

Government, trusts, and the making of better roads in early nineteenth century England and Wales

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Abstract⁴

This paper introduces new data to explain which actors developed better roads in early 19th century England and Wales. We find that central Government sponsorship and financing of new roads was limited to 100 miles on sections of the politically important London-Holyhead Road. By comparison non-profits, known as turnpike trusts, made thirty times more new road mileage by attracting capable surveyors and both public and private capital. Although the London-Holyhead Road had the highest quality, most turnpike roads were good. By Government working with and through trusts a better road network developed, especially in industrializing areas and along Mail routes.

Keywords: State capacity, infrastructure, roads, turnpike trusts, non-profit sector, public private partnerships

JEL codes: N7, N4, H1, R4

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1. Introduction

Poor quality infrastructure is common in many economies. A perennial challenge is the reluctance of sponsors, who might advocate, plan, and invest in infrastructure projects (World Bank 2017). In many cases, sponsors are public entities, like the Ministry of Transport (Dabla-Norris et al. 2012). In other cases, they could be a variety of private sector organizations, both for-profit and not (Engel et al. 2020). Financing is a further challenge as infrastructure projects are often very expensive. Public financing can come from equity, like direct transfers from the treasury, and from state owned banks which make loans. Public sponsorship and public financing often go together, but private sponsorship does not necessarily imply private financing, nor does it imply reliance on equity over debt.

In this paper, we focus on roads in England and Wales during the early 19th century to examine how various actors (public, private, and in-between) have sponsored, financed, and technically developed infrastructure in the past. Before the arrival of steam railways, England had emerged as one of the world's leading economies. It had good natural resources, mechanical skills, institutions protecting property rights, colonies, and an improvement culture. The prevailing philosophy in this economy was that public works should be paid for with user-fees and sponsored by local bodies. Adam Smith, best summarized this view when he wrote

“It does not seem necessary that the expense of those public works should be defrayed from that public revenue, as it is commonly called, of which the collection and application are in most countries, assigned to the executive power. The greater part of such public works may easily be so managed, as to afford a particular revenue, sufficient for defraying their own expense without bringing any burden upon the general revenue of the society. A highway, a bridge, a navigable canal, for example, may, in most cases, be both made and maintained by a small toll upon the carriages which make use of them.” (*Wealth of Nations*, Book V, Chapter 1 p. 591)

Building on these supports, English main roads had been significantly improved by so-called turnpike trusts starting in the 18th century. Trusts had been sanctioned by Acts of Parliament to better maintain thousands of miles of public road. Tolls were their main source of revenue. Financing came from bonds, usually purchased by local individuals and without public guarantees. The self-selected trustees, drawn from the propertied and business classes, were barred from any direct financial reward and there were no shareholders.

The traditional view in the literature is that turnpike trusts slowly improved the main roads through the 18th century until the rapid expansion of railways around 1840. The central Government in London mainly played an indirect role by scrutinizing and facilitating Acts of Parliament creating turnpike trusts.⁵ A revisionist view sees Governments as making a more significant direct contribution on certain main roads. Guldi (2012), in *Roads to Power*, argues that between 1803 and 1835 Government funding and expert control drove technical innovation, creating corridors of better British roads radiating from London (pp. 17, 29, 81). The Government's principal project in England and Wales was the Holyhead Road, connecting London with Holyhead port and mail services to Ireland. It was of political and strategic importance because Ireland had recently unified with Britain as the United Kingdom.

While it is indisputable that Parliament and Government administrations were more engaged in the early 19th century, it is not clear what Government actors accomplished in comparison to the new roads made by turnpike trusts up to 1840. The literature has not quantified new roads made by trusts, nor identified where they were built. Moreover, it is not

⁵ For a discussion of turnpike trusts see Webb and Webb (1913), Albert (1972), Pawson (1977), Barker and Gerhold (1995), Bogart (2005, 2009, 2019) and Gerhold (2014).

known whether the Holyhead Road was of better quality than turnpike trust roads, as quality has not been well documented for this period.⁶ Establishing these points illuminates structures which made road development successful in the past and even today.

Our first contribution is to better document the rationale for and the making of the Government sponsored Holyhead Road. A series of Parliamentary enquiries emphasized the strategic benefits of better connections with Ireland and improved safety on Mail roads. The Post Office and Thomas Telford, considered the best civil engineer of the day, were critical of turnpike trust management. In response, Parliament formed the ‘Holyhead Road Commission,’ which had authority to make new roads and supersede trusts operating there. Government financial contributions to the Commission were substantial, larger than any other road project of the day. The largest investments went into the route through North Wales, a mountainous area with low population density. The Road was completed in 1828. It reduced stagecoach travel times and encouraged new traffic in minerals.

Our second contribution is to clearly document how many new roads were built by turnpike trusts, along with where they were built and how. Employing textual analysis of Parliamentary Acts, and cross-referencing with historical maps and GIS tools, we estimate trusts built almost 4,000 miles of new road (as distinct from improvements to old roads) in England and Wales, mostly from 1810 to 1838. This figure represents almost 30 times more new road mileage than had been achieved through the Government sponsored and financed Holyhead Road. Drawing on historical GIS mapping, we also show that most new turnpike trust roads were made in industrializing and coastal areas, i.e., where road traffic was growing. This

⁶Quality is often indirectly studied in the literature. For new work on quality using diaries see Bogart et al. (2023).

indicates that new turnpike roads were built upon a strong foundation of economic potential. Additionally, trusts made use of new cost-effective road management techniques and they accessed England's emerging capital market through greater borrowing. New turnpike roads were also aided by loans from a nascent Government body, the Public Works Loan Board.

The third contribution is to assess the relative quality of turnpike roads. We use the national survey on road conditions in 1838, which we digitize and map for the first-time using GIS. Most turnpike trust roads are shown to have been of good quality, indicating their practical success. However, the Holyhead Road ranked in the highest quality category across its entire route. Moreover, the North Wales section of the Holyhead Road was better than that on similar mail roads in Central and South Wales, managed by trusts. We also find that London coach operators switched to using the Holyhead Road after it was improved. In short, Government sponsored and financed improvements yielded the best quality roads, but they were limited in scale and use when compared with turnpike roads, which were generally good.

In the penultimate section, we explain why the Holyhead Commission's authority was not extended to other main roads. Among other factors, we emphasize that Governments developed a more effective 'partnership' with turnpike trusts during the early 19th century. They obliged trusts to improve and be more transparent in their finances and operations. They also eased access to financing through the Public Works Loan Board and in the process fostered some roads of strategic value. In sum, Governments chose to regulate and strengthen turnpike trusts, not replace them. In doing so, they followed a pragmatic form of intervention.

The institutional structures for developing roads elsewhere during the early 19th century gives perspective to our study of England and Wales. Standard practice in Europe had local

communities maintain roads through forced labor, sometimes known as *corvee* (Conchon 2008). However, local labor resources were generally insufficient to develop better roads. Other domestic sponsors had to emerge, as international development agencies and foreign direct investment did not yet exist. In Scotland, there was a similar system to England and Wales, yet the ratio of Government Commission managed roads (1,194 miles) to turnpike roads (5,678 miles) was higher. In France and Spain, the central government coordinated and partially funded highways of strategic importance. The 'royal roads' of France and Spain provided extensive connections (Bretagnolle et al. 2010, Pablo-Martí et al. 2021). The Austrian Netherlands was the only other major European economy to extensively use turnpikes. It seems to have operated successfully at least up to annexation by France in 1794 (Blonde 2010, Cassis et al. 2016). US state governments also followed a similar path to England, but their turnpikes were organized as for-profit bodies (Klein 1990). The number and quality of early US turnpike roads was high in some states like New York (Klein and Majewski 1992). South America followed Europe in using government financing on main colonial roads (Duran et al. 2020).

Was England's institutional structure most effective? Answering this question is not straightforward because of data limitations. It appears England had more main road km per unit of land area than other European economies (Bogart et al. 2010). Coaching speeds appear to have been faster in England too (Gerhold 2014, Bretagnolle et al. 2010). The number and breadth of coaching services was also extensive (Rosevear et al. 2019). Market integration was also greater in England (Herranz-Loncan 2007; Grafe 2011; Nogues-Marco et al. 2019, Chilosi et al. 2013 and Federico et al. 2021). All these factors point to the practical success of the

partnership between Government and turnpike trusts, yet as we explain later it could not be easily transferred abroad in the 19th century.

This paper also contributes to the comparative state capacity literature. The conventional narrative posits that wars helped developed state fiscal capacity in Europe, which eventually led to more public goods spending by the state (see Besley and Persson 2008; Dincecco and Prada 2012; Johnson and Koyama 2017). This narrative does not fully describe the British experience, since until the late 19th century its railways, canals, and waterworks were built by for-profit, joint stock companies (see Casson 2009, Tomory 2017, Cox 2020, Campbell et al. 2021). Consistent with this view, our analysis shows that most roads in England and Wales were not built by conventional state actors. That said, we demonstrate that strategic considerations underlay the Holyhead Road and support for some turnpike trusts too.

Lastly, we shed light on the historical role of “Public Private not-for-profit Partnerships” (PPNPs). Besides turnpike trusts, other historical examples in England are harbor and bridge trusts, and lighthouse authorities like Trinity House. They were influential up to the late 19th century, when more infrastructure became the responsibility of municipal authorities and rural districts, both public actors, financed through taxation⁷. Even so, trusts illustrate how non-profits can play a productive role partnering with private financiers and public authorities.⁸

2. Actors, financing, and techniques for road improvement

⁷ See Webster (2022), Chapman (2021), Millward (2005), Bogart et al. (2022), Offer (2022) for details on how public authorities became more significant in the late 19th century.

