

# Did turnpikes make roads better?

## new evidence from 18<sup>th</sup> century travel diaries.

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Abstract<sup>4</sup>

The quality of English main roads significantly improved following the introduction of a novel organization, the turnpike trust, where users paid to access roads managed by a selected body of trustees. This paper documents road improvements and gives new estimates for turnpike's contribution to quality change from the mid-1600s to 1800. We digitize over 1,400 road quality comments from 66 traveller diaries and quantify them on a six-point scale according to the standards of the time. They are also mapped onto 14,000 miles of road using geographic information software. From this new dataset, we show the measured quality of many main roads increased from poor to adequate in the first half of the 18th century. In the latter half of the century there was further improvement with many main roads described as good by travellers, an increasing share of whom were in more demanding wheeled vehicles. Using a panel dataset of road segments, we show that road quality increased by more than 40 percent when roads were shifted to turnpike management compared to roads which were not. More broadly, our findings illustrate how directly paying for roads can improve their quality and how public finance innovations aided Britain's development during its transition to sustained economic growth.

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## 1. Introduction

Roads across England & Wales were generally of poor quality during the seventeenth century. Knowledge on how to properly engineer roadways was not widespread and would not be until the early nineteenth century. Yet the traditional methods could still amend and improve bad roads by straightening and widening the lanes, levelling hills, regular maintenance of the road surface and good drainage. One key constraint was the lack of *sponsorship* for financing and implementation. This paper provides new evidence that a novel organization, the turnpike trust, was instrumental in the development of better-quality main roads during the eighteenth century.

Turnpike trusts were conceived in a period when inland travel was evolving from a privilege for the elite to a broader necessity for the many, and leisure pursuits for an emerging middle class. Moreover, some road users were switching from the saddle horse and packhorse to the stagecoach and heavy wagon. Existing civil authorities, especially parishes, were perceived as incapable of meeting the demand for better roads. In response, turnpike trusts were created through Acts of Parliament, mostly in the mid-1700s. Trustees were generally members of the local gentry and typically self-selected. Uniquely, 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 managed a small mileage, sometimes no more than a 10-mile segment along a national route. Yet, collectively, turnpike trusts came to manage the bulk of the main roads for inter-urban and inter-regional travel.

There is an extensive literature on turnpike trusts, but no study has systematically analysed their impact on road quality, especially during the eighteenth century. One reason is the lack of quantitative data relating directly to quality. Scholars have been limited to anecdotes from a few famous travellers or time periods.<sup>5</sup> In the main, this lacunae has been addressed by studying road spending and indirect quality outcomes like travel speeds, seasonality, freight rates, and fares.<sup>6</sup> Most studies argue that turnpikes improved roads, but Gerhold stresses that better horses and vehicle technologies were important, raising concerns about confounding factors.<sup>7</sup> Previous studies also have limitations in focusing on London routes and long sections of road, and few systematically compare changes in outcomes on turnpike roads versus the alternative, parish roads. Hence, it is

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<sup>5</sup> Webb and Webb, *English Local*, Jackman, *The Development, Albert, the Turnpike*, p. 140.

<sup>6</sup> Pawson, *Transport*, Bogart, 'Did Turnpike Trusts?', 'Turnpike trusts and the transport', 'Turnpike trusts and property'.

<sup>7</sup> Gerhold, 'Productivity Change', 'Development of Stage'.

still unclear exactly how much improvement to the road network arose through turnpike management, especially during the period of early economic change before 1800.<sup>8</sup>

In this paper, we reassess and expand the use of *travel diaries* as a source, that has previously only been used selectively and unsystematically. From these we have derived a new, much enlarged dataset of measurable changes in the quality of the main highways. This provides new statistical evidence that turnpike trusts increased quality relative to civil parishes. The views of the travelling public, expressed in diaries, provide a useful direct assessment of road quality as it was experienced. Although subjective and qualitative in nature, many such observations can indicate the direction of change and by adopting a ranking system for comments, they can provide a measure of its magnitude. More than 1,400 relevant comments from the diaries of 66 travellers have been digitized. The diaries were chosen to cover almost all years between 1640 and 1830, most regions of England & 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. We also link diary comments to a new and comprehensive digital mapping of roads in use during the late seventeenth and eighteenth centuries.

The data indicate that the quality of the main roads rose from poor to adequate between the late seventeenth century and the mid-eighteenth century. There was further change by the late 1700s with many roads judged to be good by travellers. We also make a statistical analysis of quality at an individual road segment level in cross section and over time. First, we find that road segments under parish 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. The resulting generalized difference-in-differences estimate implies that quality increased by over 40 percent when a road came under turnpike management versus when it did not. 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. Summarizing, quality increased by about 65 percent on the average main road from 1700 to 1800, and turnpike trust management is estimated to account for 85 percent of that.

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<sup>8</sup> Rosevear et. al., 'Government' compares quality by turnpike trusts and Government in the early nineteenth century.

The systematic analysis of data from diary comments allows us to quantify and analyse quality change more thoroughly than before. Compared with previous studies of roads and turnpikes, this study has reduced sampling error (by having a larger more diverse source on quality) and measurement error (by using the ranked scoring). We also use an empirical strategy which directly compares outcomes for turnpike trust and parish roads, further addressing some limitations of 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.

Our paper contributes to several other literatures. One draws on previously unused written records to build a composite view of a subject. Recent examples include the use of autobiographies to shed light on child labour and living standards during the industrial revolution and Victorian eras.<sup>9</sup> Also related are studies using textual analysis on parliamentary records.<sup>10</sup> To our knowledge, we are the first to study many observations on road travel across all of England & Wales and to employ Geographic Information System (GIS) tools to systematically analyse these data.

We also add to a literature on productivity gains occurring through quality changes. The greater speeds in freight transport and passenger travel, which helped propel the dramatic rises in ton and passenger miles are well documented.<sup>11</sup> By examining the sources of quality change, we contribute to a broader picture of how the English and Welsh economy became more productive from the seventeenth to the eighteenth century.

Our results further speak to the effects of Britain's general reliance on a mixture of public, private, and non-profit authorities to provide infrastructure.<sup>12</sup> Trusts or guilds were especially common in delivering harbours, bridges, and lighthouses.<sup>13</sup> Like these, turnpike trusts were organised and run at a local level but were responsible for part of a national infrastructure. Justices of the Peace, leaders of county government, mainly enforced the provisions of turnpike acts on the main roads. Central government rarely invested in public infrastructure directly before the early

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<sup>9</sup> Humphries, *Childhood*, Griffin, *Liberty*, Griffin, *Breadwinner*.

<sup>10</sup> Guldi, *'Parliament'*, Hanlon, *'Analyzing'*.

<sup>11</sup> Aside from references to roads elsewhere, see Solar and Hens, *'Ship speeds'*, Kelly and O'Grada, *'Speed'*, Bogart et. al., *'Speedier'*, Bogart, Lefors, Satchell, *'Canal Carriers'*.

<sup>12</sup> See Ward, *Finance*, Casson, *The World*, Tomory, *the History*, Webster, *'The Decline'*, Milward, *Public Private*.

<sup>13</sup> See Bogart et. al., *'Organizations'* for discussions of trusts in lighthouses.

nineteenth century. Its influence was felt in the legislation of individual Acts and general regulations, like controls on vehicles. Our aim in this paper is to further establish if, where, and when there were observable improvements attributable to trusts.

More broadly, we contribute to a debate on whether institutions led to major differences in productivity and incomes, especially prior to the wave of technological changes associated with the industrial revolution. Previous contributions examine how state institutions affected development in the English context, especially in relation to old Regime institutions in Europe and Asia.<sup>14</sup> Frequently the focus has been on property rights and central government funding of war.<sup>15</sup> Our emphasis is on financing infrastructure, like roads, lighthouses, and waterworks, through authorities like turnpike trusts.<sup>16</sup> They are linked with England's predictable legal and political system, which emerged around the time of the Glorious Revolution. New ideas came about, like using tolls to improve infrastructure capacity and quality. The same is true for administrative mechanisms to improve oversight.<sup>17</sup> A detailed examination of turnpikes' contribution to road quality before 1800 provides a good illustration of how public finance innovations mattered.

In Section 2, we summarise the literature on the impact of turnpike trusts. Section 3 deals with the criteria used to measure quality changes in roads. In Sections 4 and 5, comments made by diarists regarding quality are analysed and quantified. Section 6 reports generalized difference-in-differences estimates. Conclusions are provided in Section 7.

## **2. Roads, turnpike trusts, and improvement**

### **2.1 The turnpike system: origins and features**

Until the late seventeenth century, all roads in England & 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).<sup>18</sup> Each parish could have many miles of road with little differentiation between the many local roads and the small mileage of great highways or post roads that might pass through the parish.

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<sup>14</sup> Some examples in this literature include Mokyr, *Enlightened*, O'Brien, 'The Triumph, Hoppit, Britain, Cox. 'British.'

<sup>15</sup> Some examples include Dincecco, *Political*, Bottomley, 'Institutional'.

<sup>16</sup> See Bogart and Richardson, 'Property Rights', Webster, 'The Making', Chapman, 'Interest rates'.

<sup>17</sup> For applications in the modern context. See Garrison and Levinson, *The Transport Experience*, Engel et al., 'When'.

<sup>18</sup> 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.

The number and character of parish roads varied across regions of England and Wales. Few were suitable for wheeled traffic in the north and the west;<sup>19</sup> carrier services to London from these regions continued to rely on pack horses in the early eighteenth 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 nineteenth century, it also appears that Government lacked the capacity or political desire to finance change directly<sup>20</sup> but regarded roads, like other infrastructure, as a local issue to be addressed by the Justices, relying on parish resources.<sup>21</sup>

The preambles to turnpike Acts universally complained that the existing roads were ruinous, bad and so deep, narrow and incommodious that they were almost impassable, especially in the winter season. In one act, it was stated that “The want of drains and bridges interrupted traffic, to the Disappointment, Prejudice and Loss of the Woollen Manufacturers and other Traders, as well as Damage to their Goods”.<sup>22</sup> Worse still, some roads were “dangerous” to all passing through. The witnesses to Parliamentary Committees, from whom these statements were generally drawn, attributed the decline in road quality to the many heavy carriages frequently passing through and the nature of the soil. Parishes, particularly in lowland England, had little experience or access to materials for maintaining roads robust enough to deal with the greater weight of wheeled traffic.

