
ruts	2				
sad	5		2		
sands/sand/sandy	19	15	5	2	
sharp		2		2	
slippery	1	2		2	1
sloughs	3		1	1	
slow		1			1
smooth	2	4		1	
splashy				1	
steep	30	15	13	8	
stone/stones/stoney	43	33	13	29	2
straight	1	3			
tedious	12	5	3	3	4
tiresome		1		1	
tolerable/tolerably	3	9		5	5
turfy				1	
uneven	2	3			
unpleasant		3		1	
vile		2			
watery/water	11	2		2	
wet	6	1	1		
wide/widened	1	3		3	
worst/worse	11	6	1	2	
wretched		1			2

II. Documentation of GIS shapefile for road quality from diarists

A.II.1 Road Quality for did Shapefile

The coding for the names of diarists in in Table A.II.1

Table A.II.1: Travel Diaries containing road quality comments

"Who" Field	Diarist	reference
AL	Lister, Anne	Whitbread, Helena, (2010) The Secret Diaries of Miss Anne Lister, (Hatchett Digital, UK)
AW	Witts, Agnes	Sutton Alan, (2008) The Complete Diary of a Cotswold Lady, (Amberley Publishing, Stroud, UK)

AY	Young, Arthur	Young, Arthur (1769) A Six Months Tour through Southern England Vol 1 and Young, Arthur: (1771) A Six Months Tour through Northern England Vol 1-4, (Strahan, Nichols, London)
BN	Newton, Revd Benjamin	Fendall C.P. & Crutchley E.A., (1933) The Diary of Benjamin Newton, Rector of Wath, (Cambridge University Press, UK)
BS	Silliman, Benj	Silliman, Ben, (1810) Journal of Travels in England, Holland & Scotland Vol 1, 2 & 3, (Sergeant, Ezra, New York)
CF	Fiennes, Celia	Morris C., (1995) The Illustrated Journeys of Celia Fiennes 1685-c.1712, (Alan Sutton Publishing, Stroud, UK)
CH	Hatchett, Charles	Raistrick Alan, (1967) The Hatchett Diary - a tour through the counties of England & Scotland in 1796, (Bradford Barton Ltd, Truro, UK)
Cjudg	a Cornish judge	a Cornish judge: PD/220, Diary of a journey into Cornwall, (Cornwall County Record Office)
CM	Moritz, Carl Philip	Nettel R., (1965) Carl Philip Moritz, journeys of a German in England 1782, (Jonathan Cape, London, UK)
CRO	Anon (male)	Anon (male) : DD/TB/14/25, Crowcombe Manuscripts- Travel Diary to Norfolk, (Somerset County Record Office)
DCW	Webb, Daniel Carless	Webb, Daniel Carless, (1812) Observations and remarks during four excursions made to various parts of Great Britain in 1810 and 1811 (reprint), (British Library, Historical Print Editions)
EB	Butcher, Revd Edmund	Butcher, Revd Edmund, (1805) An Excursion from Sidmouth to Chester in the summer of 1803 Part 1, (Symonds)
FK	Keilmansegg	Keilmansegg, Diary of a Journey to England in the Years 1761-1762, ()
GT	a gent	Hutchings E., (1993) A Gentleman's Tour 1776, (Hunnyhill, Newport IOW, UK)
GW	Woodward, Revd George	Gibson D., (1982) A parson in the Vale of White Horse; George Woodward's letters from East Hendred 1753-1761, (Alan Sutton, Stroud)
GX	a touring gentleman	AD43, Journal, tour of Cornwall, (Cornwall County Record Office)
JB	Byng, Hon John	Souden D., (1991) Byng's Tours; The Journals of the Hon. John Byng 1781-1792, (Century (London) & National Trust); Andrews C.B.Torrington Diaries & Bryant, Arthur, Torrington Diaries (both Etre & Spottiswood, London), Adamson D. Rides Round Britain (Folio Society)
JC	Courtney, John	Neave S. & D., (2001) The Diary of a Yorkshire gentleman; John Courtney of Beverley 1759-1768, (University of Hull, UK)
JE	Evans, Rev J	Evans J., (1800) A tour through parts of North Wales in the year 1798, (White, London)
JH	Hanway	Hanway, (1756) A Journal of an eight day journey from Portsmouth to Kingston, ()
JMF	Fisher, Jabez Maud	Morgan, Kenneth, (1991) An America Quaker in the British Isles (Records of Social and Economic History, New Series XVI, (The British Academy)
JSK	Skinner, Revd John	DD/SAS C1193, Diary of an excursion through Somerset, Devon & Cornwall in 1797 & Hants & Kent 1801, (Somerset County Record Office); Wolfe V. "Journal of a Somerset Rector 1803-1834" Oxford