⁸ For more on non-profits see Bennett and Iossa (2010), Mendel and Brudney (2012), Oechler Solana (2014), Glaeser and Xiong (2017), and Zwalf (2022); for private partnerships see Engel et al. (2020); For transport policy generally, see Garrison and Levinson (2014).

Turnpike trusts (mainly composed of local landowners, Justices of the Peace, clergy, and commercial interests) were given authority over the planning, improvement, and maintenance of roads by individual Acts of Parliament. The roads remained Crown property and would revert to the civic authorities when the powers granted to the trust ended. The system had its origins in the late 17th century, but it flourished in the decades after 1720. By the early 19th century there were close to 1,000 trusts managing different sections of the main road network.

Turnpike improvements and maintenance were paid for with tolls and bonds secured against future toll income. The interest on the bonds generally ranged from 4 to 5%. Strikingly from today's perspective, the interest payments were not guaranteed by a central public authority. That meant the bondholder bore the full default risk. Trust mortgage registers indicate bondholders tended to be local landowners and manufacturing interests, and in some instances women, charities, and shopkeepers (Albert 1972, Buchanan 1986). As it turned out, few bondholders ever seized the toll revenues because of missed interest. Most earned a 4% return on the face value of the bonds (Bogart 2019).

Broadly, the turnpike system operated with limited public oversight and scrutiny through the 18th century. Trustees initiated nearly all proposals for new roads and improvements. Parliamentary committees had some influence when reviewing bills establishing or extending their term of authority; yet there is no evidence that committees significantly shaped trustee proposals. Trustees also took the lead in procuring land for improvement.

Importantly, trustees had considerable control over finances. Parliamentary Acts set maximum toll schedules for different users, including wagons, coaches, and drovers, but trusts had the ability to vary the tolls below the maximums and negotiate with users for an annual

ticket. Trustees largely determined debt levels and hence risk. Their finances were partly revealed in committees reviewing bills for individual trusts, but no systematic financial report was required for all trusts until the 1820s. Their activity was restricted to the roads named in their Act and a major financial limitation was that trustees could not earn any profits or pay themselves a salary. This characteristic is why we consider trusts to be non-profit organizations.

Why did trustees serve with no profit motive? One potential answer relates to an “improvement” culture, where elites were motivated to better their locality (Defoe 1986, Guldi 2012 p. 140). Another answer is that trustees benefitted indirectly from their decisions. Land prices and rents increased when transport links were improved, particularly if this was achieved with low tolls and no land tax. In support of this motivation, there is evidence property income was higher in parishes which had turnpike roads compared to those without (Bogart 2009).

There were two primary public sponsors of road improvement in England and Wales. The first were civil parishes, overseen by Justices of the Peace. They relied on land taxes and “Statute Labour” (similar to corvee). By the 19th century parishes were mainly responsible for maintaining local or minor roads, totaling around 100,000 miles. By most accounts, changes to roads made by parishes were on a lower scale than turnpikes and likely to be associated with changes in land use, like enclosure and drainage. Government administrations in London are the second primary public sponsor and are given emphasis here. Governments were headed by Tory ministries from 1807 to 1830, which covers much of our period. Their primary political concerns were war, suppressing revolution, and Union with Ireland. However, some Government boards and agencies, like the Post Office, were arguing for more intervention in public works. There was some precedent for such a policy. In 1751, the Treasury took the

unusual step of granting £3,000 to a trust for the Military Road constructed along Hadrian's Wall (Lawson 1966). Further, the Commission of Scottish Highland Roads & Bridges was established in 1803. It acted like a public agency sponsoring and financing infrastructure in the less developed upland areas. Working against the idea of Government intervention was the philosophy, expressed by Adam Smith and others, that central governments should not sponsor and finance roads, due to corruption and misallocation. Many Members of Parliament (MPs) seem to have adhered to this philosophy (Guldi 2012, p. 138).

The Public Works Loan Board was the only major public investor in turnpike bonds. The Board or PWLB was founded in 1817 to allocate Government-funded loans to local authorities with the aim of providing relief and to stimulate the economy (Webster 2018). The PWLB lent £401k to 107 trusts in England and Wales between 1817 and 1832 (Bogart 2019). It was one of the first agencies to significantly increase public financing of new roads as explained below.

There was an evolution in who supervised road projects and in what technologies were used. Turnpike trusts generally employed a local surveyor who led the process of hiring labor and procuring materials. In the 19th century, it became common to also take advice from a more experienced General Surveyor. There were two well-known road surveyors articulating different approaches. Thomas Telford argued for a 'scientific' approach with detailed specifications and documented planning for a road with well-placed stone foundations and a surface cover of rammed, broken stone. A second surveyor, John Loudon McAdam, argued for pragmatic engineering, adjusted to local conditions, including good drainage, well-sifted broken stone or gravel, and gentle curvature of the road profile. McAdam's innovations were also in

management, avoiding unnecessary expenses but selecting good quality materials. McAdam and his associates would become influential working for turnpike trusts.

3. Parliamentary enquiries and Government intervention

The starting point for our analysis is the early 19th century when criticism of turnpike trusts grew, and the state of the roads became a larger public issue. The first focused parliamentary initiative was the 1810 Select Committee “to enquire into the state of the road from Shrewsbury to Holyhead”. The Committee was convened in the wake of the Act of Union with Ireland in 1801 to facilitate rapid and reliable communication with Dublin (Guldi 2012). The engineer Thomas Telford was contracted to survey the Irish Mail routes and make recommendations, especially for the Holyhead Road. Telford was damning about the Road’s condition, which was then managed by turnpike trusts (BPP 1810/11 Appendix, BPP 1814). This supported the Post Office view that the Holyhead Road was the worst route used by its Mail coaches (BPP 1810 p.42). Through North Wales horses had been killed or maimed on the poor surfaces, Mails had over-turned at tight bends, and were at risk from unfenced precipices (BPP 1814/15 p.366). Along the whole route from London, witnesses criticized turnpike road surveyors, who in their view used poor quality materials, laid in a slovenly manner with poor foundations, and took narrow crooked paths up unnecessary gradients⁹.

The Committee concluded that on the Welsh section of the London to Holyhead Road the future care and management thereof should be taken out of the hands of local trustees.¹⁰ The Committee further argued that reasonable tolls were inadequate to pay for keeping it even

⁹ BPP 1814/15 p357; reiterated in BPP 1817 p. 253 and in Telford’s later reports BPP 1824 Appendix.

¹⁰ BPP 1814/15 p358; and in Telford’s later reports BPP 1824 Appendix p. 27.

in tolerable repair and could not repay the cost of improvement¹¹. Hence, grants of public money were essential. They stated that: “...appeals from Ireland to English Law courts,... property disputes, ... trade exceeding £20 million... for family connections, and the benefit of better classes in Ireland educating their children in England” are “political objects of such great public consideration... *and justify the most liberal aid being granted by Parliament*”¹².

Momentum grew after, and in 1817 another Select Committee made proposals which led to Government intervention. A dedicated Holyhead Roads Commission was set up in 1819 under the chairmanship of the leading Irish MP, Sir Henry Parnell. It also included a member of the existing Commission of Highland Roads & Bridges in Scotland and the First Commissioner of Woods, Forests and Land Revenues, who managed the finance of public works (Hughes, 1964). Its chief technical adviser was Telford.

The Holyhead Commission intervened in various ways. First, seven turnpike trusts on the road between Shrewsbury and Bangor had substantial mileage of road transferred to the Commission. The Commission would recommend improvements and Government funds would be channeled through it under a single management. The Commission would retain the road after completion and collect tolls to finance maintenance.

A second type of intervention applied to a branch of the Holyhead Road and the worst sections through England, between London and Shrewsbury. Temporarily, financing would be channeled through the Commission. Once completed the sections of new road would be transferred to the adjoining, existing turnpike trusts, which would be responsible for financing

¹¹ BPP 1814/15 p358; repeated in BPP 1819, p127 when the Committee considered the section across Anglesey

¹² BPP 1814/15 p359; This was recited and expanded by the Committee in BPP 1817, p8