Turnpike trusts emerged as a potential solution. 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.<sup>23</sup> The ‘turnpike trust system’ subsequently grew in the 1720s and more rapidly in the 1750s and 60s. By 1836 there more than 1,000 trusts managing nearly 20,000 miles of road.

The novel powers of turnpike 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

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<sup>19</sup> Jackman, Development, p.87, Sheldon, ‘From Trackway’, p. 72, Croft, Packhorse, pp. 2-8.

<sup>20</sup> Government concerns about poor roads grew in the early 1800s, see Rosevear et al 2023, ‘Government’.

<sup>21</sup> See Webb and Webb, English, Chapter3.

<sup>22</sup> Opening of the Bradford (Wilts) Turnpike Act of 1751.

<sup>23</sup> For more on the model of giving legal powers to a ‘trust’, see Harris, Industrializing.

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 and of different types) 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 prior to the early nineteenth century.

## 2.2 Assessments in the literature

Detailed analyses of changes in quality on turnpike roads have been challenging because of limitations in relevant quantitative data. In a general survey of transport, Jackman used legal and anecdotal commentary to argue that before turnpike management, roads in the seventeenth century were poor, and good ones were rare.<sup>24</sup> Using a selected set of diaries and court documents he found evidence of bad turnpike roads, along with evidence that some were very good.<sup>25</sup>

Pawson’s, *Transport and Economy*, is one of the first comprehensive assessments.<sup>26</sup> Pawson documented that many towns which grew to prominence in the eighteenth century got London coaching services only after roads were turnpiked.<sup>27</sup> In some regions, like Wales, wheeled traffic was unusual in the 1750s and 60s when roads were first turnpiked but much more common by 1800.<sup>28</sup> Pawson also documented the remarkable fourfold decrease in journey times for stage-coach services between 1660-1800, which was attributed to turnpike roads.<sup>29</sup> Most importantly for our purposes, Pawson quantified commentary on quality by Arthur Young in 1771. Whilst this showed 29 percent of turnpikes were bad, very bad or vile, the corresponding figure for non-turnpikes was 61 percent. Similarly, 29 percent of turnpikes were excellent or very good while only 3.7 per cent of cross roads (not leading to London) were so judged. An analysis of comments in 33

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<sup>24</sup> Jackman, *Development*, pp.101, 301.

<sup>25</sup> In *English Local Government*, p.146, Webb and Webb used Parliamentary documents to conclude that the early turnpike trusts were at best inefficient and at worst corrupt, employing new resources badly. They found examples of improvements from the early eighteenth century and although they thought these limited, conceded that “no considerable improvement in the highways of England would have taken place for ... the first three quarters of the eighteenth century without turnpikes”.

<sup>26</sup> Albert, *The Turnpike Road System* is another important work. Due to space constraints we do not discuss it fully.

<sup>27</sup> Pawson, *Transport*, pp.282-3

<sup>28</sup> Pawson, *Transport*, p.285

<sup>29</sup> Pawson, *Transport* pp. 288,-292.

Board of Agriculture Reports at the end of the eighteenth century found turnpike roads, excellent, very good or good in two-thirds of counties examined.<sup>30</sup>

In a series of innovative papers, Gerhold stressed other sources of improvement like better horses, vehicles and economies of scale. Gerhold created a productivity index, based on the Leeds to London carriers service, and attributed 31 percent of the growth to better roads, 6 percent from savings on horse provender, 27 percent from larger firms and 11 percent from the use of fly waggons.<sup>31</sup> Drawing on directories, it is further suggested that turnpikes were 'rarely' a pre-condition for waggons on London routes.<sup>32</sup> In 1681 and 1690, half of the listed services used packhorses and half used four wheeled waggons. By 1705 there had been considerable growth of waggon services (56%) and only minor growth of packhorse services (6%).<sup>33</sup> So, there was a key shift from packhorses to waggons before turnpikes. Gerhold further analysed the impact of turnpike roads on stage-coaches between 1663 and 1840. A large dataset revealed speeds and fares increased mainly after 1760, indicating that the early turnpikes had little effect.<sup>34</sup> Gerhold made further estimates of productivity growth in stage-coaching on London routes, finding major growth between the 1760s to the 1780s. Some credit is given to steel springs, along with better roads.<sup>35</sup>

In a series of papers, Bogart introduced new datasets on road spending, freight charges using assessed land carriage rates, and land rents or property values.<sup>36</sup> Furthermore, Bogart used econometrics to compare outcomes on parish versus turnpike roads. One paper studies the evolution of inter-city freight rates depending on the fraction of route mileage managed by turnpike trusts. Importantly, rate trends were compared on routes recently getting turnpikes with routes that had none or did not yet have them. In this way, the unobserved differences in freight rates across routes can be differenced out as well as the common time trends shared by routes regardless of turnpike status. Bogart estimated that if turnpike trusts managed an entire route, freight charges declined by about 20 per cent, accounting for half the overall decline from 1700 to

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<sup>30</sup> Pawson, Transport, pp.268-269

<sup>31</sup> 'Productivity', p. 504. In a note of caution he intimated little reliance should be placed on the precise figures.

<sup>32</sup> *Ibid*, p. 500.

<sup>33</sup> Gerhold, 'Packhorse and wheeled vehicles', pp.5-8

<sup>34</sup> Gerhold, 'Stage coaching', pp. 819-20.

<sup>35</sup> *Ibid.*, pp.829, 833

<sup>36</sup> See Bogart, 'Did Turnpike trusts increase' for analysis of road spending.



1800.<sup>37</sup> The inference is that quality improvements from turnpike trusts must have generated enough productivity gains to offset the increased tolls.<sup>38</sup>

In summary, various works in the literature argue for road improvement from turnpiking in the eighteenth century, especially after 1750. The inference from changes in productivity, service routes, or use of wheeled vehicles also suggests a steady improvement in quality partly attributable to turnpikes. However, previous studies are often not geographically precise about where changes took place and when these were associated with a particular turnpike. The most comprehensive analyses depend on data for London services. The degree to which the latter are representative of traffic on all turnpikes changed over the eighteenth century. Furthermore, few have considered the comparative change or the “difference-in-differences” for outcomes on turnpike versus parish roads (the exception is Bogart as above). Finally, with the exception of Pawson, few previous studies have tried to measure differences in quality directly. A larger sample encompassing travel on parish as well as turnpike roads is needed to measure differences in quality. This requirement for new data and improved methodologies, to explore in detail the previous general conclusions, we will now explain.

### 3. Traveller diaries as a source on road quality

This study uses a new dataset drawing on 66 travel diaries. Around half are published in the last 70 years and a similar number are digital copies of older transcripts (the online appendix provides details). 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; in all cases the least edited/summarised edition was used. The diaries describe well specified journeys over many decades, from which we extract more than 1,400 comments on road quality.

We have devised a road quality scoring system that allows comparisons and relative change to be assessed. As shown in Table 1, the words and phrases of the diarist are assigned to six categories: 1 & 2 generally poor, 3 & 4 adequate, and 5 & 6 generally good. The diarist’s mode of travel is also recorded, either on horseback, in a vehicle, or uncertain.

*Table 1; Data entry criteria used to classify road quality comments.*

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1. **Very bad/dangerous;** worst, terrible, execrably bad; insufferably bad; unsuitable for carriages; very steep extremely hazardous; detestable; had to walk horses; break-neck, tide covers sands, hazardous ford.

<sup>37</sup> Bogart, ‘Transportation revolution’, pp. 481, 491-2.

<sup>38</sup> Bogart, ‘Turnpike trusts and property income’ uses a similar methodology applied to a different outcome.

2. **Bad**; rough; dirty lane; large stones; very dirty & narrow; full of ruts; very dirty; very stony; rough for coaches; too bad for postchaise; poor, under indictment; rough, hard & uneasy; deep & heavy, deep & unpleasant, unpassable, ruinous.

3. **Not good**; sandy hard going; hilly and uneven; sandy steep and heavy; dirty stony; narrow; Summer Road only; indifferent, winding, uneasy, no very good way, mountainous, hard hilly, overhung.

4. **Acceptable**; pleasant road; not best, not very ill, rather sandy; uneven hilly but free from ruts or stones; tolerable; adequate, good at this season {terrible before}, in repair, indifferent good, middling, good over mountains.

5. **Good**; level & pleasant hard as garden gravel; delightfully pleasant; fine road firm, level gravel; clean road; fine road; very level; delightful road level, hard straight, pleasant paved pebbles; very agreeable.

6. **Very good**; most excellent turnpike; very fine, well-pitched,

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Note; 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 the diarist compares winter and summer quality the score is averaged

The journeys have been linked to a historical GIS road dataset. The latter includes (i) all roads that came under the management of turnpike trusts and in which year, (ii) all main roads in 1680, and (iii) all the classes of main roads, principal “other roads” and parish roads along travellers’ routes mapped by Cary around 1825. Altogether 80,000 miles of road are represented as polylines (the online appendix provides further 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 ranked quality score (1 to 6). In total, quality is observed for 1,431 individual sections of road summing to 13,930 miles.<sup>39</sup> Crucially for our panel analysis, 267 road sections have quality scores over time, based on significant spatial overlap in the polylines associated with at least two diary comments.<sup>40</sup>

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 after the date. Going forward we refer to a road section as ‘turnpiked’ if it was under turnpike trust management when observed by a diarist. Practically, this meant a road was subject to tolls immediately after the Act and maintenance was the trust’s responsibility. Parishes were

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<sup>39</sup> Note that data on roads through private parks, town streets, and under construction were excluded.