		University Press); Jones, Roger, West Country Tour – Diary of an excursion through Somerset, Devon & Cornwall in 1797 (ex Libris Press)
JT	Taylor, Joseph	Cowan, W, (1903) A Journey to Edenborough by Joseph Taylor late of the Inner Temple, (William Brown, Edinburgh)
JTwp	Taylor, John	Taylor, John, (1870) Works of John Taylor, The Water Poet, (Spenser Society)
LH	Harley, Lord	Harley, Lord & Historic Manuscripts Commission, (1901) The Manuscripts of His Grace Lord Portland. Vol VI (Travels of Lord Harley), (Historic Manuscripts Commission)
LRA	La Rochefoucauld brothers	Scarfe Norman, (1995) Innocent Espionage - The La Rochefoucauld brothers' Tour of England 1785, and (2001) To the Highlands in 1786 - the inquisitive journey of a young French aristocrat, (Boydell)
LRF	La Rochefoucauld	Scarfe, Norman, (1988) A Frenchman's year in Suffolk, 1784, (Boydell)
LS	Simond, Louis	Simond, Louis, (1817) Journal of a tour and residence in Great Britain, during the years 1810 and 1811 Vols 1 & 2 (Archibald Constable, Edinburgh)
PH	Hawker, Col. Peter	Payne-Gallwey R., (1893) The Diary of Colonel Peter Hawker 1802-1853 Vol I & II, (Kingsmead Reprints, Bath)
RP	Pococke, Dr Richard	Cartwright, J.J., (1889) The Travels through England of Dr Richard Pococke, successively Bishop of Meath and of Osory Vol I & 2, (Camden Society)
RRA	Angerstein, R.R.	Angerstein, R.R. , (2001) RR Angerstein's Illustrated Travel Diary, 1753-1755, (Science Museum)
RS	Stackhouse, Rachel	RS/1/174, Diary of Rachel Stackhouse of visit to Bath and Salisbury, (Cornwall County Record Office)
RT	Thoresby, Ralph	Hunter, Rev J, (1830) The diary of Ralph Thoresby Vols 1 & 2 (Thoresby Society digital copy), (Colburn Bentley)
RW	Warner, Richard	Warner, Richard (1800) A Walk through some of the Western Counties of England, (Crudwell, Bath)
SC	Curwen, Samuel	Oliver A., (1972) The Journal of Samuel Curwen, Loyalist Vols I & II, (Harvard University Press, USA)
SF	Fox, Sarah	Frank J. (Dresser M.), (2003) The Diary of Sarah Fox (nee Champion), Bristol 1745-1802, (Bristol Records Soc)
SP	Pepys, Samuel	Latham R.C. & Matthews W., (1995) The Diary of Samuel Pepys (Vols 1 to 9), (Harper Collins)
SS	Shaw, Revd Stebbing	Shaw, Revd Stebbing (1789) A tour of the West of England in 1788, (Robson & Clarke)
TB	Baskerville, Thomas	Baskerville, Thomas, (1893) Manuscripts of His Grace the Duke of Portland at Welbeck Abbey Vol 2, (Historic Manuscripts Commission)
WBra	Bray, William	Bray, W, (1778) Sketch of a tour into Derbyshire & Yorkshire, (White, London)