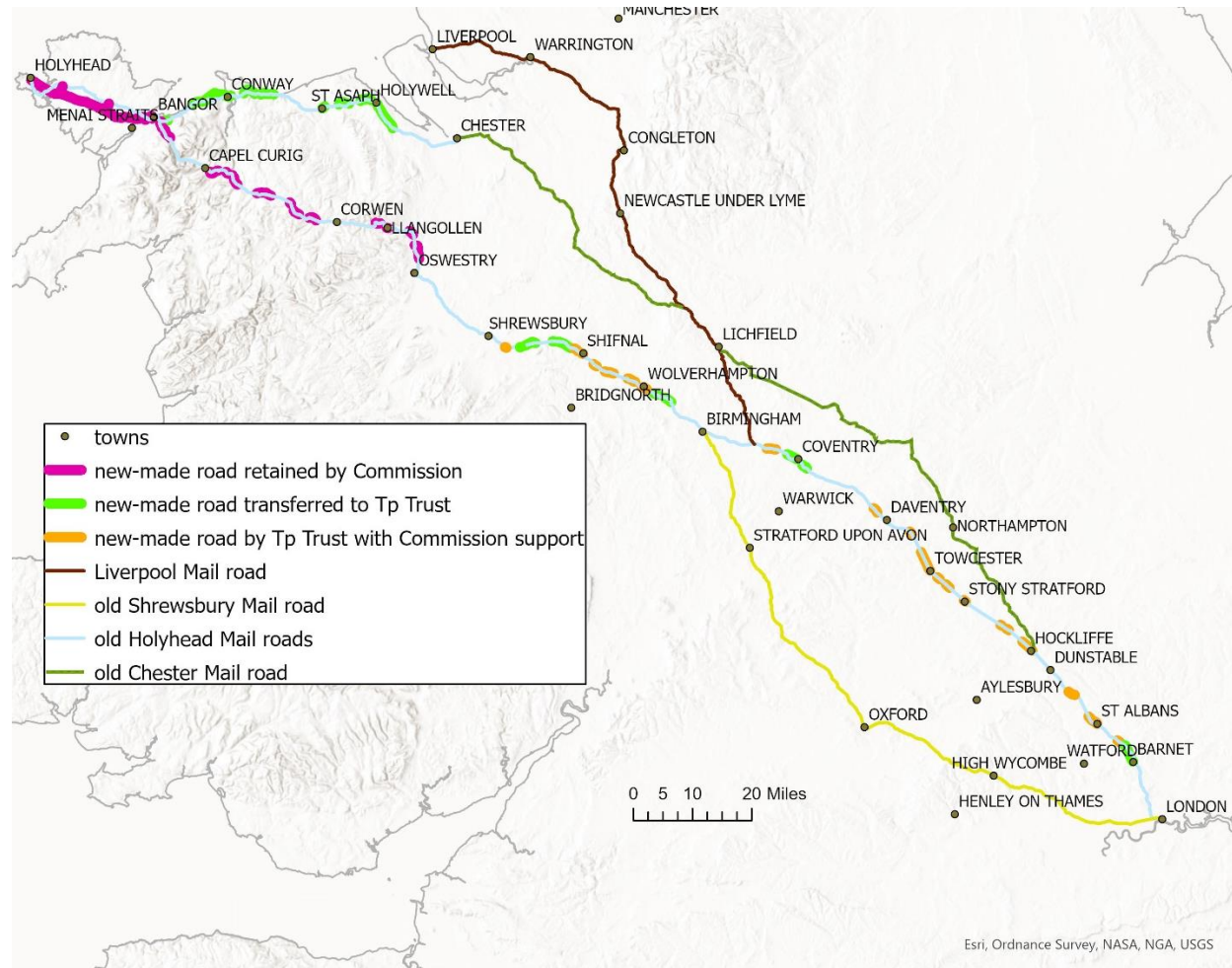
maintenance thereafter. But these trusts would be obliged to accept oversight, in which the whole of the road would be surveyed annually. If necessary, the Commission could force the trusts to raise tolls and pay for the required work and further improvements.

In a third type of intervention some turnpike trusts along the Holyhead Road were merely supported; this was less prescriptive but crucially left local trustees in control (Parnell 1833, p. 288). It involved surveillance by the Commission, and potentially critical advice by Telford and his deputy engineers. It also meant support in obtaining loans from the PWLB.

4. Accomplishments of the Holyhead Road Commission

Figure 1 maps new sections of road that were eventually built under the three categories of intervention. They went from London through Birmingham ending in Holyhead and the branch from Chester to Bangor. The first type, roads retained by the Commission, are thick purple lines. The second, roads improved by the Commission and then transferred to trusts, are thick green. The third, where trusts along the English section were supported by the Commission, are thick orange. Thin lines identify other Mail roads to Chester and Liverpool which could potentially be used for the Irish Mail and were totally managed by turnpike trusts.

Figure 1. Classification of improvements made directly and indirectly by the Holyhead Roads Commission.



Sources: created by authors using a GIS version of John Cary's map of the 1820s with the 1st Series Ordnance Survey (OS) map.

Following the first type of intervention, improvements on the Welsh Section of the Holyhead Road required £150k over 106 miles of road, of which 52 miles was on a new-made line (purple in Figure 1); these were directly funded by the Government as grants (BPP 1831)¹³. Building the suspension bridges over the hazardous waters of the Menai Straits and the Conway estuary required a loan of £333k which was to be repaid from the bridge tolls. By 1826 Telford

¹³ Grants of £339k from Parliament not to be repaid, referred to in BPP1830, include the Irish Roads and the Harbours

was reporting that all the high priority new sections had been completed. Where the old road had been only 12 feet wide in places, the new road was 24 to 30 feet wide and gradients were no more than 1 in 30, rather than being up to 1 in 8 as before. Between the new sections, the highway had been upgraded so the entire route had good foundations with broken stone as the running surface and adequate drains to carry away surface water. The project was kept to budget with a few exceptions. The technically challenging Menai bridge suffered significant over-runs and the new road across Anglesey required an additional £10k in 1832 (Guldi 2012).

The second type of intervention, where the Commission held temporary authority, led to 22 miles of new alignments on the Chester to Bangor Road along the North Wales coast. The new road was completed to the same high standard at a cost of £53k in Government grants (BPP 1831, p. 21). Eleven sections of the road through the English Midlands had been identified as needing essential improvements by Telford. These received public funding of £44k through the Commission and a further £83k from other loans (BPP 1831, p. 16). The shorter sections had been speedily dealt with under direct supervision by Telford. The larger projects near Barnet, Coventry and Wolverhampton were completed by 1826. Summing over the first and second types of intervention, the Holyhead Commission received £203k in grants and £127k in repayable loans for road construction, which are not insignificant sums. For comparison, total toll revenues for all turnpike trusts were £1,034k in 1821 (BPP 1840).

There were also changes resulting from the third or “supporting” intervention on the other English sections of the Road. The annual surveys by Telford and his assistants were forthright in naming and shaming poor surveyors and bad practice. Several trusts had the

confidence to undertake independent improvements. They reduced hills, filled valleys, and widened carriageways. Some followed the alternative methods recommended by McAdam.

Positive, but varied, impacts followed from the interventions made by the Holyhead Commission. Communications with Ireland were significantly improved. The schedule for the Holyhead Mail from London was cut from just over 41 to 28 hours, allowing the Mail packet to sail earlier for Dublin. Stagecoaches ran regular high-speed services, now performing the 110-mile journey from London to Birmingham in 11.5 hours rather than 18. But the travel and trade flows on the Welsh section were not particularly large. Only two regular stagecoach services were established while a string of others ran intermittently and then failed¹⁴. There was a notable increase in lime and coal traffic, as demonstrated by the following case. In Nov 1821, before the Road was fully made, 245 carts and 52 wagons carrying coal had passed through Welsh toll gates, which is approximately 300 to 500 horses (BPP 1822, p. 14). In all of 1830, 22,206 horses pulled coal carts and wagons through the same gates (BPP, 1831/2 p. 581).

5. New Roads built by turnpike trusts

The new Holyhead Road was celebrated as a national achievement and an example of what could be done by systematic application of the latest engineering principles. However, as detailed in this section, exclusively focusing on the Holyhead Road obscures the increase in new roads made by turnpike trusts in the early 19th century.

The role of turnpike trusts expanded in the wake of the formation the “Select Committee on the Turnpike Roads & Highways”. This Committee issued reports in 1819 and

¹⁴ Annual Reports of the Commission accounts Tables from BPP (1824) to BPP (1840)

1823 after taking evidence from stagecoach operators, the Post Office, and the Board of Agriculture (Webb and Webb, 1913 p. 172). It highlighted failures of road management and poor maintenance by surveyors in some turnpike trusts. However, this Committee favored “leaving generally the direction of the affairs of the different turnpike trusts in the hands of their respective Commissioners (Trustees), whose experience, character and interest, afford the best pledges of ability, attention and economy” (BPP 1819, p343). How did turnpike trusts respond to this direction, especially concerning the making of new roads rather than improving old ones? Making a new road generally involved constructing the highway on a new alignment across land not previously designated for such. The cost was significantly greater and would require more financing and technical skill than had hitherto been necessary for trusts.

We examine several sources to quantify new roads made by turnpike trusts. One group includes the titles of all Parliamentary Acts, which created the individual turnpike trusts.¹⁵ Textual analysis of these titles identifies when new roads were intended to be built. Acts distinguish three main categories: (1) a diversion was a new loop out of the existing line, replacing an old section; (2) a branch was a new line from a point on the original turnpike to a new terminus; (3) a new road would be sought for a totally new line between terminals. Between 1750 and 1835 there were 337 Acts that mentioned making a new road or extension. Most such acts were in the 1820s and 30s. The time-series is shown in the online appendix.

A second group of sources are historical maps for which we have created GIS versions for (i) the turnpike network, (ii) all main roads shown on detailed (generally inch to a mile)

¹⁵ A full list of Turnpike Acts after 1700 was obtained from the Parliamentary Archive. See Bogart and Richardson (2011).

maps of individual English & Welsh Counties from the 1770s to 1790s, (iii) all main roads on a national map published by John Cary c.1825. These are georeferenced against the 1st Series Ordnance Survey (OS) map for the whole country c.1850. For some southern counties of England, the OS draft surveys of c.1810 provide another reference point for change. The sources are detailed further in the online appendix.