<sup>40</sup> Overlap of c.30% was allowed if other factors were consistent, though most pairings had far higher congruence.

responsible on that segment only if the trust relinquished control or Justices made such a determination. The data were grouped into four time periods or eras: (i) prior to 1720, before extensive turnpiking, (ii) from 1720 to 1765, initial turnpikes in use, (iii) from 1765 to 1800, when turnpikes formed a network, and (iv) after 1800, the mature phase. Table 2 lists diarists making comments on at least 100 miles. It demonstrates the relative diversity within each era. One of the most prolific commentators, Daniel Defoe, not in fact a diarist, will be analysed separately below.

*Table 2; Main Diaries from which road quality comments were taken for England & Wales*

Diarist	Distance with comments pre-1720 (miles)	Distance with comments 1720-1765 (miles)	Distance with comments 1765-1799 (miles)	Distance with comments after 1800 (miles)	Total miles of journeys recorded in diary	% Journey miles with comments
Celia Fiennes	1,696				5,511	31
Samuel Pepys	326				4,199	8
Joseph Taylor	214				914	23
Ralph Thoresby	116				8,004	1
Lord Harley		306			2,284	13
Richard Pococke		271			7,243	4
Cornish judge		231			734	31
Jabez M Fisher		13	359		4,500	8
Arthur Young			2,285		2,406	95
Agnes Witts			1,393		1,2391	11
John Byng			1,123		6,534	17
Samuel Curwen			866		4,567	19
Chas Hatchett			755		1,678	45
La Rochefoucauld			649		2,501	26
Stebbing Shaw			226		1,175	19
Gent on tour			753		887	85
John Skinner			128		6,033	2
Caroline Powys			112	22	5,147	3
Louis Simond				186	2,306	8
Anne Lister				145	3,801	4
Peter Hawker				135	10,828	1
Benjamin Silliman				101	1,605	6
Others	301	730	544	537		
Total in each Era	2,653	1,551	8,722	1,104	(see note)	4

Notes: 301,000 miles of travel have been analysed from 73 diaries & collections (104 individuals); 66 of these have road quality comments; only diaries with comments on more than 100 miles listed here. Comments on sections of road greater than 50 miles have not been included in this table or in the quality comparisons as they give insufficient spatial detail for useful analysis.

Source: see Online Appendix for references to diaries and collections.

### 3.1 Perception, bias, and environmental factors

Analysis of traveller diaries is well suited to revealing changes attributable to turnpike management. They were usually written on or close to the day recorded, rather than years later. Also, they usually provide precise dates and locational details of journeys undertaken. Diarists were

also likely to be typical of the social classes that were regular users of the long-distance turnpike roads and so most motivated to comment on how these might alter in quality.

Yet there are some limitations of this source. 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 seventeenth and early eighteenth centuries were 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 eighteenth century, a quality road was: wide enough for two vehicles to pass; firm, so that the surface was not cut into deep ruts by the wheels; smooth, to minimise jolts; and 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, rocks 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, inn-keepers and peasants who never travel far from home, may give execrable roads (and tell no lie) the nomination of very safe and good ones". Conversely travellers might expect turnpike roads on which they paid a toll, to be well-repaired and so be more vigorous in their condemnation when these expectations were frustrated.<sup>41</sup> The judgement of commentators was also referenced against their own, wider travel experience. Hence, a pedestrian might feel quite competent to classify a road as good or bad, using their recollection of journeys made by other modes. Individuals may change their reference points slowly, so any upward change in standards would be drift on a generational time frame rather than a step change.

Perception could introduce another bias through the choice that diarists make about the routes they take. 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. The result may be under-reporting on roads used primarily by freight carriers or farmers.

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<sup>41</sup> Albert, *Turnpike*, p. 141, quoting Edwin Gay.

This effect will not unduly bias our attempt to measure quality on the most travelled roads but might upwardly bias quality on parish or turnpike roads as a whole.

Environmental factors also mattered. It was inherently easier to maintain a satisfactory road across some soils (clay was bad), 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 a lower quality road. Nevertheless, low volumes of traffic on a toll road would adversely affect the funds that were applied to road improvement. Consequently, it was not inevitable that turnpiking would lead to improvement in road quality or that a good quality road was necessarily improved. Furthermore, if a road was very bad, an improvement in quality might not have been sufficient to make it good; making it adequate would be a positive achievement. We try to address these issues in our analysis.

#### **4. Change in road quality and the impact of turnpike trusts: a first look**

Daniel Defoe was a famous author and commentator of the early eighteenth century and in his *Tour of the whole island of Great Britain* devotes a whole section to the state of the roads in the 1720s.<sup>42</sup> He emphasised the badness of the old roads across the Midland clays and the danger posed by flooding north of London. He extolled the virtues of turnpiking particularly on important roads for trade. For instance, after turnpiking, Defoe said that the Ipswich Road (initial Act 1695) had become firm and safe and the North Road through Wadesmill built on a high, firm causeway. South of there, the turnpiked road to St Albans had been “repaired, narrow places widened, hills levelled and bottoms raised”. Nearer London, at Edmonton, sluices controlled the water that previously caused dangerous flooding and along the whole road “about 300 new bridges” had been built.<sup>43</sup>

Such claims might be exaggerated but the comments by our diarists tend to support Defoe. For example, Defoe mentioned three main roads north from London where they ran onto the Midland clays; at Arrington Lanes, Stangate Hole, Baldock Lane and Hockley Hole. In the Online Appendix, we summarise the direct and indirect information on road quality at three of these locations. Arrington “Lanes” was turnpiked in 1710 and Defoe states that after turnpiking this previously intolerable road was much amended. In 1750 Pococke, who made regular observations

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<sup>42</sup> Defoe, *A Tour*, Appendix Volume 2.

<sup>43</sup> Even if culverts and drains were included the figure of 300 new bridges sounds exaggerated

of quality in his diary, passed this way without adverse comment. Another diarist Courtney, travelled this way ten times in 1764/66 without comment. Baldock Lane, turnpiked in 1719, had been described in the 1660s by Pepys as very bad. Defoe could only express confidence that this recent turnpike road would improve; between 1759 and 1766 Courtney passed easily this way without comment. Importantly this became the main route for the increasing flow of London stages to the Northeast. Hockley Hole was turnpiked in 1710; Fiennes in 1690 had called it a sad road, impassable in winter, but Defoe states that after turnpiking it was handsomely repaired. In 1770 Young said it was a good turnpike and earlier in 1762 Kielmansegg, a regular diary commentator, had passed it with no judgement. This became a particularly busy route after turnpiking but drew no further adverse comments.

The Diaries provide observations that immediately before turnpiking some sections of road were indeed bad. In 1788 Shaw found the Headington road “impassable” in the year it was turnpiked and Agnes Witts observed the badness of Winchcombe road in 1792, the year the trust was created. Direct evidence of rapid improvement after turnpiking is found in the diaries. In 1750 George Woodward travelling from Abingdon to Oxford praised the improvement of the road through Bagley Woods made by the newly created trust. In 1757, four years after turnpiking, Pocke found that the Eling road into the New Forest had been made very good. Within a year of turnpiking in 1756, Pocke described the New Marylebone Road as a fine way, communicating with all the Northern Roads. A Cornish judge reported the new Okehampton turnpike was a greatly mended road in 1765. In 1788, Shaw observed “an excellent new turnpike” a year after the Odiham & Farnham turnpike was created. Agnes Witts could hardly contain her praise for the recent improvement to the old road down Nailsworth Hill made by the trust in 1792. She also found the new road created two years previously near Llandovery, was charming, while in 1791 Byng praised the magnificent new made turnpike road at Ferrybridge. However, a touring gentleman in 1795 commented that although the new turnpike to Wareham was good, he still had to open 40 gates along it. There were complaints on turnpikes where work was in progress. Agnes Witts found the new line being built through Headington impassable and Byng complained that at Southall the road was nearly impassable in advance of turnpike completion. Nevertheless, complaints of poor quality in the years soon after turnpiking were rare.<sup>44</sup>

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<sup>44</sup> Of 29 comments made up to four years after turnpiking, 18 were above average, 10 average and only one near Cheltenham was very bad.

The diaries provide multiple comments on particular roads both before and after turnpiking. Comparing changes in quality on the two main routes from London to the North reveal significant differences. Prior to any turnpiking, the London to Carlisle Road had a high incidence of poor-quality scores through Cheshire and Lancashire. There were poor sections such as Hockley Hole in the south and through the mountains north of Kendal.<sup>45</sup> By 1770, when all this road was under turnpike trusts, these and adjoining sections were scored as good. In contrast, the long middle section of this route on turnpikes between Newcastle under Lyme and Preston was singled out by Arthur Young in 1770 as having “execrable roads”. He advised “all travellers to consider this country as sea, and as soon as they think of driving into the ocean as venturing into such detestable roads”.<sup>46</sup> The twelve diarists commenting on the section through west Lancashire in the eighteenth century all gave it a score below average; this was clearly a very problematic road which turnpike trusts were failing to improve significantly.

Sections of the Great North Road from London to Edinburgh were described as bad prior to turnpiking, especially the southern sections which included the notorious Baldock Lane in Hertfordshire. Certain northern sections were already good, at least for mounted travellers. Diarists judged most of the Great North Road adequate by 1770 after it was turnpiked and any poor sections made good by the 1790s. When considering the full length of the two northern roads, there are few obvious differences between the engineering challenges faced by the two groups of trusts. Contrasting performance perhaps points to management differences, like the finance and the skill of the surveyors and trustees, as being factors for successful improvement in road quality.