Occasional diary examples:

XTxx and YTxx from

Gray. Todd (2000) "Travellers' Tales Vol 1 Exeter" The Mint Press, Exeter, UK. Clarke p73, Maton p75, Rokeby p22

Gray. Todd (2000) "Travellers' Tales Vol 2 East Devon" The Mint Press, Exeter, UK. Ashburnham p11, Lorenzo p9, Dunsford p79, Evans p82, boy p119, p128, Gilpin p33, Lipscome p62, Mundy p122, Portman 126, Price p110, Russell p130, Southey p69, Stroud p129, Stukeley p18, unknown male p25,

Gray. Todd (2000) "Travellers' Tales Vol 3 Cornwall" The Mint Press, Exeter, UK. Farrington p87, unknown female p115, Price p87, Racket p74, unknown gent p65, unknown visitor p45, Vyvyan p42.

ZJIE from;

Simmons, Jack (1969) "Journeys in England", David & Charles, Newton abbot, UK.

PrG from George, The Prince: , Visit from Windsor to Petworth p36 Margetson "Journey by Stages"

Commentator Comments meeting criteria.

RMS – letter to Reading Mercury

gent - Letter to Gentleman's Magazine

DDFO Defoe before turnpiking, DDFOP Defoe after turnpiking; Defoe, D (1986) "A Tour through the whole island of Great Britain" Ed Rogers P. Penguin Books; first published 1724-6

Xjack – quoted by Jackman

Cary and Paterson Road Books.

II.1.1 The Shapefile

Function

This mapping shapefile records the comments on road quality made by diarists which were analysed during this study.

Source

The file was created by Alan Rosevear, selecting and copying the sections of road on which quality comments were made by travellers in three master databases (diaries up to 1729, 1730 to 1799, 1800 and after - these contained all travel information on journeys made by the diarists). All the mapping was part of the CAMPOP Transportation Project and was compiled using ArcGIS Pro on a personal licence.

The diaries for which road quality comments were derived and references to their origin are listed in Table AI).

Methodology

The overall approach has been to:

1. Read and understand the context of the road quality comment in the diary
2. Select that part of the main diary journey line to which the comment applies

3. Copy this section to a Road Quality ex diaries shapefile and enter all relevant details in the database Table.

Each source diary was hand annotated to identify sections that describe the quality of the road (not the associated factors such as weather or scenery). A new shapefile was created using the OS ca 1850 1st series as the base map. In each case when the road quality on a journey is described with words that appear in the ranking system devised for this project (Table 2), that section of road was copied as a polyline into the new shapefile. Each line carried with it any data fields that are shared with the “all diary journeys” source (date, who, start and end details of the whole journey, Notes, via), though the road quality section may not start or end at the places specifying the main journey in the diary. Additional fields were added relating to quality (text description and a score) and the turnpike status of the road based on details in an overlay shapefile with turnpike roads created for the CAMPOP Transportation project.

Sections of road which had more than one polyline and associated comments were identified by visual inspection of the mapping. Each of these “clusters” was assigned a unique MatchID number for use during analysis of change in quality over time. To be accepted as overlapping, a significant portion of the lines must be congruent, and factors known to affect quality such as hills and wet areas should be similar in both sections. Overlaps of 50% in distance were accepted and occasionally overlaps of 33% were accepted where the nature of the road did not change beyond the overlapping length of each section. Where a short, well specified section overlapped within a longer section, this was accepted.