Comparison of the GIS version of John Cary's map of the 1820s with the OS map of the 1850s, confirms the new lines of road authorized by turnpike Acts, our first source. Some new roads incorporated sections of older paths or highways – only the parts on new alignments have been mapped or counted as “new” mileage. Also comparisons of the Cary map with the earlier County and draft OS maps reveal many more sections of new road than were specified in the wording of Turnpike Acts. These were diversions from the alignment of roads managed by existing turnpike trusts. Some of these were associated with other new infrastructures, such as bridges or canals, and others with changes in land use. However, most were smooth deviations around impediments such as sharp junctions, meandering paths, or steep inclines.

Our new, comprehensive analysis reveals that between 1750 and 1838, there were 4,000 miles of new-made road and diversions on new alignments. They formed a significant part of the turnpike network that had grown to 23,000 miles of road. In the period after 1810, turnpike trusts had independently created around 2,650 miles; 29 times more than the 92 miles made by the Holyhead Road Commission. Table 1 summarizes the relative changes in total turnpike miles over time, along with diversions and new-made turnpike roads. Most total mileage came under trusts between 1750 and 1810 (row 1). By comparison, 66% of new road

mileage was laid during the three decades following 1810 (row 2). By 1838, 17% of the turnpike network had been built as diversions or new-made roads.

Table 1; Changes in total turnpike mileage, new roads, and dis-turnpiking relative to all Highway mileage

miles	1750	1770	1790	1810	1830	1838
(1) Turnpike total	3,921	15,613	17,871	20,619	22,840	22,887
(2) Diversions and new-made Turnpike*	74	188	375	1,339	3,596	3,991
(3) Dis-turnpiked, returned to parish*	7	46	211	652	2,259	2,829
(4) All highways (parish & turnpike roads) **	123,742	123,856	124,043	125,007	127,264	127,659

* This cumulative mileage is estimated from comparison of GIS mapping of turnpikes in 1750 and 1838; only roads and footpaths through public space on the 1850 OS map are included. A further 254 miles of disturnpiked roads were no longer public routes; 69 miles of these had been enclosed in parks and gardens. 78 miles of new made road that was dis-turnpiked before 1838 is assigned here.

** This Cumulative mileage starts from Table 11 of BPP1840 Appendix for 1838 mileage of non-turnpike highways for wheeled vehicles; estimated as 104,772 miles. Combined mileage estimated assuming that all 1838 parish roads existed in 1680 and the only new roads were built by turnpike trusts, so 123,333 miles of parish road in 1680.

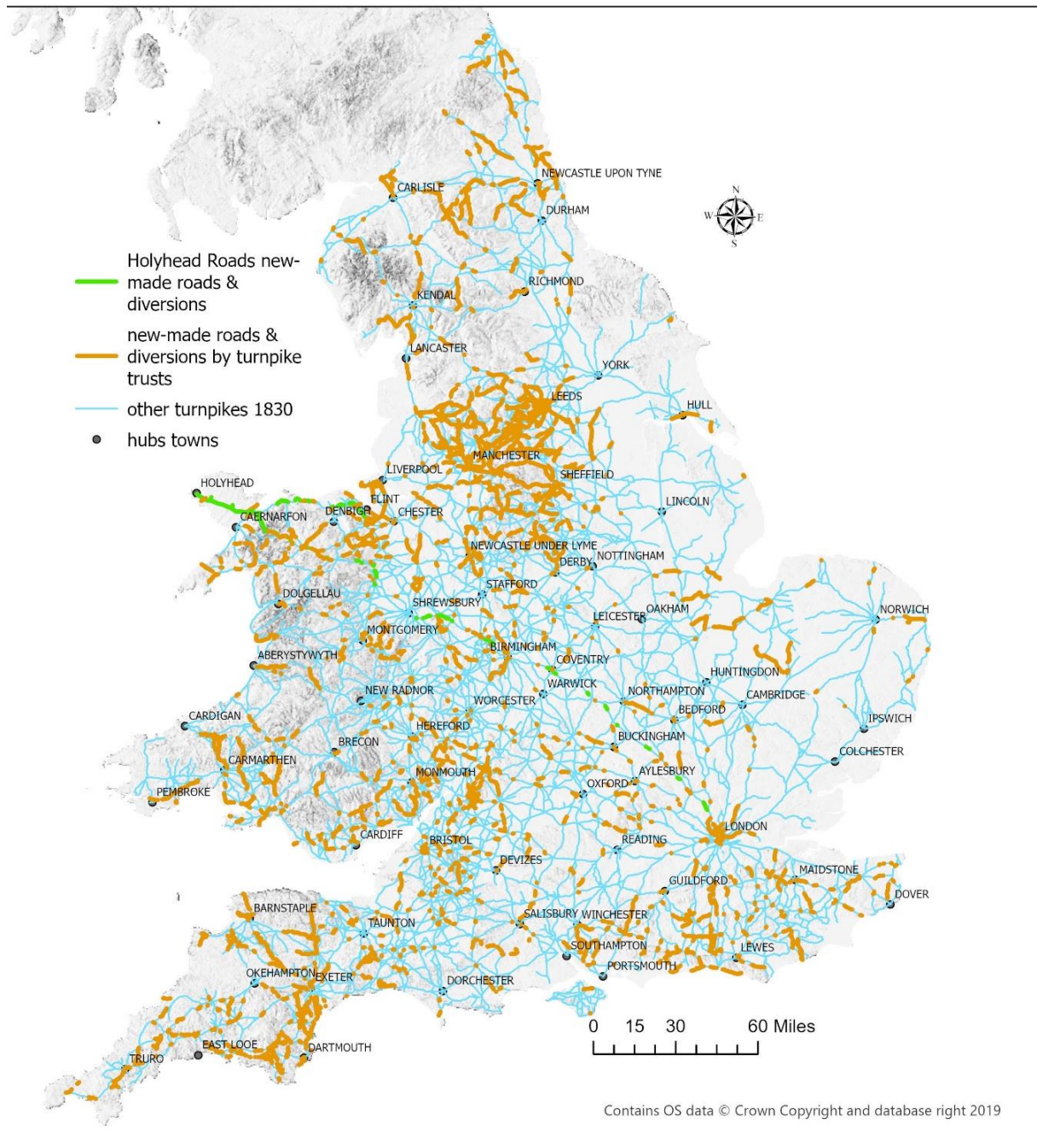
We also found that as trusts built new roads, they relinquished management of older ones, which reverted to the parish authorities. Row 3 in Table 1 details the significant amount of 'dis-turnpiking,' which took place. Row 4 reports total mileage of all highways under either parish or turnpike control to further illustrate the magnitude. It is possible that through dis-turnpiking trusts avoided the expense of maintaining redundant roads and adjusted their local network to where traffic generated more revenue.

Their economic logic is illustrated in Figure 2, which maps new made sections of turnpike road in orange and all other turnpike roads in blue in 1838. The Holyhead Road is shown in green for comparison. Town names on the map reveal that most new-made turnpike roads were built near hubs of the coaching network. Moreover, they were concentrated in regions where local economies were growing. For example, in South Wales and Durham where

mining was increasing, and along the South coast, where resorts provided recreational and leisure outlets for the newly affluent. The greatest concentrations were in the northwestern manufacturing regions of Lancashire and West Yorkshire, particularly between the two large inland towns of Manchester and Leeds (see the online appendix for a detailed map).

The implication is that new turnpike roads were generally built where traffic was growing or expected to grow. The resulting toll revenues helped to pay for new roads directly and indirectly through expanded borrowing. Tables annexed to Reports by two Committees (BPP 1821 & BPP 1840) show the mortgage debt for each trust and the dates when these loans were taken out. Many trusts building new roads saw increased debt. For instance, the nine trusts building roads near industrial Leeds had debts totaling more than £150k. The longest of these, the 18 miles of the Leeds to Whitehall trust, had an outstanding debt of £65k from a loan in 1806 when it was created. In total for all of England and Wales, turnpike debt increased from £4.4 million in 1820 to £7.3 million in 1840, an increase of 66% (see Bogart 2019).

Figure 2; *New roads constructed between 1800 and 1838*



Sources: Authors calculations. See appendix for methods and sources.

Trusts' borrowings were facilitated by several factors. Britain's credit markets became more integrated and intermediaries, like banks, expanded in number and in risk-taking (see Neal 2000, Brunt 2006, Trew 2010). In this context, when interest rates in the London market fell, as

in 1823 and 1824, trusts were able to capitalize and borrow more. It is also likely that the requirement for regular reporting of common financial statements to Parliament helped trusts tap into growing capital markets. This was introduced steadily from 1821 with reports through County Clerks and from 1834 very detailed tables were published in parliamentary reports. Mandatory financial reporting gave lenders information, which instilled confidence and should have encouraged more lending to trusts.

The Government funded Public Works Loan Board (PWLB) was another boost to turnpike road making. From a list of all PWLB loans between 1819 and 1832, £384k have been linked to 101 individual trusts (see Bogart 2019). The total amount of loans to trusts we identify as making new roads was £352k or 91.6% of all PWLB loans. While providing help, the PWLB's role should not be overstated. The trusts which got PWLB loans made 706 miles of new road, which is only 16.9% of all new road made by trusts by 1838.¹⁶

To conclude this section, McAdam's techniques also helped trusts make new roads. McAdam and associates were employed by many trusts as surveyors across the country, including for some of the largest (Bristol in 1816, Exeter 1820, Bath and The Metropolis Roads in 1826). Macadam's methods promised to reduce the cost and thus could spur building. As suggestive evidence, the online appendix shows that the number of trusts hiring McAdam surveyors surged just before the wave of acts for new turnpike roads in the mid-1820s.