## **5. Changes in road quality and the impact of turnpikes: a national assessment**

### **5.1 Mapping road quality**

The breadth of the data allows us to map the quality for all observed road sections that were either non-turnpikes (generally maintained by parishes) or turnpikes across England and Wales. Figure 1 shows non-turnpike roads, making a distinction between those that would be turnpiked later and not.<sup>47</sup> Regardless, they were generally poorer (74 percent of the mileage), with no strong regional pattern. The few better non-turnpike roads are also scattered, with no regional pattern.

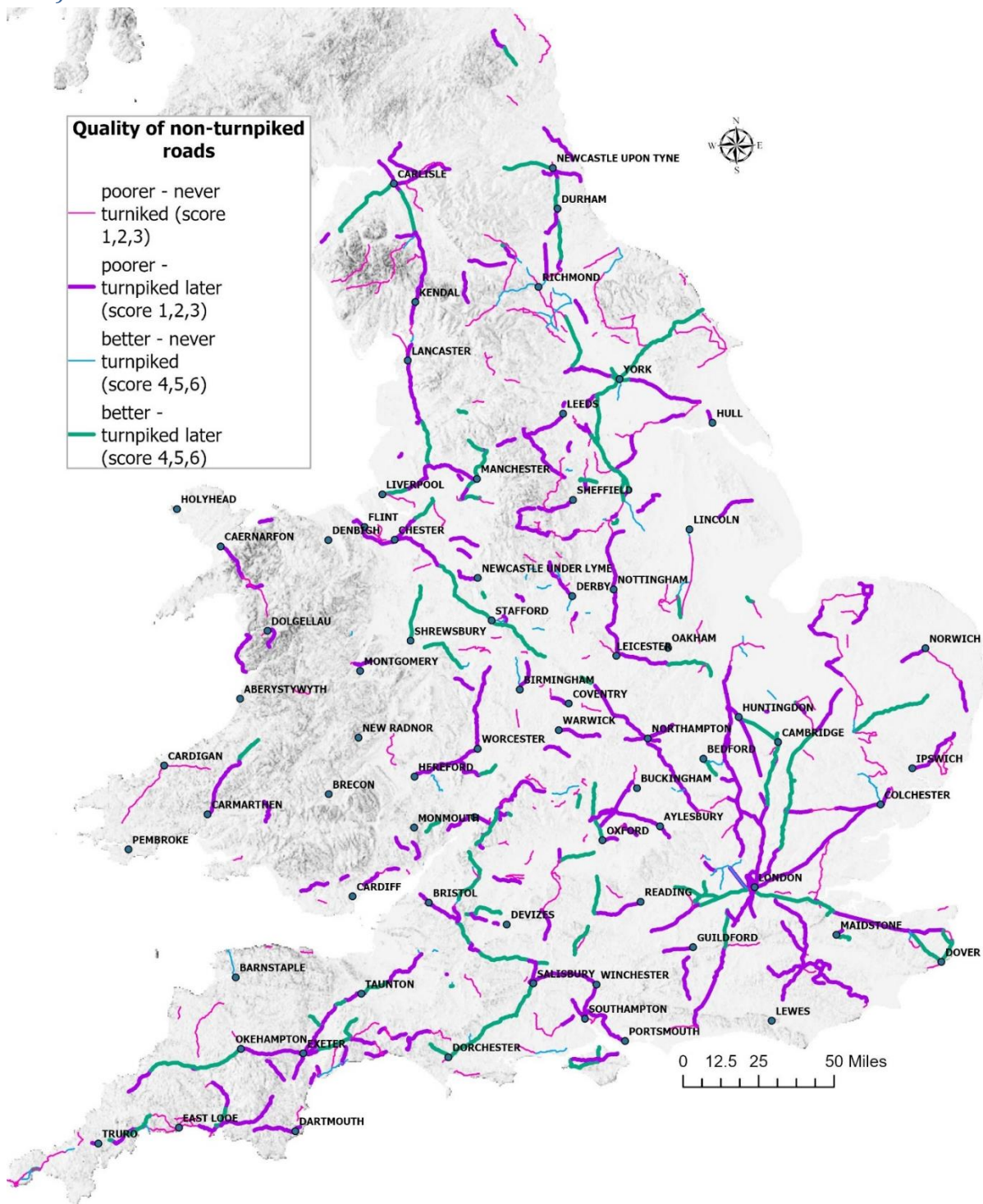
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<sup>45</sup> Taylor had to walk his horses down from Shap in 1705.

<sup>46</sup> Young, Northern Tour, Vol.4 p. 435.

<sup>47</sup> Note that where there are multiple comments by a diarist on a section of road, the last record will be on top and so determine the colour seen.

Figure 1. Road quality reported by diarists on roads that were not turnpikes at the time; all eras (1640 to 1830).



Source: See text for details. Note: Total mileage displayed here 6,074 miles; poorer roads never turnpiked 1,766 miles; poorer roads later turnpiked 2,746 miles; better roads never turnpiked 388 miles; better roads turnpiked later 1,174 miles (analysis excludes town and park roads). Note that where there are multiple comments on a section of road, the last record will be on top and so determine the colour seen in this GIS mapping for the common section. (approx. 500 miles have multiple observations).



Figure 2 maps observed quality for roads that were turnpikes.<sup>48</sup> A high proportion had better quality scores (62 percent of the mileage). These included long stretches of the main post roads radiating from London as well as a cross-country route from Exeter to Birmingham and a corridor between Lichfield (north of Birmingham) and Manchester. The poorer scores remain on several of the turnpike roads across the Midland clays, in the Weald of Kent and West Lancashire and more generally in upland areas.

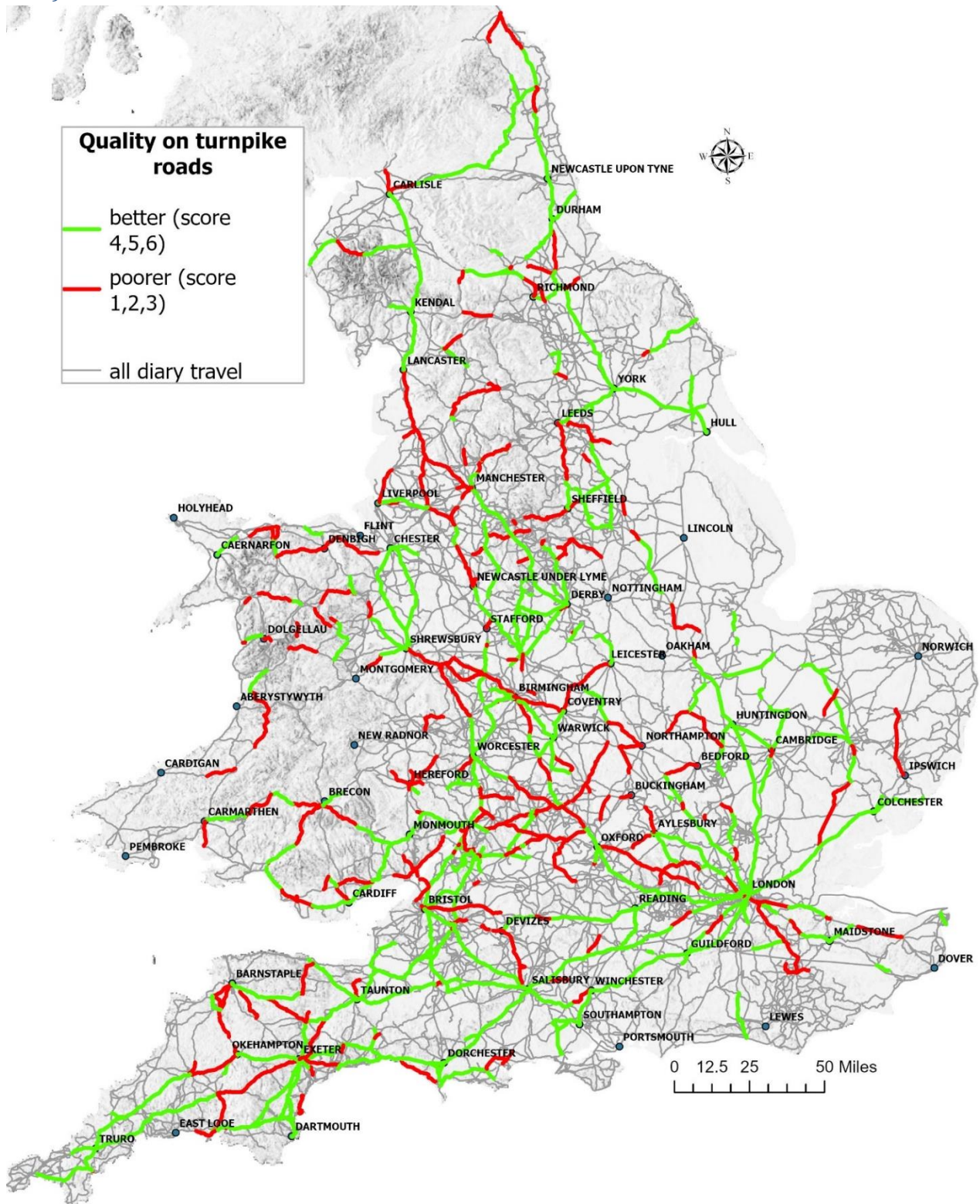
Importantly, most of the major post roads operated by turnpikes are classified as better. For example, much of the principal road down the spine of the Southwest peninsular from Gloucester through Bristol to Exeter and through Cornwall to Truro and Penzance was better after 1750. The poorer quality turnpikes tended to be branch or cross-roads off these main trunk roads to small remote towns or on alternative routes to these destinations, e.g., the roads to Barnstaple in Devon. Thus, there is differentiation with inter-urban routes carrying the most traffic brought up to a good standard and those carrying least traffic being less good in general.

The grey lines in figure 2 show all the roads diarists used without comments on quality prior to 1800. The absence of comments by diarists on many of the miles they travelled might be interpreted as indicating that these were “as one might expect” i.e., average, but there is insufficient evidence to justify this positive metric in our quantitative analysis.