Table A.II.2: Attribute data for Road quality for did.dbf

The dbf table contains the following fields

Field Name	Data Type	Description & Codes
FID	Object ID	
Shape	Geometry	Polyline ZM
year	Long Numeric	Year of journey
Month	Text	Month of journey
day	Long Numeric	Day of journey
Who	Text	Initials of traveler diarist (see list Table II.1; w; note that close associates of the diarist (AB) appear as (ABw – wife; ABs – son; Abd – daughter; Abf – friend etc)
Means	Text	Mode of travel; foot = as pedestrian march = marching soldiers sedan = sedan chair – carried by men on foot horse, horhi, horlo, hordo, horli = <u>saddle horse</u> (own horse, hired horse (e.g. post, hack horse), borrowed horse (on loan, not paid for), double horse i.e. riding pillion or 2 on the horse), horse litter hcar, hacar, hgig, hchai, hease, pchai = <u>hired passenger vehicle</u> (carriage, Hackney, gig, chaise (1 horse), funeral hearse, postchaise (2 or 4 horse))

		<p>prcar, prgig, ownca, ownngi, ownch, holit = <u>private passenger vehicle</u>; prxxx is owned by someone other than diarist, ownxx vehicle owned by diarist (carriage/coach, gig, waggon, cart, carriage, gig, chaise, cart, horse litter)</p> <p>owncp = own carriage with hired post horses</p> <p>cart, wag, cartc wagg; <u>freight vehicle</u>; private cart, private waggon, carriers cart, carriers waggon</p> <p>staco, mail, posco, carav, dili wagpa, bus, tram = <u>public service passenger vehicle</u> (stage coach, mail coach, post coach, caravan, diligence, passenger in wagon/long coach, omnibus, tram)</p> <p>rail = steam railway carriage</p> <p>boat = craft along an inland river or lake</p> <p>ferry = across a river or inland water</p> <p>ford = uses inter-tidal ford to cross river</p> <p>ship = seagoing vessel, coastal ferry)</p> <p>2pc1h = party using 2 postchaise and one saddle horse</p> <p>unclear = not even able to classify so not used in analysis.</p> <p>code with? - Indicates mode not stated but judged by other evidence to be this mode and so used in analysis bus, mail, carav, dili pawag, staco</p>
Section	Text	Approximate location of the section with comments
startplace	Text	Starting place of relevant journey – note that the section with a quality score may start after this
Via	Text	Intermediate points on the whole journey
endplace	text	finishing place of relevant journey - note that the section with a quality score may finish before this
Notes	Text	Relating to the whole journey
RQdescriptia	Text	the relevant comment on quality made by diarist
Score_qual	Long Numeric	Quality score 1 to 6 based on key words in quality ranking Table 2
Category	Text	A = generally good (score 5 & 6); B = adequate (score 3 & 4); C = generally poor (score 1 & 2)
era	Long Numeric	1= before 1760; 2 = 1760 to 1789; 3 = 1790 to 1820; 0 = later periods
eraRQ	Long Numeric	Merging of era number and category letter
eraRQtp	Long Numeric	Merging of era number and category letter and tp at date number
Tp_at_date	Long Numeric	1 = not turnpike, 2 = is turnpike at date of diary entry
decade	Long Numeric	Taken from year field
Tpname	text	Standardized turnpike trust name from inspection of turnpike road shapefile
tpdate	Long Numeric	Year of first turnpike Act for this section by inspection of turnpike road shapefile
Tp1838	Long Numeric	1 = not turnpike, 2 = is turnpike in 1838
horswhee	Long Numeric	1 = saddle horse, 2 = wheeled vehicle, 5 = on foot; 0 = unknown exclusion codes 13 = streets; 14 = private roads, 15=ferry; 16 = roads being built; 17= bridges

exclusion	Long Numeric) = used in analysis; 3 = streets (these are used in analysis); 4 = private roads (not used), 5=ferry (not used); 6 = roads being built (not used); 7= bridges (not used; 10 long sections of road included in general analysis but excluded from matching sections) ; 11 comments made after 1820 (excluded)
MatchIDs	Long Numeric	A unique number for sections of polyline that overlap each other (note there may be more than two of these)
match	Long Numeric	Y= matched (note if exclusion 10 will be no Match ID
miles	Long Numeric	Calculated Statute miles of the section
decade	Long Numeric	decade in which comment made
NewID	Long Numeric	unique ID for this section
tplater	Long Numeric	12= not turnpiked at time of comment but turnpiked later; 0 = all others

III. Historical GIS road dataset part 1. Ogilby's Strip Map

Function

This mapping file reproduces the lines of road on Ogilby's strip maps of the Great Roads of England & Wales, published in 1675. It also includes notes on the road quality, entertainment and frequency of travel that were made by Ogilby in the commentary that accompanied the published maps in Britannia. A small number of roads that were added by Morgan in later revisions are included.