6. The quality of roads

¹⁶ The denominator (new miles) in this calculation is 4151, larger than in table 1. It includes some roads that Acts said were new, but were excluded in table 1 as sections of existing parish road incorporated into the turnpike.

Turnpike trusts built many new roads in the early 19th century, but we don't know about the quality of most, or in comparison to the Holyhead Road. Key evidence concerning road quality comes from a survey of trusts in 1838 (The State of the Roads Report, BPP 1840, Appendix). One question asked the trusts to self-assess the condition of their roads. Although it is like asking students to mark their own exams, the responses were open to public scrutiny and hence had to be plausible. Nearly all trusts responded to the survey and this question. Of special interest are trusts supported through or managed by the Holyhead Commission.

We adopt a six-point scoring system for words and phrases used in the responses to rank quality. At the extremes of this scale terms such as execrable or very bad mark the road quality as 1 - very poor, whereas excellent or the finest, mark it as 6 - very good. A mark of 4—acceptable, is given for terms such as tolerable, adequate, and good. We apply this score to the 96% of turnpike mileage in the 1838 report. Of the total, 62% was characterized as “Good” or “Very good” (score 5 or 6) and only 7% was classified as “Bad” or “very bad” (score 2 or 1). The remainder, 27%, was “Not Good” or “Acceptable” (score 3 or 4). Thus, we find that most turnpike roads were of good quality, based on the standards of the time.

Table 2 gives a summary of quality scores according to levels of Government intervention. The Holyhead Road (row 1) and those under trusts but supervised or assisted by the Holyhead Commission (row 2) had a higher mean quality score compared with independent trusts (row 3). The mean difference (5 vs. 4.4) is statistically significant, based on a two-sample t-test with unequal variances. Finding that Holyhead Commission roads were of the highest quality is particularly impressive since a comparison with Telford's 1814 report shows they were previously in a very poor condition compared with adjoining roads. A map in the Online

Appendix illustrates the dramatic quality upgrade on the Holyhead Road using Telford's evaluation in 1814 and the quality scores in 1838. Another map in the online appendix illustrates where turnpike roads were poor, average, or better throughout England and Wales.

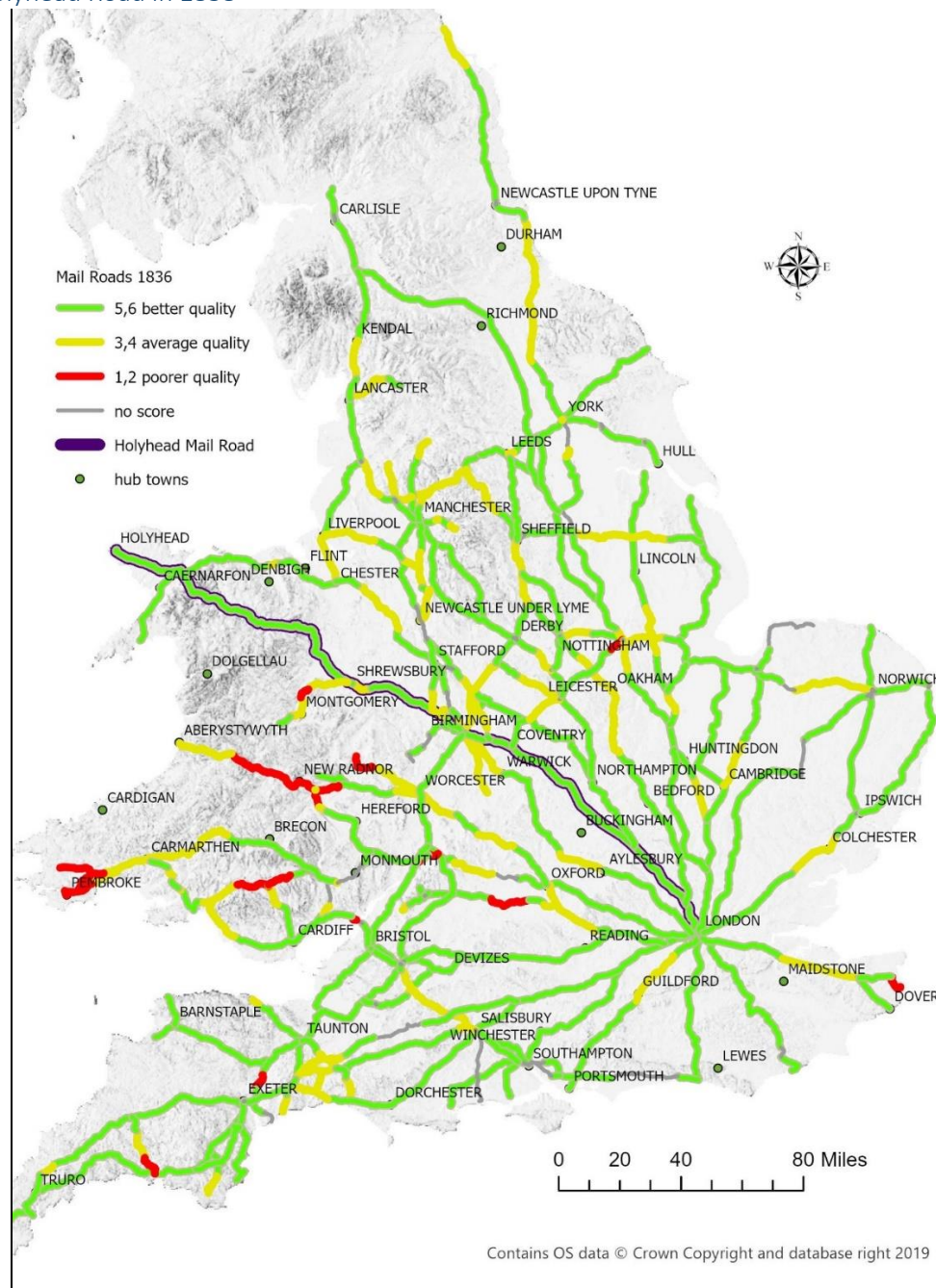
Table 2; Road Quality scores in 1838 for various levels of Government intervention and assistance

	Mean quality score	Std. dev. score	Min. score	Max. score	Number of trusts
(1) Holyhead Commission new road	5				
(2) Improved road by Holyhead Commission, transfer to Trust	5	0.5	4	6	8
(3) No Commission assistance— independent turnpike trust	4.4	1.2	1	6	1,058

Sources: authors' calculations. See Data appendix for details.

Figure 3 shows quality scores on roads used by Mail coaches, which are listed for 1836 by Bates (1969). Nearly all Mail routes in England and Wales were maintained by turnpike trusts and 27% of total turnpike mileage was used by Mail coaches. Figure 3 illustrates that long, unbroken sections of the Mail routes radiating from London were rated better than average as far as Dorchester, Poole, Brighton and Leicester. We find that 72% of Mail routes had a quality score of 5 or 6. Thus, in general Mail roads administered by turnpike trusts were closer to the high standard on the Holyhead Mail Road than to the overall turnpike average.

Figure 3; Mail coach routes in 1836 showing quality for the corresponding turnpike roads and the London-Holyhead Road in 1838



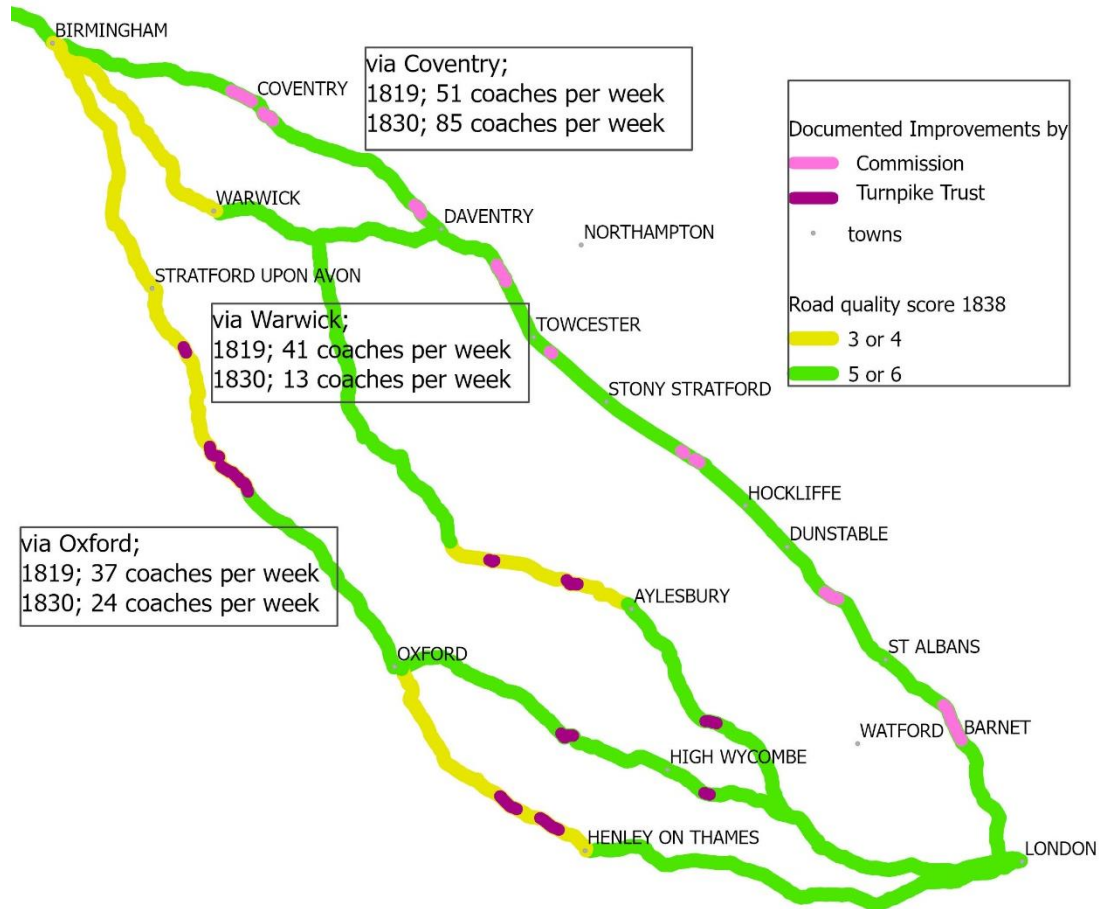
Sources: Mail routes are identified in Bates (1969) and mapped by authors. The Holyhead Road is outlined.