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<sup>48</sup> Some roads have multiple sections and some will have multiple reports on a section.

Figure 2. Road quality reported by diarists on roads that were turnpikes at the time; all eras (1640 to 1830).



Source: See text for details. Note: Total mileage displayed here 7,899 miles; better quality turnpikes 4,908 miles; poorer quality turnpikes 2,991 miles. (analysis excludes town roads). Note that where there are multiple comments on a section of road, the last record will be on top and so determine the colour seen in this GIS mapping for the common section. (approx. 600 miles will have multiple observations)

Figure 3. Quality of roads through Southwest England between 1750 and early 1800s

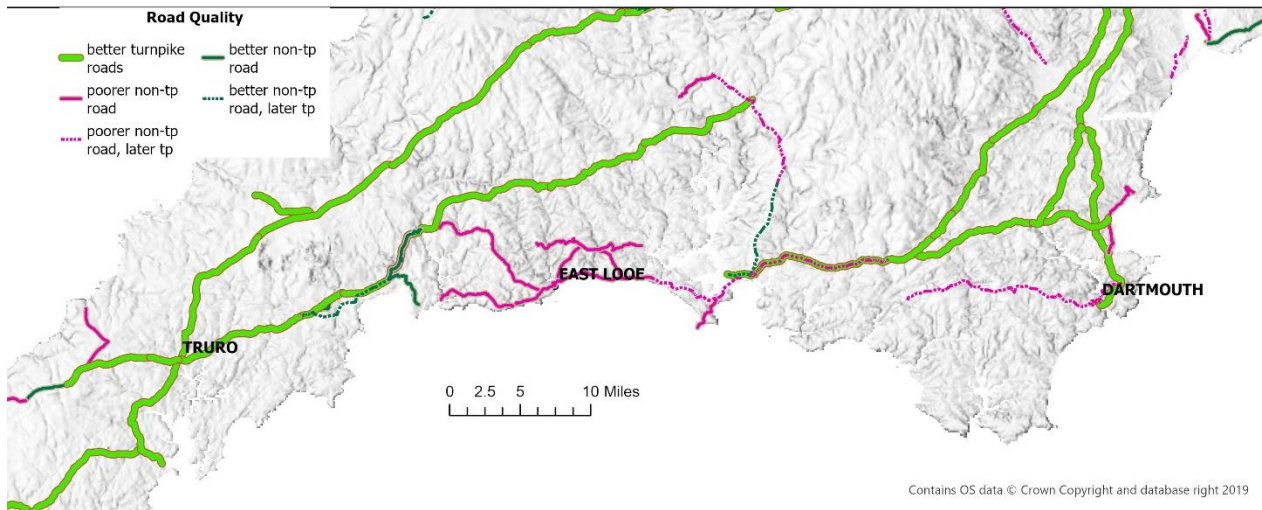


Figure 3 maps quality in the far Southwest, offering a regional perspective. Few of the non-turnpike roads were judged as better and poorer ones were observed even in areas where a better turnpike road was maintained nearby, e.g., East Looe. This is consistent with the views of earlier commentators that investment in maintaining parish roads lagged that of the turnpikes. The turnpike road segment between Dartmouth and Looe is also revealed as poor before turnpiked and better after (note two classes of symbol mark this section).

## 5.2 Assessment of quality scores across eras

We now compare the “average” quality score (1 to 6) on turnpike and non-turnpike roads in each era. The drawback is that this takes no account of unobserved heterogeneity in road segments and differences in the composition of the sample at different periods. In the next section, we address these issues with panel data. The summary in Table 3 consistently places the average quality score for turnpiked roads above that of non-turnpiked. For example, in era 3 turnpike roads have an average of 3.8 versus 2.8 for non-turnpike. This difference, based on hundreds of diarists’ comments, suggests a 35% higher quality, which is statistically significant based on a difference in means test (the t-stat assuming equal variances is 9.36). Although eras 2 and 4 have smaller samples, they show a similar quality difference between turnpike and non-turnpike roads. Comparing columns (2) and (3) there is little difference in the average score for roads that would be a turnpike later and those that were never to be. This suggests there was no clear bias in the selection of the better parish roads for upgrading to turnpikes.

*Table 3; Average road quality score on sections of turnpikes and non-turnpike roads from diary comments*

<i>Era</i>	average score (observations)		
	(1) <u>turnpike at time</u>	(2) <u>not a turnpike at time</u>	(3) <u>Will be a turnpike later, subset of (2)</u>
1. <i>pre 1720</i>	4 (1)	2.6 (264)	2.7 (200)
2. <i>1720 to 1765</i>	3.8 (11)	2.3 (94)	2.5 (65)
3. <i>1766 to 1799</i>	3.8 (671)	2.8 (293)	2.9 (103)
4. <i>after 1800</i>	2.9 (41)	2.0 (18)	2.0 (9)

Notes: authors calculations. See text for details.

The data from all diary comments are analysed based on mileage in Table 4. There is greater uncertainty for those eras with low turnpike mileage but overall, more than half the non-turnpike mileage is scored 1 or 2 (i.e., very bad or bad). In era 3 when there were most observations, 51 per cent of the non-turnpike mileage was scored 1 or 2 and 14 per cent 5 or 6 (good or very good) whereas for corresponding turnpiked roads the ratio was almost the reverse with 21 per cent scoring 1 or 2 and 41 per cent 5 or 6.

*Table 4; Mileage of turnpiked and non-turnpiked roads with quality score at different eras from diary comments*

era	at time	Miles with quality score			Total
		1 or 2	3 or 4	5 or 6	
1. <i>pre-1720</i>	non-turnpike	1,386	785	477	2,648
	turnpike		4		4
2. <i>1720 to 1765</i>	non-turnpike	693	232	157	1,081
	turnpike	13	166	61	240
3. <i>1766 to 1799</i>	non-turnpike	1,031	703	294	2,028
	turnpike	1,466	2,596	2,840	6,902
4. <i>after 1800</i>	non-turnpike	144	67		211
	turnpike	357	221	71	650

Notes: authors calculations, see text.

A notable finding in this analysis is the proportion of the pre-turnpike mileage that was judged by users to be good (score 5 or 6); 18 per cent of the mileage pre-1720 and 14 per cent from 1720-65 had these high scores. There were famously good sections of road in the provinces; the road from Honiton towards Exeter in Devon for instance was scored as very good (6) by three commentators on horseback prior to turnpiking and an average of 5.7 by three other commentators in vehicles after turnpiking. This does illustrate that the increase in average score is constrained by merely looking at change: for roads scoring 6 before turnpiking, there is no scope for recording more improvement, only the retention of the high score amidst rising traffic and rising expectations on the turnpike. Also notable is that around 20 per cent of the turnpike mileage continued to be

judged poor (score 1 or 2) even during era 3. This highlights that turnpiking was not a formulaic solution such as building new infrastructure; both the starting point and any progress were site specific and assessing change should ideally take account of this:

Although there must be more uncertainty in interpreting the data from era 4, there appears to be a deterioration in observed quality by diarists after 1800. We speculate on the reasons. The lower average quality is consistent with the growing concern with the poor quality of turnpikes expressed by Parliamentary Committees after 1810 and discussed by Rosevear et al (2023). However, it is also possible that good roads had become the norm and were no longer worthy of comment. The lower level of reporting, or lack of interest in quality by diarists may be because the creation of a generally good network meant that travellers could now choose a good road and favour this for their journey without concern. It seems unlikely that fewer observations reflect some autonomous change in what diarists chose to write about.

We close this section summarizing how the modes of diarists' travel changed over this time (Table 5). In era 1, prior to 1720, only a tenth of the mileage was assessed by travellers in a wheeled vehicle; this rose to 40 per cent in era 2 and 80 per cent after 1765.<sup>49</sup> Improved carriage design would obviously have been a factor, but these better coaches could not have operated if roads had not improved from a ruinous condition. Importantly, diarists seemed to favour using wheeled transport when on a turnpike; in era 3 the ratio of miles travelled in a vehicle versus horseback was 2.7 to 1 for non-turnpikes and 5.3 to 1 for turnpikes. Though travellers still needed to use non-turnpikes, they commented more adversely on their quality. These changes in mode may have been a further factor raising expectations of what was average quality and so the attraction of traffic to the turnpikes would tend to reduce their road quality score without any change in actual quality. The increased use of lighter faster coaches, rather than saddle horses, would have changed what turnpikes were expected to achieve; a more comfortable and convenient highway.

*Table 5; Mode of travel of diarists commenting on road quality*

<i>Era</i>	<i>% horseback</i>	<i>% vehicle</i>	<i>% uncertain</i>	<i>Total mileage</i>
1. <i>Pre 1720</i>	85	10	6	2652
2. <i>1720 to 1765</i>	30	40	30	1321
3. <i>1766 to 1799</i>	19	80	2	8930
4. <i>after 1800</i>	2	80	18	861

<sup>49</sup> In era 1 this is a lower percentage than in the full data set of diary travel; in era 2 it is similar and in era 3 a substantially higher percentage – i.e. a higher proportion of the coach passenger miles are carrying comments after 1750, a time when the transition from saddle horse to vehicle is occurring.

Notes: authors calculations, see text. In era 2, the uncertainty mainly is from Defoe who probably travelled mainly on horseback

## 6. Turnpikes and Quality change: difference-in-differences estimates.

In this section, we use 639 observations on 268 road sections where we can link at least two diarist comments between 1660 and 1819.<sup>50</sup> Linking is based on diarists commenting on the same or overlapping road sections during their journey. Two diarists may be linked by starting their journey in the same town or ending in the same town, but not always. We address the potential measurement error from linking diarists using the same road, but with different starting and ending towns.<sup>51</sup> For each road section  $i$  in year  $t$ , we create an indicator variable  $turnpike_{it}$ , which equals 1 if the road section was turnpiked and zero if not. In this sample, 23% of the observed road sections were never turnpiked. For the rest, they were turnpiked at various dates between 1695 and 1792. Later we classify turnpiking in eras 1 and 2, and separately in era 3 between 1765 and 1799.