Source

The initial mapping in ArcGIS was undertaken by Max Satchell for the Campop Transportation Project using good quality digital images of the strip map pages. Later editing and the additional commentary were made to the shapefile by Alan Rosevear using a facsimile copy of "Britannia, Volume the first, or an illustration of the Kingdom of England and Dominion of Wales by a geographical and Historical Description of the Principal Roads thereof; Printed 1675" (Old Hall Press, 1989).

Methodology

The initial GIS map of Ogilby's roads was created in ArcMap by Max Satchell using georeferenced copies of the pages from the plates in Britannia. The shapefile was created in ArcMap using the OS First Series ca 1850 as a base map. Polyline plotting was guided by matching the strip map with surviving road, pathway and boundary features and named locations on the maps. Advice from local historians who had previously mapped the roads manually, was used to refine the primary mapping. This working road map polylines were later edited by Alan Rosevear in ArcGIS Pro and details from the commentary on the pages adjoining the maps in Britannia added. Some details of the road lines and junctions were refined by matching with digital copies of 18th century County maps. A small number of additional roads that were in later editions of the strip maps by Ogilby's assistant, Morgan were identified by Max Satchell and have been mapped here.

Ogilby classified the roads in his commentary

- Direct Independent Road radiating directly from London (roads 1-14) – DRP indicates also a post road; DRPo indicates a short loop from these roads,
- Direct Dependent Road – branches directly out of a DR road (roads 15-32)
- Cross Independents – not branching from a DR road (roads 34-65)
- accidentals- usually more than one road radiating from a hub town. (roads 66-85)

These have been numbered from the plate number assigned by Ogilby.

The "Ogilby plus" shapefile also includes:

- extra sections linked to the main road – usually a loop on the strip map
- The roads added by Morgan

These were not characterised by Ogilby but have been assigned road numbers based on the road from which they branch.

The roads were mapped in the order used by Ogilby and in general the Direct Roads are continuous polylines. The cross Roads and accidentals occasionally run on the same line as a Direct Road. To avoid double counting and ambiguity, the polylines for Cross Roads were cut and the overlapping sections removed.

Table A.III.1: Attribute data for Ogilby plus.dbf

The dbf table contains the following fields

Field Name	Data Type	Description & Codes
FID	Object ID	
Shape	Geometry	Polyline ZM
Type	Text	DR = Direct Independent Road radiating directly from London DRP = Direct Independent Road which was a post road radiating directly from London DRPo = short loop from these Direct roads, DDR = Direct Dependent Road – branches directly out of a DR road XP = Cross Independents – not branching from a DR road XA = accidentals- roads radiating from a hub town. MA = extra sections linked to the main road – usually a loop LOOP = other loops derived from map MOR = roads on Morgan map 1679
COMMENTS	text	Places on this section of road
class	Long numeric	1=Main line (London radial) 2 = Cross Road 3 = Morgan road 4 = Diversions from principal line
road_no	Long numeric	The plate number in Britannia – x01 indicates branch from road 1; 300 = Morgan road
Road_route	text	Terminal towns and main intermediates on whole route as listed by Ogilby
qualcommen	text	Text and phrases from Commentary regarding quality of road
qualscore	Long numeric	1 to 6; Score based road quality comments and Table in Road Quality paper
gdbadscore	Long numeric	12, 34, 56 = Simplified quality score on 3 level scale
entertainm	text	Text and phrases from Commentary regarding entertainment and accommodation on the road
frequented	text	Text and phrases from Commentary regarding how frequently the road is used
New_ID	Long numeric	Unique ID for this section of road
miles	Float	Calculated Statute miles

IV. Historical GIS road dataset part 2. Turnpike Main roads

Function

This mapping file records the main roads of England and Wales for the period ca 1680 to 1850. It includes all known turnpikes and roads that were considered “main” roads by cartographers of the period. Roads linking the designated roads, ferries and fords on the main lines and bridges are included so that a road network is formed. Newly built roads and new alignments are identified and provision made to select turnpike road sections in order to generate turnpike maps for the main decades from 1725. It is a source of data for the Rosevear, Bogart, & Shaw Taylor (2025).