The poorly scoring Mail routes in Central and South Wales are of special interest as they provide a revealing comparison for the Welsh sections of the Holyhead Road. Those sections near the extremities of the longer routes ran through mountainous, and economically poor

areas to places such as Aberystwyth or Pembroke. Their lower quality score suggests that in low traffic areas, turnpike trusts yielded inferior road quality to the Holyhead Road.

Data on advertised stagecoach services further illustrate the relative quality advantage of the Holyhead Road. Here we draw on a study which characterizes stagecoach traffic across England and Wales in 1819 and 1830 (see Rosevear et al. 2019). The three main routes between London and Birmingham are shown in Figure 4. The route through Coventry was part of the Holyhead Road. Those through Oxford and Warwick were managed by turnpike trusts. In 1819 prior to Holyhead Road improvements there were 51 weekly coach services to Birmingham via Coventry and 78 via Oxford and Warwick combined. In 1830, there were 85 weekly coaches via Coventry, compared to only 37 via Oxford and Warwick. The superiority of the whole Coventry route, selected by Telford and improved through the direction of the Holyhead Commission, is revealed in the high quality of this route in the 1838 survey. The other two routes by contrast had significant sections of “average” quality, despite some improvements carried out by the independent trusts with less Government involvement. In this case, consistent quality pulled existing services away from less consistently managed routes.

Figure 4; Stage coach traffic from London to Birmingham, before and after improvements on the English sections of the Holyhead Road with road quality data from the 1838 survey.



Sources: Services in 1819 from Pigot Directory; in 1830 from Robson Directories. See Rosevear et al. (2019) for more details on these sources.

Notes: The Government funded/assisted sections were via Coventry.

7. Wider powers for a Roads Commission denied

The success of the Holyhead Road Commission in supervising improvement along a whole Mail route prompted calls to replicate its accomplishments to directly improve other major Mail Roads. In 1827, the Commission was given powers under a new Act to survey and recommend improvements on the Liverpool Mail Road. This branched off the London Holyhead Road at Stonebridge, between Coventry and Birmingham (see Figure 1). Telford made proposals for a better line of road with a new bridge over the Mersey at Runcorn (total estimated cost £173k to reduce the Mail journey by 2.5 hours, BPP 1826/7). Telford completed a survey along this route

(BPP 1829) identifying poor sections but praising improvements made by the Darlaston Turnpike Trust under a surveyor whom Telford had recommended. However, no new funds were granted to the Commission for the Liverpool Road and there is no map evidence suggesting new alignments were constructed.

In 1830 a 'Northern Roads Bill' was put before Parliament replicating the Commission's previous work by supervising improvement to the Edinburgh Mail Road through York and the West Coast Mail Road from London to Portpatrick. Opponents of the Bill complained it was a "Scottish Job", improving mainly roads to Scotland with English taxes. Also it was said the Edinburgh Mail was already faster than the Holyhead Mail and that the eventual cost would be substantial¹⁷. Amidst a storm of opposition, the Bill failed (Webb and Webb 1913, p 179). Dyos and Aldcroft (1969 p77) further suggest its failure was due to enthusiasm for steam-powered railways following the opening of the first line between Liverpool and Manchester in 1830.

More broadly, Governments were achieving their desired outcomes working with existing turnpike trusts, not replacing them. It is safely assumed all public authorities of the time wanted improved roads through their territory to facilitate rapid deployment of the military in the face of invasion or civil strife.¹⁸ Our analysis in section 5 suggests these goals were generally achieved through better regulation of trusts, like mandatory financial reporting, which promoted building. Also, Governments might have been passive in seeing that turnpike trust responses to meet civil communication, often coincided with pressing military needs. For example, from 1800 to 1838, 861 miles of new turnpike road were created in the 10-mile wide

17 House of Commons Debates 3rd June 1830, Vol 24. See <https://api.parliament.uk/historic-hansard/commons/1830/jun/03/northern-roads-bill>

¹⁸ It can also be the case that good roads facilitate opposition to regimes (see Aidt et al. 2022).

coastal strip along the Channel Coast from the naval base at Plymouth, through the ports of Portsmouth and Dover to Chatham. A similar stretch of the less vulnerable North Sea coast from the Thames to the Tees had only 60 miles of new made turnpike added. This surge in turnpike building towards the Channel coast was responding to demand for travel to the new seaside resorts from Torbay to Brighton and Broadstairs (Rosevear et al. 2019). The Government did not have to replicate the Commission to speed military access when the tolls paid by commercial traffic on turnpikes could finance the road improvement to politically vulnerable coastal and urban areas. There is one exception where the Government directly financed a new road of military significance towards the Channel coast. It was a seven-mile service road behind the so-called Royal Military Canal.

There is also one documented case where the PWLB helped to develop roads of military value. The biggest PWLB loan (£16.5k) was for a joint project involving the Plymouth Eastern, Ashburton and Exeter trusts. Its surveyor justified the project as an “important line of communication between the metropolis and one of the grand naval arsenals of the kingdom.” Determining whether other PWLB loans went to roads of military value awaits future research.

8. Discussion and conclusions

In this paper, we study how various actors sponsored, financed, and technically developed better roads in England and Wales during the early 19th century. The relative contributions of Government bodies and turnpike trusts are discussed in the previous literature, but they have not been well established with respect to new road making and relative quality. We first document the accomplishments of the Government sponsored Holyhead Road Commission. Its principal project, the Mail Road serving Ireland, was a

demonstration of the best engineering practice led by Telford. However, the Commission made less than 100 miles of new road and its financing and supervisory model was not replicated on most other roads in the 1820s and 1830s. Second, we document that non-profit turnpike trusts were responsible for building 4,000 miles of new road, much of it in a similar period to the Holyhead Road. Thus, on a directly comparable basis, trusts built thirty times the mileage of the Government funded Holyhead Commission between 1810 and 1838. As documented by historical GIS mapping, many new turnpike roads were in industrializing and coastal areas.

How did trusts manage to build so many more new roads? Firstly, they embraced the best practice of pragmatic, professional surveyors such as McAdam instead of relying on local surveyors. Secondly, they developed a capacity to borrow on a larger scale. Thirdly they capitalized on and responded to the growth of regional traffic from both the industrial and leisure economies of the post Napoleonic War period.

Our third contribution is to assess the relative qualities of roads using a survey from 1838. The 106 miles of the Shrewsbury to Holyhead Road, comprising both new alignments and intervening sections of improved road, is found to have a high score for quality. Yet, more than 14,000 miles of equivalent improved road under turnpike trust management also had a similar high quality score. As the Mail routes illustrate, long stretches of good quality turnpike radiated from London to places of commercial importance such as Bristol, Derby, Southampton, and Brighton. However, sections of lower quality turnpike road interrupted the mail journeys more frequently the further one travelled from the economic heart of the country.

Financial and political economy considerations help to explain these outcomes. The high quality of the Holyhead Road could not be financed by the toll income arising from the low

traffic of the area, and therefore it needed additional financing with public money. In the absence of financial targets, there were no criteria against which to assess the engineering options and Telford was free to build the best possible road with current technology. In contrast the turnpike trusts were obliged to match investment to potential future toll income. Thus, some trusts were constrained in the quality they could provide. One intervention by the Government was to require turnpike tolls to be increased to fund improvements on the whole Holyhead Road, including the busy English sections, setting a precedent for others. Trusts had been exposed to local pressure keeping tolls low and granting exceptions on some traffic, effectively lowering their ability to make interest payments, curtailing their borrowing powers, and reducing resources for improvements. The tendency to keep tolls low would continue for some turnpikes in 1830s, particularly those away from the great arterial routes.

The Holyhead Road Commission was successful in making a good quality road, so why were its powers not extended in England and Wales? The standard explanation is that conservative, landowner MPs did not want the Government Commission model to be replicated along all nationally important roads. Parliament was already baulking at the expenses of the Holyhead Road and it's even more costly associated harbors and bridges. Furthermore, Government administrative capacity was still under-developed despite its increased fiscal capacity after the Napoleonic Wars. We think it also likely that the Government was effectively working in partnership with the existing turnpike trusts and influenced them to minimize the negative aspects of their localism, underpricing, under-skilled staff, and lack of strategic planning. With targeted monitoring, reporting as regulation and users such as the Post Office to provide pressure, the turnpike trusts demonstrated that they were a force for improvement

that responded to both local, regional and to some extent national needs. Roads of military value often had commercial potential and on this basis the turnpike model continued to provide a mechanism that matched adequate, not necessarily excellent, road infrastructure to economic and political demand. When interests were not aligned, the Government could build strategic roads directly or use the Public Works Loan Board to encourage trusts to do so.