The dependent variable is the natural log of the quality score. The log scale minimizes the effect of extreme values, like score 6. In our baseline, we estimate the following generalized difference-in-differences specification:

$$\log(\text{quality}_{it}) = \text{turnpike}_{it} + \alpha_i + \delta_t + \varepsilon_{it}$$

where  $\alpha_i$  is a fixed effect (FE) for the road section,  $\delta_t$  is a fixed effect for decade or year, and  $\varepsilon_{it}$  is the error term.<sup>52</sup> In the baseline, decades are used to measure time fixed effects. For robustness, we also estimate specifications including fixed effects for each year. Some include indicators for whether the diarist was in a wheeled vehicle or mode unknown. The reference group was travellers on horseback. Note the latter mode indicators are perhaps correlated with  $turnpike_{it}$ , so we include them in selected specifications only. Diarist fixed effects are also added in some specifications, as a few made observations on the same road section or multiple road sections over different years. Other econometric challenges are addressed as well.

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<sup>50</sup> The online Appendix gives an example of the data selection and of selected sections with multiple paired observations.

<sup>51</sup> Observations covering town streets were excluded. We are concerned here with change over several years, on main roads, and those that occurred before the changes brought about by Macadam after 1815.

<sup>52</sup> 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

The estimates in Table 6 help quantify to what degree turnpikes increased quality. Specifications in column 1 use road section and decade fixed effects and cluster standard errors on road sections. The coefficient implies that when a road section switched to turnpike management, diarists significantly increased their quality assessment by 42 log points. Estimates in column 2 restrict the sample to linked diarists starting in the same town. Column 3 restricts to linked diarists ending in the same town. In these the estimated quality increases are smaller and less precise, but still significant. In column 4, we use year fixed effects and cluster standard errors on road section and year. The turnpike coefficient is similar to columns 2 and 3. In column 5 fixed effects for the mode of the diarist are added. The turnpike coefficient is similar suggesting that the judgement of quality was not significantly affected by the mode of travel. In column 6, the diarist fixed effects are added. The estimates are similar again. In terms of magnitudes, the coefficients in column 4 imply that when a road was turnpiked its quality score is estimated to increase by 38% ( $=\text{EXP}(0.324)-1$ ).

*Table 6: Generalized difference-in-differences estimates for effect of turnpikes on road quality*

	1	2	3	4	5	6
Variable	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.
Turnpike dummy	0.411 (0.109)***	0.350 (0.154)**	0.293 (0.161)*	0.324 (0.114)***	0.323 (0.114)***	0.273 (0.125)**
Decade FE	Y	Y	Y	N	N	N
Link on same start town	N	Y	N	N	N	N
Link on same end town	N	N	Y	N	N	N
Year FE	N	N	N	Y	Y	Y
Diarist mode FE	N	N	N	N	Y	Y
Diarist FE	N	N	N	N	N	Y
Cluster St. err. On	Road	Road	Road	Road & year	Road & year	Road & year
N	634	234	219	633	633	591
R-square, within	0.158	0.307	0.321	0.378	0.378	0.433

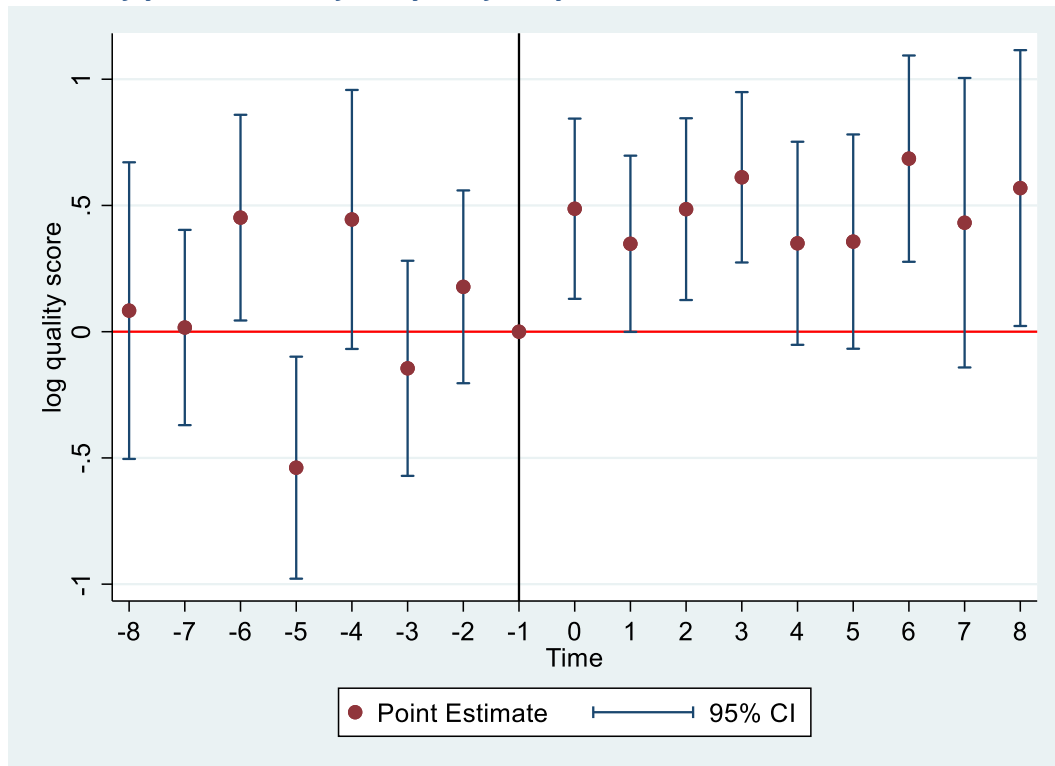
Note: The dependent variable is the natural log of the quality score. All specifications include road section fixed effects. \*, \*\*, \*\*\* indicate statistical significance at the 1, 5, and 10% levels.

In our previous regressions, the trends in road quality up to period  $t$  are assumed the same on road sections that would be turnpiked in period  $t$ , as those on sections that would not be turnpiked by period  $t$ . We test for ‘parallel trends’ by estimating a panel event study using time measured in decades. The specification is the following where  $I(d)turnpike_{it}$  is an indicator variable for the road’s turnpiking year relative to decade  $d$ . For example, a value  $I(-4)=1$  in decade  $d$  would imply the road section would be turnpiked 4 decades from  $t$ . When observed in any other decade, the indicator  $I(-4)=0$  for this road section.

$$\text{Log}(\text{quality}_{it}) = \sum_{d=-8}^8 I(d)\text{turnpike}_{it} + \alpha_i + \delta_t + \varepsilon_{it}$$

As our data sometimes includes multiple quality scores in a decade, we calculate the average as our dependent variable for that decade. The total number of observations is 572, and we observe quality scores up to 8 decades before a turnpike and up to 8 decades after. The event study estimates are shown in Figure 5. The omitted time period is -1, one decade before turnpiking. The point estimates to the left of -1 show no significant or precisely estimated change in the quality trend at least four decades before turnpiking. To the right of -1, the point estimates imply that quality increased after turnpiking and remained significantly higher for at least four to six decades.

Figure 5; Event study point estimates for impact of turnpike trusts



Source: see text. 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.

One remaining concern is a bias from comparing trends in quality for roads which were turnpiked later with roads which were turnpiked earlier. To partly address this issue, we collapse the time frame to four eras as above: (1) pre-1720, (2) 1720-1764, (3) 1765-1799, and (4) 1800-1819. In each era, we select only one observation for a road segment if there are multiple observations. We choose the latest one in each era. In era 1, a few roads get turnpikes, but we



don't observe quality on those segments before, so it is generally the "pre-period." In eras 2 and 3, some roads get turnpiked and they are observed. In era 4 we don't observe any roads newly getting turnpiked, so it is the last post-period with no new adoption.

In Table 7 we estimate difference-in-differences with era and road segment fixed effects. The new feature is to analyse different samples according to era of turnpiking. In column 1 we consider the full sample. The estimate is larger than in column 1 of Table 6 perhaps because we collapse observations into one per era, and if multiple, we select the highest score. The more interesting comparison is across columns in table 7. In column 2, the sample includes diarist comments on roads which were turnpiked in eras one, two, or never. The estimate is very similar to col. 1 in raising road quality by 52.8 log points. In column 3 we add segments which were turnpiked in era three, but only when they are observed in eras one and two to avoid a compositional shift in the sample from early and late turnpiking. In column 4, diarist comments on roads which were turnpiked in era three or never are in the sample. Across all samples, the estimated effect of turnpikes is similar, reducing concerns about comparisons of roads turnpiked at different times.

*Table 7: Generalized difference- in-differences estimates for subsamples and different Eras*

	1	2	3	4
Variable	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.	Coeff. St. err.
Turnpike dummy	0.519 (0.116)***	0.528 (0.127)***	0.543 (0.125)***	0.517 (0.273)*
Sample	all roads	roads turnpiked in era one, era two, or never	roads turnpiked in era one, era two, never, or in era three but only obs. in Era one and two	roads turnpiked in era three or never
Road & Era FE	Y	Y	Y	Y
Cluster St. err.	Road	Road	Road	Road
On				
N	431	395	405	140
R-square, within	0.257	0.247	0.235	0.144

Note: The dependent variable is the natural log of the quality score. All specifications include road section fixed effects. The four eras are (1) pre-1720, (2) 1720-1764, (3) 1765-1799, and (4) 1800-1819. \*, \*\*, \*\*\* indicate statistical significance at the 1, 5, and 10% levels.