Source

This is one of several specific shapefiles derived from the turnpike road mapping for the Campop Transportation Project. The original ArcGIS mapping file (turnpikesall, later roadsall2022) was drawn using digital images of Cary map sheets held in the Cambridge University Library and was the framework for the 1830 main road network; primarily a turnpike network. The principal roads (classed as post road or turnpike by Cary) were mapped as polylines by Max Satchell using the ca 1850 OS 1st series map as the underlying base map. The roads on the OS map acted as a guide and best judgement was used where these did not clearly represent the road shown on Cary. An initial allocation of these main roads to a turnpike trust was made by Max Satchell based on paper sketch maps drawn by Alan Rosevear. The allocation was then refined by Alan Rosevear. Additional roads were added to this shapefile by Alan Rosevear to create the full 1830 and 1838 main road network. In order to create a “network” of roads, linkage roads were added, either minor (often urban) roads from the Cary map, or roads to ferry crossings based on the OS 1st Edition. This large file was the source for several working maps. The turnpike_main_roads map file was formed by removing fields that related to checking of the draft mapping and any roads that were clearly not main roads or linking roads.

Filename; turnpikes_main_roads.shp – as a ARCGIS Pro file

The newly created turnpike_main_roads map file was further built upon by Alan Rosevear to include the “Other Main Road” (OMR) Category of road on the Cary map, using the same technique (some of these had been mapped as link roads already). Bridges, ferries and fords on the main roads and many side roads were mapped as individual polylines. The naming of the trusts was coded so that sections of highway that were subject to tolls in 1838 (active turnpikes and toll bridges) could be distinguished from sections that had once been subject to tolls (lapsed turnpikes ie dis-turnpiked) and those that were toll free (i.e., were parish roads, Improvement Commission Roads, County Bridges, estate roads) and those that were private toll roads.

The turnpike roads were assessed to determine whether each section lay on the line of a pre-turnpike (ancient) road or was a new line. Potential new roads were identified by textual analysis of turnpike Acts. Whether these were on new alignments or were upgrading of older lanes or minor roads was determined by comparing the line on the OS 1st series map (ca 1850), the Cary map (ca 1825), the OS draft maps of 1806-1820 ish and large scale County maps published from ca 1760 to 1800. To aid the identification of “diversions” or new alignments, and to help triangulate ambiguous sections of main road, some sections of the older, pre-turnpike roads were added,

based normally on the roads shown on the 18th century County maps, using the OS first series as the base map.

The file was transferred to ArcGIS Pro in January 2022.

The current reference file (dated Jan 2023) contains

Category	Mileage	Number of polylines
Turnpikes (active 1838)	22,897	13,069
Turnpikes (lapsed/dis-turnpiked)	3,058	2,262
Turnpike made after 1838	626	384
Private toll roads	76	48
Toll-free roads (Other main roads)	14,521	6,650
Bridges		141
Ferries		391
Total mileage mapped	41527	23,100
Each Shapefile consists of 8 files – total size of these		39.6Mb