The generally high quality of the turnpike road network in 1838 points to the success of what can be considered an early Public-Private not-for-profit Partnership (PPNP). Prior to 1810 the existing turnpike trusts had effectively been private, not-for-profit organizations which had dealt with the acute, local problems of poor quality main roads with very little Government oversight. By the 1820s, the direct and indirect interventions by Government had strengthened the public component requiring better governance. Financial reporting became mandatory and open, increasing the confidence of investors, and exposing any ill-judged financial strategies. Increased scrutiny of management and publicizing best practice promoted both employment of skilled surveyors and good technology on a national scale. The Loan Board provided supplementary finance, likely in scenarios where the toll income could not generate the investment desired by broader political and social interests. This partnership approach resulted in a sustained improvement in existing roads and the building of new roads to accommodate economic growth before railways. The partnership was also applied in other infrastructures, for example lighthouses, bridges, and harbors.

England's PPNP model may not have been easily transferable to other economies during the early 19th century. Its success depended on reasonably high road traffic to generate a steady rising income without burdening individual travelers with high tolls. England may have

been unique in having the critical mass of urban manufacturing and leisure needs. Its success also depended on a level of confidence between central government and the turnpike trustees that they could improve roads without excessive expense, within a stable legal and financial framework. These conditions were often absent elsewhere during the early 19th century. Perhaps for that reason, central governments elsewhere played a more direct role, as with the royal highways of Spain and France. Scotland and Ireland provide interesting cases because they generally had lower traffic levels than England and Wales. Yet in these economies, the turnpike model was applied, most likely because they operated under the UK parliament and Common Law legal system. The impacts of alternative historical structures and the role of traffic potential deserve more research.

We conclude by noting that elements of England's PPNP model are used in infrastructure today. For example, Zwalf (2022) discusses a related application to Australia's highways. The historical conditions for PPNP success (moderate traffic density, along with a stable legal and financial framework) are present in many economies, including those in the middle income group (see Engel et al. 2020). Our historical study shows that PPNPs can work in developing good quality roads and at reasonable cost. It also suggests that PPNPs could be efficacious where Governments have proven reluctant to directly sponsor and finance infrastructure.

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Data availability statement:

The data and methods underlying this article are available in the article and in its online supplementary material.

Appendix:

Official Papers

Parliamentary Papers on Committee Reports and 19th century Turnpike Acts were downloaded from The Chadwyck-Healey ProQuest web-based Collection. Earlier turnpike Acts were from the private collection of copies of original published Acts held by the authors and from a sample set of Acts obtained as pdfs from the House of Commons Library.

The mapping

Road maps were generated from earlier mapping of turnpike roads in ARC GIS Pro. The main shapefile was generated using a georeferenced version of the First series OS map ca 1850, as the base onto which the polylines representing the line of turnpike roads were drawn individually using visual inspection of 18th and 19th century maps. The principal source was Cary's map of England and Wales – sheets 1 to 62, printed at 2 miles to the inch – digital images from the Cambridge University Collection – originally georeferenced and plotted in ARC Map by Max Satchell. The polylines were assigned to particular turnpike trusts and dates of the relevant Act were added based on the original Acts mentioned above.

A separate shapefile was created for the Cary mapping of all main roads (post roads, turnpikes and “other main roads”) with some of the “other” roads added to aid triangulation of improvements.

A third layer of digital mapping was generated as a single shapefile using Bryant's County maps from the 1830s for a number of southern counties (all classes of road on these maps were included – turnpike and non-turnpike; Hertfordshire, Buckinghamshire, Oxfordshire, Gloucestershire).

A fourth layer of digital mapping for the late 18th century was generated as a number of shapefiles from nominated cartographers for all individual northern counties and a few southern counties; all “turnpike” roads and non-turnpike roads were also mapped (listed in Appendix Table 1). Visual inspection of the digitized county map was used to identify the lines of roads for remaining counties of Wales and Southern England. There are no good quality on-line 18th century maps available for four, small southern counties (Cambridgeshire, Huntingdonshire, Middlesex, Rutland), so new lines could not be confirmed for these.

Reference was made to the OS draft map sheets on Wikimedia Commons where available (many parts of Southern England and Wales ca 1810/20.).

Each map layer was continuously refined while working on the other layers (i.e. uncertainties resolved by cross referencing and modification of all layers when confirmed). The subsidiary roads were particularly important since these provided well defined junctions which could be triangulated to follow changes in the line of the main roads. This was further enhanced by creating shapefiles of well-defined point features; shapefiles of “place points” (e.g. parish churches or road side inns), bridges, ferries and mills (from the OS and 18th cent maps), tollhouses (from turnpikes.org.uk web site -by A Rosevear). These were generally placed on the OS First series base map.

In some areas, over the period of the map series, the cross roads had been altered by Parliamentary Enclosures and large land drainage schemes. These stand out as rectilinear roads on the OS base map. So far as possible the roads drawn on the digital maps followed the profile on the old county maps, picking up old residual features such as sections of footpath and field boundaries where appropriate.

However, where the rectilinear roads on the OS map broadly followed the more sinuous line on the old map (e.g. over featureless open moor), the former was adopted as the default option when only the start and terminus of the old road could be unambiguously specified.

Appendix Table 1: Main roads on these 18th century County maps digitized;.

County	Cartographer	date publ	date survey	digital version or publication
Bedfordshire	Jefferys, Thomas	1771	1765	https://maps.princeton.edu/?utf8=%E2%9C%99
Berkshire	Rocque, John	1760		https://biblio.unibe.ch/web-apps/maps/zoom
Buckinghamshire	Jefferys, Thomas	1770	1766-8	http://digitalarchive.mcmaster.ca/islandora/
Cheshire	Burdett & Faden	1794		http://digitalarchive.mcmaster.ca/islandora/
Cornwall	Martyn, Thomas	1784		http://digitalarchive.mcmaster.ca/islandora/
Cumberland	Donald	1774	1770-71	2nd ed. 1802; http://digitalarchive.mcmaster.ca/islandora/
Derbyshire	Burdett, Peter	1767	1762-6	https://maps.nls.uk/joins/10424.html
Devon	Donn, Benjamin	1765		http://digitalarchive.mcmaster.ca/islandora/
Dorset	Faden, William	1796		http://digitalarchive.mcmaster.ca/islandora/
Durham	Armstrong, Andrew & Jefferys, Thomas	1768		http://digitalarchive.mcmaster.ca/islandora/
Essex	Chapman & Andre	1777	1772-4	http://digitalarchive.mcmaster.ca/islandora/
Gloucestershire	Taylor, Isaac	1775		Gloucestershire by Isaac Taylor
Hampshire	Milne	1791		https://www.oldhampshiremapped.org.uk/h
Herefordshire	Taylor & Faden	1786		http://digitalarchive.mcmaster.ca/islandora/
Hertfordshire	Dury & Andrews	1766		https://www.ub.unibe.ch/research/special_c
Kent	Dury & Andrews	1769		https://www.ub.unibe.ch/research/special_c
Lancashire	Yates, William	1786		http://digitalarchive.mcmaster.ca/islandora/
Leicestershire	Prior, John	1777		Leicestershire in 1777; John Prior's map edited by
Lincolnshire	Armstrong, Andrew	1779		http://digitalarchive.mcmaster.ca/islandora/
Norfolk	Milne & Faden, William	1797	1790-4	http://digitalarchive.mcmaster.ca/islandora/
Northamptonshire	Faden, Jefferys & Eyre	1791	reviewed at assizes 1775	http://digitalarchive.mcmaster.ca/islandora/
Northumberland	Armstrong, Andrew	1769		http://digitalarchive.mcmaster.ca/islandora/
Nottinghamshire	Chapman, John	1774		http://digitalarchive.mcmaster.ca/islandora/
Oxfordshire	Jefferys, Thomas	1769	1766-7	https://pictureoxon.com/frontend.php?action
Shropshire	Rocque, John	1752		http://digitalarchive.mcmaster.ca/islandora/
Somerset	Day & Masters	1782		http://digitalarchive.mcmaster.ca/islandora/
Staffordshire	Yates, William	1775	1769-1775	http://digitalarchive.mcmaster.ca/islandora/
Suffolk	Faden, William	1783		http://digitalarchive.mcmaster.ca/islandora/
Surrey	Lindley & Crosley	1793	1789-90	https://www.londonpicturearchive.org.uk/zo
Sussex	Gream & Faden	1795		http://digitalarchive.mcmaster.ca/islandora/
Warwickshire	Yates, William	1793	1787-9	http://digitalarchive.mcmaster.ca/islandora/
Westmoreland	Jefferys, Thomas	1770	1768	http://digitalarchive.mcmaster.ca/islandora/
Wiltshire	Andrews & Drury	1773		http://digitalarchive.mcmaster.ca/islandora/
Worcestershire	Taylor, Isaac	1772		http://digitalarchive.mcmaster.ca/islandora/

Yorkshire	Jefferys, Thomas	1775	1767-1770	http://digitalarchive.mcmaster.ca/islandora/
Glamorganshire	Yates, George	1799		https://www.peoplescollection.wales/items/
Monmouthshire	Snell, Robert	1785		https://www.flickr.com/photos/britishlibrary/
Six Counties of North Wales	Evans, John	1795		http://digitalarchive.mcmaster.ca/islandora/
Six Counties of South Wales	Bowen, Emanuel	1766		https://www.crouchrarebooks.com/maps/wa

Assigning New roads

In this analysis the aim was to identify sections of road that had been constructed along new alignments during the turnpike era. Although many pre-existing roads (here categorized as Ancient Roads) were adopted and improved by turnpike trusts it is not easy to identify where and when improvements such as widening, gradient reduction, surface improvement and better drainage were made since these do not change the line on the map at the available resolution (for the early maps 1 inch to the mile). However, it is possible to identify new lines of road by comparing mapping at two or more time points; importantly these new lines are likely to involve the most important changes in quality (they use the latest engineering methods) and required greater investment per mile to build than routine improvement of an existing line. In judging the relative importance of Government and local investment in roads, comparing roads built on new alignments provides a sound comparison of like with like.