How much of the change in quality score can turnpiking account for? If the turnpike indicator is excluded from the specification in column 1 of Table 6, then the decade fixed effects

imply that quality increased by 48.6 log points from 1700 to 1790, a 62.5% increase. If the turnpike indicator is included, then the decade fixed effects imply that quality only increases by 8.8 log points from 1700 to 1790. Thus, turnpikes appear to account for 85% of the change. 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.

## 7. Conclusions

The comments by diarists suggest that prior to turnpiking maybe a fifth of the main roads, that travellers used were thought to be good. Nevertheless, road quality was poor on certain important post roads and those in some mining and industrial areas. These were routes carrying an increasing amount of heavy traffic, which probably over-whelmed the ability of civil parishes to maintain these highways. When these were turnpiked, how well did they improve quality? During the early eighteenth century, diary comments suggest that turnpiking of some main roads did have a positive effect on quality. Our analysis shows there was an increase in average quality score from 2.7 for roads yet to be turnpiked in era 1 to 3.8 for turnpikes in era 2. This differential with again an average score of 3.8 is shown with more confidence for era 3 (after 1765). That said, this is still only just above average on the six-point quality scoring system.

When assessing this progress, the hierarchy of quality criteria derived from contemporary discussion of turnpikes should be applied. The complaints before 1750 were primarily that 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. Defoe highlights the benefits of raised causeys, new bridges, and better drainage as much as improved surfaces in his praise of turnpike success. Against the criteria, shifting the quality score from mainly bad (score two) to adequate (score between three and four) was a mark of success. Resilience to the adverse effects of weather and safe travel were also major “improvements” on the turnpikes in the first half of the eighteenth century. Based on the quality terms used in diaries before 1750, the emphasis was on safety and reliability above speed and comfort; getting the basics right before matters of mere convenience. The end of this period saw a substantial change in the mode of transport chosen by travellers with far more opting to use

wheeled vehicles rather than the saddle horse. The availability of better designed carriages was a necessity for the transition to wheeled vehicles but would not have been sufficient without a substantial improvement in the safety and reliability of the roads that had been turnpiked.

What about the different effects from early and late turnpiking? 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 and would have sufficient traffic to generate funds to further improve a growing road network. However, on some of these later turnpikes, traffic was lighter and on the radial, county-based turnpike trusts, many minor roads had been drawn into the system. These inevitably placed a limit on what improvement could be achieved and our observations show the average quality score for turnpikes remaining stubbornly just above average 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.

There are many more diary comments after 1765 and these provide a firmer basis on which to deduce improvement. Judged against the quality of these roads before turnpiking there was significant improvement. Diarists after 1765 began to mention the speed and how pleasant the road was. On average the beneficial change still did not increase the average quality score above four and such a small differential and mediocre quality score “on average” was disappointing, given the resources that were clearly being expended. Nevertheless, the improvements in efficiency and speed of public transport would imply more improvement in convenience was taking place, particularly on those major turnpikes used as stage coach routes. The number of coach services began a long period of sustained growth after 1760 suggesting that the indirect criteria of service levels amplified the perception of road quality improvement measured on a linear scale.<sup>53</sup>

Other factors do suggest that an average quality measurement understates the degree of improvement. Firstly, we should consider the implications of a drift in perceptions of quality. Contemporary comments in diaries and magazines point to an intergenerational drift upwards. A shift from expecting a road to be safe and reliable to one which should be comfortable when travelling quickly, would push up the standard expected by a generation that now used lighter faster vehicles routinely. We cannot quantify this change but are confident of the direction. It is

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<sup>53</sup> For growth of coaching traffic see Rosevear et al, ‘Spatial Patterns’

also consistent with quality decreasing by nearly the same amount on turnpike and non-turnpike roads after 1800 as reported in Table 2.

We generally find that good or excellent quality scores were concentrated on a set of principal roads connecting key hub towns. 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 resource for better materials and management, likely fuelled this differentiation. Alternative routes with lower quality, though still nominally turnpikes were fading back to be almost indistinguishable from the parish road network into which all turnpikes were integrated. Nevertheless, even on the principal highways there were still sections of poor road. Some of these resulted from insuperable engineering challenges for existing technology, others could probably be attributed to poor local management by particular turnpike trusts. This heterogeneity, inherent in a locally based regime, meant that the turnpiking had yet to create a truly national network that could be described as universally good; though it was now “good in many parts”.

The detailed data from diaries does provide evidence that by the 1790s a substantial mileage of road under turnpike management was not only safe and resilient but was the favoured path for travellers in both public and private vehicles. Sections of poor parish road had been successfully repurposed 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 our results are consistent with previous studies but, with greater sensitivity and specificity in the analysis, we have removed many of the uncertainties, particularly in the geographic and temporal spread of change. By creating a ranking system, we have been able to analyse most of England and Wales over many decades with a granularity similar to the scale of individual turnpikes. With this increased sensitivity and statistical analysis we observe improvements in turnpiked roads before 1750 that had not been apparent in earlier, indirect studies. Our new dataset has brought into focus the value of an underused source, the diaries of travellers, to provide sufficient observations for statistical analysis. The insights this brings,

particularly over the difference between turnpike and parish roads has wider implications over management of critical infrastructure in the eighteenth century.

Our paper contributes to the broader picture of how the English and Welsh economy became more productive from the seventeenth to the eighteenth century. Through studying turnpike trusts, it further establishes there were observable improvements attributable to the mixture of private and non-profit authorities which commonly provided infrastructure in England and Wales. A larger potential implication from this study is that the public finance innovations, like turnpike trusts, were one of the factors accounting for England's precocious economic growth. Our data suggest that without the organizational and fiscal innovations of the turnpike trusts, road quality would not have improved before new techniques were developed in the early 1800s. Without better road quality it is unlikely that passenger travel along the main road network would have become less seasonal, speedier, and more productive as it did between 1750 and 1820. Commerce would have flowed less freely and as result, economic gains would have been constrained. While we cannot yet detail the full productivity change due to public finance innovations, its direction is clear and may apply across other infrastructure sectors as well.

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## Online Appendix

# Did turnpikes make roads better? new evidence from 18th century travel diaries

Dan Bogart, Alan Rosevear, & Leigh Shaw-Taylor

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- VI. Road quality where London roads enter the Midland clay belt



## I. References for diaries mentioned in the text

In the text we reference several diaries. These are listed below.

### Diaries mentioned in the text

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## II. Documentation of GIS shapefile for road quality

### Function

This mapping shapefile records the comments on the quality of the road during journeys in England & Wales made by diarists analysed during this study. It is the primary data source for the paper on

“Using Diaries to Assess Road Quality”, by Bogart, Rosevear and Shaw Taylor (2023) and is part of the Online Appendix” for this paper.

### 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 “diaries full by period” 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 ARC GIS Pro on a personal licence.

The diaries for which road quality comments were derived and references to their origin are listed in Table 1 and are a sub-set of those used for the larger diary journeys database (see “diaries all April 2023” Data Table for the full list).

### 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 new 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, comfort or scenery). A new shapefile was created using the OS ca 1850 1<sup>st</sup> 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 1), 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 road 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 PairID number for use in analysis to 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 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 II.1. Attribute data  
*Road quality ex diaries.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 below; note that close associates of the diarist (AB) appear as (ABw – wife; ABs – son; Abd – daughter; Abf – friend etc)
Means	Text	Mode of travel; <b>boat</b> = ferry, craft on inland river) <b>foot</b> = as pedestrian <b>hcar, hacar, hgig, pchai</b> = hired vehicle (carriage, Hackney, gig, postchaise) <b>horse, hhors, bhors, dhors</b> = saddle horse (own horse, hired horse (e.g. post, hack horse), borrowed horse (not paid for), double horse i.e. riding pillion or 2 on the horse) <b>prgig, prcar, prch, prwag. prcart, ownca, owngi, ocart</b> = private vehicle; <b>prxxx</b> is owned by someone other than diarist, <b>ownxx</b> vehicle owned by diarist (gig, carriage, chair, waggon, cart) <b>bus, mail, carav, dili pawag, staco</b> = public service vehicle (omnibus, mail coach, caravan, diligence, passenger in wagon, stage coach) <b>rail</b> = steam railway carriage <b>ship</b> = seagoing vessel, coastal ferry) <b>unclear</b> = not even able to classify so not used in analysis. <b>code with?</b> - Indicates mode not stated but judged by other evidence to be this mode and so used in analysis bus, mail, carav, dili pawag, staco
starttown	Text	Starting place of relevant journey – note that the section with a quality score may start after this
endtown	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
via	Text	Intermediate points on the whole journey
descriptio	text	Key words and phrases from diary entry relating to road quality
Score_qual	Long Numeric	Quality score 1 to 6 based on key words in quality ranking Table 2
Era	Long Numeric	1= up to 1705; 2 = 1705 to 1750; era 3 = 1750 to 1810; 4=1810 onwards
decade	Long Numeric	Taken from year field

goodbad	Long Numeric	merging the 6 point scale to 3 grades (good, adequate or bad; 12, 34, 56)
justgb	Long Numeric	merging 6 point scale to 2 points – 123 less than average; 456 better than average
Tp_at_date	Long Numeric	1 = not turnpike, 2 = is turnpike at date of diary entry (swipe across line with both layers active)
Tp1838	Long Numeric	1 = not turnpike, 2 = is turnpike in 1838; exclusion codes 13 = streets; 14 = private roads, 15=ferry; 16 = roads being built; 17= bridges
Multiple	Long Numeric	Simple combination of two previous fields; 11 = never turnpiked; 12 = not tp at time of observation but was eventually turnpiked; 22 = turnpike when observation and eventually; 33 = streets; 44 = private roads; 55 = ferries; 77 = bridges or roads being built; 100 and 110 = sections too long to be useful; 111 = non-turnpikes too late to use (after 1815) 122 & 1220 = turnpikes after 1815 cut-off date
pairID	Long Numeric	A unique number for sections of overlapping polyline that overlap each other (note there may be more than two of these)
Class	Long Numeric	County in which line mainly lies
Goodbad_tpn	Long Numeric	takes the good bad score (123 or 456 – if not tp at time add 1 to get 1231 or 4561; if tp at the time add 2 so 1232 4562;
tpdate	Long Numeric	Year of first turnpike Act for this section by inspection of turnpike road shapefile
Tpname	text	Standardized turnpike trust name from inspection of turnpike road shapefile
tpnamegdbadtntp	Long Numeric	separates out to make plotting map to identify non tps that will later be turnpiked; the same basic code as good bad tp field but 1231 is bad and multiple 11, 1232 is bad multiple22; 1239 is bad multiple 12 (i.e. is not turnpiked but will be later) similarly 4561, 4562 and 4569 for good classes; (redundant for this study)
miles	Float Numeric	Calculated Staute miles of the section

Number of data lines = 1612

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

1. **Very bad/dangerous;** worst, terrible, execrably bad; insufferably bad; unsuitable for carriages; very steep extremely hazardous; detestable; had to walk horses; break-neck, tide covers sands, hazardous ford.
2. **Bad;** rough; dirty lane; large stones; very dirty & narrow; full of ruts; very dirty; very stony; rough for coaches; too bad for postchaise; poor, under indictment; rough, hard & uneasy; deep & heavy, deep & unpleasant, unpassable, ruinous.