Table A.IV.1 Attribute data for Turnpike_main_roads.dbf

The dbf table contains the following fields

Field Name	Data Type	Description & Codes
FID	Object ID	
Shape	Geometry	Polyline ZM
NOTES	Text	Comments relating to the section of road
NAME	Text	Further comments and explanations
TRUST	Text	<i>Name of the turnpike trust that managed the road;</i> simple name ABC = a turnpike in 1838; {ABC} = road was turnpiked but responsibility lapsed before 1838; [ABC] = turnpike trust created after 1838 {{ABC}} = road was toll-free (parish road, link road, managed by a non-turnpike Authority such as an Improvement Commission) -ABC =Ferry (space)ABC = bridge *ABC – turnpike Act but not built +ABC = Private road
DATEOFACT	Double	Year of relevant turnpike Act relating to this section of road
DATELAPS_1	Double	Year of the turnpike Act relating to this section of road lapsed or not renewed
Old_or_new	Text	<i>Was there a road on this alinement before turnpiking?</i> A= ancient (i.e. old line of road including pre-turnpike lines) N= new made named in a Turnpike Act after 1800 Na = new made named in a Turnpike Act after 1838

		<p>NE= new made named in Act pre-1800 Nq = new made in Act but uses existing track/lane after 1800 NEq = new made in Act but uses existing track/lane before 1800 NG = Government financed new road after 1800 NEG = Government financed new road before 1800 NX = new made urban street D= diversion or improvement after 1800 identified by comparing maps or individual turnpike studies DE = diversion or improvement pre-1800 identified from maps Da = diversion or improvement after 1838 identified from maps DGL = diversion financed by Government loan after 1800 BN = new bridge after 1800</p>
wasTP	Text	<p><i>Was it a turnpike?</i> T=turnpike or lapsed turnpike; IC = Improvement Commission; (note some of these had previously been turnpikes) X= not a turnpike at time of mapping; P=private toll road; TB=Toll bridge; B= toll free bridge (usually County Bridge); F=inland ferry; FXL=major ferry; FZ=coastal ferry; FD=Ford;</p>
USE_ID	Long	Unique ID number for each section
1830road	Long	<p><i>Sections selected to create a main road network in 1830</i> 1= all roads under turnpike management at the date 2= all roads not identified as a legal turnpike at the time but classified by Cary as Turnpike 3= Link roads (ULR, RLR, XLR) 4= main ferries.</p>
TP_1725	Long	1725= a turnpike at this date
Sequence of fields TP_1750 to TP_1850	Long	1750 in decades to 1850 - Year entered in corresponding field indicates a turnpike at that date
Cary_map	Long	<p><i>Classification of the road on Cary's map</i> 1= post road, 2= turnpike; 3=Other Main Road; 4 = other road; 5=ferry; 8= estate road; 9 = not on Cary's map</p>
Newmade	Text	<p><i>Indicates whether road built on a new alignment</i> N18 = new line built after 1800 but before 1838 N17=new line built before 1800 Nafte= new line built after 1838 GF= Government funder after 1800 Nno= Act after 1800 says new but this section followed the line of an existing lane or minor road Nnoe= Act before 1800 says new but this section followed the line of an existing lane or minor road NX = new built urban road or street ZMR=Military Road</p>

Miles	Float	Calculated geometry of section in statute miles
dis_tp	Short	1 = section was dis-turnpiked (returned to parish mangement) before 1838

V. Historical GIS road dataset part 3. Cary roads

Function

This mapping file (split into 2 parts) reproduces the main roads and many of the minor roads on John Cary's large scale map of England & Wales. This was published between 1822 and 1827 as a series of 62 sheets on a scale of 2 miles to the inch. The GIS mapping uses the 1st series OS map as a base so is effectively at a resolution of at least 6 inches to the mile.

Source

This is one of several specific shapefiles derived from the turnpike road mapping for the Campop Transportation Project. The original ArcGIS mapping file (turnpikesall, later roadsall2022) was drawn using digital images of Cary map sheets held in the Cambridge University Library and was the framework for the 1838 main road network; primarily a turnpike network. The principal roads (classed as post road or turnpike by Cary) were mapped as polylines by Max Satchell using the ca 1850 OS 1st series map as the underlying base map. The roads on the OS map acted as a guide and best judgement was used where these did not clearly represent the road shown on Cary. An initial allocation of these main roads to a turnpike trust was made by Max Satchell based on paper sketch maps drawn by Alan Rosevear. The allocation was then refined by Alan Rosevear. Additional roads were added to this shapefile by Alan Rosevear to create the full 1838 network. This large file was the source for several working maps. The Carymap file was formed by selecting only those lines which had been taken from the Cary map. The fields containing the allocation of these to turnpikes and turnpike dates, where appropriate was retained.