3. **Not good**; sandy hard going; hilly and uneven; sandy steep and heavy; dirty stony; narrow; Summer Road only; indifferent, winding, uneasy, no very good way, mountainous, hard hilly, overhung.

4. **Acceptable**; pleasant road; not best, not very ill, rather sandy; uneven hilly but free from ruts or stones; tolerable; adequate, good at this season {terrible before}, in repair, indifferent good, middling, good over mountains.

5. **Good**; level & pleasant hard as garden gravel; delightfully pleasant; fine road firm, level gravel; clean road; fine road; very level; delightful road level, hard straight, pleasant paved pebbles; very agreeable.

6. **Very good**; most excellent turnpike; very fine, well-pitched,

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Note; 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 the diarist compares winter and summer quality the score is averaged

Table II.2; 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, Stukely 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 Defore 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.

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

#### Function

This mapping file reproduces the lines of road shown 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 ARC GIS was undertaken by Max Satchell for the Campop Transportation Project using good quality digital images of the strip map pages. Later editing and addition of comments 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 by Max Satchell using georeferenced copies of the pages in an original copy of the plates from Britannia. The shapefile was created in ARC map 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 was later edited by Alan Rosevear in ARC GIS Pro to add details from the commentary on the pages adjoining the maps in Britannia. Some details of the road lines and junctions were refined by matching with digital copies of 18<sup>th</sup> 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.

## Attribute data

*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 & 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 paper on Road quality after 1800.

##### Source

This is one of several specific shapefiles derived from the turnpike road mapping for the Campop Transportation Project. The original ARC 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 1<sup>st</sup> 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 1<sup>st</sup> 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 1<sup>st</sup> 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 18<sup>th</sup> 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

#### Attribute data

*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	<p><i>Was there a road on this alinement before turnpiking?</i></p> <p>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  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></p> <p>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></p> <p>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></p> <p>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></p> <p>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</p>

		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
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 1<sup>st</sup> 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 ARC 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 1<sup>st</sup> 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' 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

## Attribute data

*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;

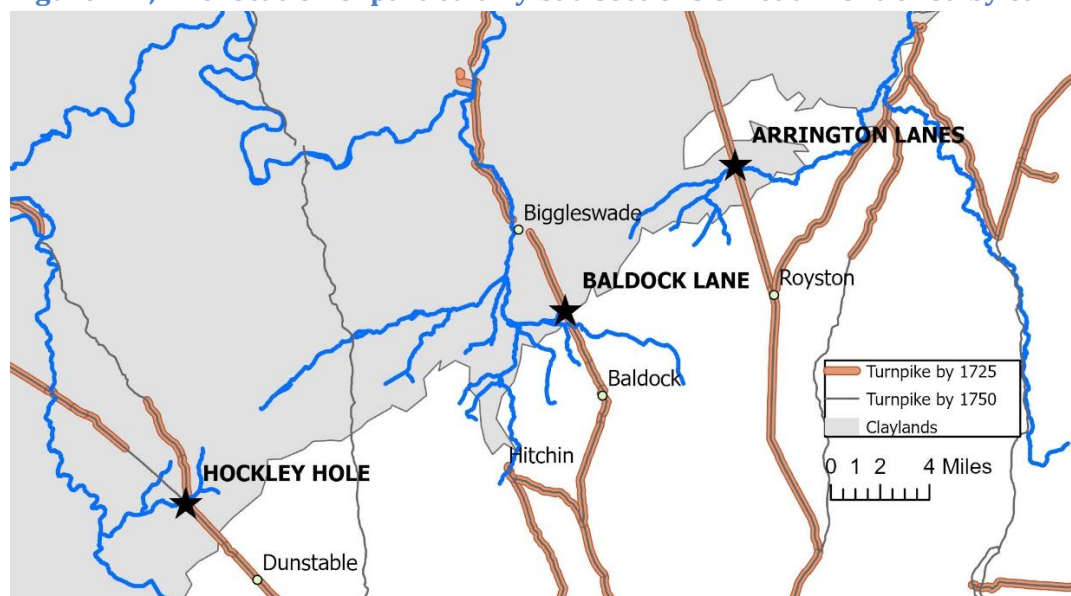
		TB=Toll bridge; B= toll free bridge (usually County Bridge); F=inland ferry; FZ=coastal ferry;
Cary_map	Long	Class of road on Cary map; 1=post road (blue); 2 = turnpike (yellow) ; 3= other main road (maroon); 4 = other road (no colour); 5 = ferry; 8=estate road (uncoloured through enclosed park)
Miles	Float	Calculated geometry of section in statute miles

## VI. Road quality where London roads enter the Midland clay belt

Here we illustrate the type of data found in diaries or secondary sources and the selection of data for statistical analysis.

Three of the notoriously bad sections of road named by Defoe are shown on Figure A. These lay in similar locations where the main roads from London ran out onto the Midland clays (Stangate lies further north of Arrington). At these points the road had descended the steep scarp face of chalk hills (the Chilterns) and headed northwards onto the deep Midland clays, but had to cross streams emerging from the porous greensands above the clay. The roads north from here were referred to as “lanes” indicating that they were enclosed or confined, offering little scope for varying the route. These were particularly challenging situations for “traditional” or natural, un-metalled roads since not only was traffic concentrated on deep wet ground but good road making stones and gravel were not found in the adjoining parishes. To the south the less confined roads across the higher ground were inherently easier to maintain; to the north the road was still difficult but firmer. Turnpiking facilitated improvement by increasing the resources applied at these problem points within a small number of the parishes along a road.

**Figure V.A; The location of particularly bad sections of road mentioned by earlier travellers.**



Year	Who	Mode	Comments	Quality score	Statistical pairing*
			HOCKLEY HOLE – road to Midlands & Northwest England		
1680	Ogilby#		down Chalkhill thence (if in winter) a dirty way leads you to Hockley, alias Hockley in the Hole...here the road to Woburn branches out	2	
1697	Fiennes	horse	sad road called Hockley Heath, impassable in winter	1	<a href="#">linked</a>

1700	Defoe	horse?	soft clay; horses die from work	2	section too long
<b>1710</b>	<b>Turnpike Act</b>		<b>Puddlehill - ruinous, almost impassable, dangerous</b>		
1770	Young	chaise	turnpike is good	5	<a href="#">linked</a>
1789	Witts	coach	pleasant	4	section too long
			before 1710; 25 diary journeys- 2 poor comments		
			after 1710; 14 diary journeys - 2 positive comments		
			26 stage coach services per week in 1749 – with winter timetable* 153 stage coach services per week in 1791 – no winter schedule*		
			BALDOCK LANE- road to Northeast England		
1661	Pepys	horse	ways very bad	1	<a href="#">linked</a>
1667	Pepys	carriage	Baldock Lanes already very bad	1	<a href="#">linked</a>
1680	Ogilby#		Baldock Lane notoriously bad	2	
1683	Thoresby	stage	bad lanes	2	poor overlap
1705	Fiennes	horse	base way, narrow lanes & rooty	2	poor overlap
1710	Defoe	horse?	through Baldock Lane, very bad	1	<a href="#">linked</a>
<b>1719</b>	<b>Turnpike Act</b>		<b>Stevenage Biggleswade- ruinous, bad, especially in Winter, very dangerous</b>		
			before 1719; 18 diary journeys- 5 poor comments		
			after 1719; 18 diary journeys - no comments		
			14 stage coach services per week in 1749 – with winter timetable* 80 stage coach services per week in 1791 – no winter schedule*		
			ARRINGTON LANES- road to Northeast England		
1700	Defoe	horse?	deep clay, Arrington Lanes	2	section too long
1704	gent	horse	worst & deepest ever rode	1	<a href="#">linked</a>
<b>1710</b>	<b>Turnpike Act</b>		<b>Royston Wandesford Bridge - very ruinous, hazard, dangerous, cannot pass</b>		
1724	Defoe	horse?	tolerable good way & hard ground	4	<a href="#">linked</a>
			before 1710; 9 diary journeys- 2 poor comments		
			after 1710; 9 diary journeys - 1 positive comment		

			5 stage coach services per week in 1749– with winter timetable*		
			34 stage coach services per week in 1791 – no winter schedule*		

#Ogilby's Britannia; London Trade Directories used in Rosevear et al (2019).\* as used in difference-in-differences analysis

Ranking by the ratio of journeys with comment to no comment on a section of road could provide further evidence of improvement but is less satisfactory than the method scoring the individual comments (though both generally show the same direction of change).