Note that not all the road claimed as turnpikes could be linked to a valid Turnpike Act and in several towns, management of the roads had been transferred to Improvement Commissions by the time of Cary's mapping. In some instances Cary appears to have anticipated a planned turnpike improvement which was later implemented in a different way. There are several examples where he shows both the old turnpike and a recent "new" road as turnpikes though one had lapsed. Cary had been commissioned to map the roads used by the Post Office so it is assumed that these main roads were well surveyed (or copied from other reliable surveyors) and the mapping had been progressively changed as road improvements were made. Some of these changes are evident at the edges of adjacent sheet that were published at different dates and show a change in status or alignment of a through road.

Filename; Carymapsouth and Carymapnorth.shp – as a ArcGIS Pro file

The newly created Carymap file was further built upon by Alan Rosevear to include the "Other Main Road" (OMR) Category of road on the Cary map, using the same technique. This created a complete network of the main roads on the Cary map (the OMRs category included some roads that were actually turnpikes and others that remained as parish roads). In addition, during the course of work on travel by diarists, the "others" category of road (generally parish roads) was mapped for areas of particular interest for individual travellers or to help triangulate ambiguous section of main road. During work on other travel topics (coaches, diaries, road improvements) the Carymap file was

updated/corrected/refined and added to as the other mapping files were created. The file was transferred to ArcGIS Pro in January 2022. The inclusion of so many minor roads made the full map file slow to load and so it was split along a straight line drawn arbitrarily from the Wash to Mid-Wales. Some road sections at the boundary could not be conveniently assigned to North or South so there will be some overlap (of no more than 5 miles) in the area close to the split boundary and both halves should be used when plotting features straddling this boundary.

The current reference file (dated Dec 2022) contains

Cary classification	Code in ARC mapping	Carymapsouth (miles)	Carymapnorth (miles)
Post Road (blue)	1	2598	1752
Turnpike (yellow)	2	11642	6674
Other Main Road (maroon)	3	9451	3912
Other road (uncoloured)	4	28721	13262
Total mileage mapped (includes estate roads and ferries)		52575	25746
Each Shapefile consists of 8 files – total size of these		39.7Mb	18.5Mb

Table A.V.1 Attribute data for Carymapsouth.dbf and Carymapnorth.dbf

The dbf table contains the following fields

Field Name	Data Type	Description & Codes
FID	Object ID	
Shape	Geometry	Polyline ZM
NOTES	Text	Comments relating to the section of road
TRUST	Text	Name of the turnpike trust that managed the road; simple name ABC = a turnpike in 1838; {ABC} = road was turnpiked but responsibility lapsed before 1838; [ABC] = turnpike trust created after 1838 {{ABC}} = road was toll-free and managed by a non-turnpike Authority such as an Improvement Commission. Blank = a parish road
DATEOFACT	Double	Year of relevant turnpike Act relating to this section of road
DATELAPS_1	Double	Year of the turnpike Act relating to this section of road lapsed or not renewed
wasTP	Text	Was it a turnpike? T=turnpike or lapsed turnpike; IC = Improvement Commission; X= not a turnpike at time of mapping; P=private toll road; TB=Toll bridge; B= toll free bridge (usually County Bridge); F=inland ferry; FZ=coastal ferry;

Cary_map	Long	Class of road on Cary map; 1=post road (blue); 2 = turnpike (yellow) ; 3= other main road (maroon); 4 = other road (no colour); 5 = ferry; 8=estate road (uncoloured through enclosed park)
Miles	Float	Calculated geometry of section in statute miles