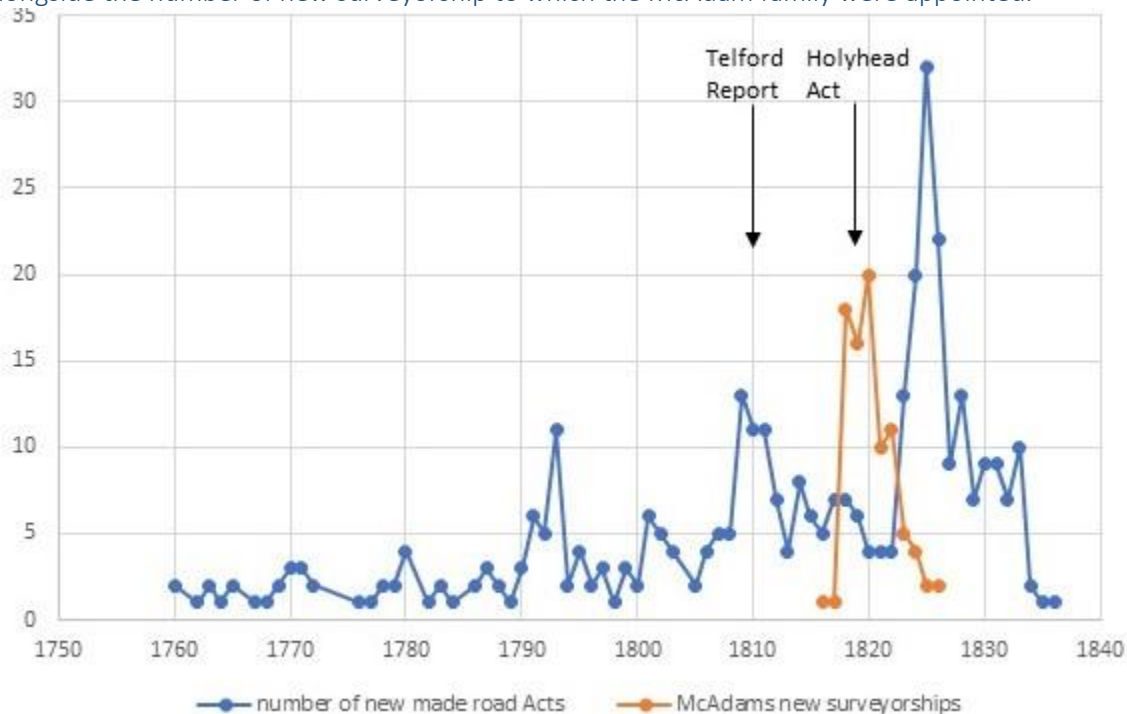
New lines were identified from two sources: the Turnpike Acts and comparative mapping.

Wording of Turnpike Acts; The use of the word “make” or “making” in the title or preamble to a turnpike Act was taken to indicate that the whole road, or a branch was to be constructed along a new alignment; “turning” occurs occasionally and was taken to indicate a diversion along a new path for part or end of an existing road. There were 380 potential candidates based on this, dating from 1729 to 1866: 377 up to 1836 relevant to this study.

We document that the term “making a road” or “making a new road” became more frequent in Acts. Between 1750 and 1799 there were 57 Acts that mentioned making a new road or a new extension to an existing turnpike road. Between 1800 and 1835 the number that involved new lines rose substantially with a further 280 such Acts (see Appendix Figure 1).

Peak years for Acts to build new roads, like 1825-27, were generally associated with low interest rates and higher trade (Bogart and Richardson 2011). Notably the Acts series does not show a clear link between new road making Acts and Telford’s first report in 1810 up to the passage of the Holyhead Act in 1819. However, examining the dates at which McAdam and his sons took up contracts as surveyors (Appendix Figure 1) does shed light on another channel. The McAdams were employed by many turnpike trusts in making improvements to existing lines of road and building new lines across the country. Macadam’s methods plausibly may have encouraged new road building as they promised to reduce operating costs.

Appendix Figure 1; Number of Turnpike Acts mentioning “new road making” in each year, plotted alongside the number of new surveyorships to which the McAdam family were appointed.



Source: See Assigning New roads in data appendix. For McAdam surveyors see Reader (1980).

Comparative matching on maps: The “new made” candidate turnpikes were classified in the shapefile. This allocation was done by the century in which the improvement was made based on the date of the relevant turnpike Act (coded N17 and N18 for pre and post 1800). Those sections of road financed through the Holyhead Road Commission were classified separately. With the relevant 18th century map visibly overlaying this turnpike layer, the validity of the assumption that “making or turning” identified a section of new line of road was checked. Ten Acts were excluded as not sufficiently “new” to qualify for the mileage calculations – these were either because in three cases the phrase was “making turnpike” and in the preamble it was clear that there was an existing road or in the others, there was an existing track on the 18th century map, albeit across moorland in 3 cases and along an old Roman Road in another. On some other roads there were sections where a portion of pre-existing (parish) road can be seen on an earlier map but these sections did not connect and did not constitute an “existing road between the named terminal towns”. In lowland England, a new road would inevitably come close to, or overlay some sections of existing parish lanes (which would be poor quality) whereas in northern Britain the lines of many new roads were totally separate from any previous lane or parish road. Where the new road followed the line of an old parish road it was classified separately for analysis.

A first iteration was made of new Diversions (deviations where a new section of improved road loops out of the main line for sufficient distance to be apparent on the scale of these maps). This used the Cary map (of the 1820s) – in many cases Cary showed a short distance of parallel main roads (i.e. the old and new line) and one was easily assigned to be “new”. To date these, reference was made to the wording of Acts (for stated improvements) or local history studies of individual turnpikes. A number had to be dated by estimation – by checking whether the roads shown by Cary were on pre-Cary maps (18th

century County maps) or post Cary maps (Bryant or the OS). Diversions made after Cary were identified by comparing Cary with the roads carrying milestones, tollhouses or labelled as “XX Turnpike Trust” on First Series OS maps. Pre-1800 diversions were identified as differences in line between the Cary map and the 18th century county maps. There were few printed Acts accessible to us for this period so identifying a date for the improvement is less certain and an estimated date was entered (but the analysis only requires knowing the century, which is clear). In some cases, it is assumed that the “improvement” occurred at or near the date of turnpiking (i.e. the trust made an improvement as soon as it was granted powers).

Cross referencing with maps revealed many more sections of new road than were specified in the wording of Turnpike Acts. These were new ‘diversions’ from the alignment of roads managed by existing turnpike trusts. Most diversions can be dated by reference to local studies and clauses in turnpike renewal Acts. Where a diversion was part of an Act post-1838 or could be dated from local studies it is not credited as an improvement made before 1838. Similarly, diversions made as the result of railway construction (from 1830) were not included. However, some diversions made after 1838 (e.g. by a Highways Board) may still be credited in the total mileage in the Table. Nevertheless, we believe this over-accounting is small since the parlous state of most trust finance meant that undocumented new road building was unlikely after 1838.

Our methodology will not identify “diversions” made before detailed county mapping ca 1775 so will underestimate those across open common and moor, e.g. by John Metcalf (Kellett 2009). Sections of new made turnpike running along ancient lines are omitted. We find that in 1838 there were a further 796 miles of road that were part of Acts for new made roads but were judged to run along the alignment of an existing parish road. We estimate a potential uncertainty on the post 1800 figures of about 100 miles. The reported new alignments total includes approximately 60 unconfirmed miles in Counties for which there are no good 18th century maps.

The Total Parish mileage for all English and Welsh counties was calculated from the Appendix tables in the questionnaire survey (BPP 1840). Mileages were calculated back from this by adding in those ancient roads that had been turnpiked- it is assumed that no new mileage had been created by the parishes. This will be an approximation since 1680 to 1840 spans a period of enclosures, drainage schemes and emparkment which did alter the line and number of roads in some parishes. In general, these decreased the length of parish roads by simplification and straightening but had much less impact on roads to be turnpiked. This means that the calculation of parish road mileage for the earlier dates will be underestimated in some areas but will not be significant nationally. The table adds new mileage made during each period and returns to the parish roads what was disturnpiked as a result of non-renewal of Acts or replacement of a road by a new section.

The fate of disturnpiked roads was determined by comparing the line traced from the 18th century map with the First Series OS base map. Where a line of road or footpath still existed on the OS base map it was assumed that the disturnpiked section had been returned to parish responsibility and was still a public road. This included roads that had been transferred to town Improvement Commissions (i.e. were now maintained by local taxation). All other sections of disturnpiked road were assumed to have become private. In most of these cases a road could no longer be traced on the OS map through fields, open ground or other infrastructure such as canals. In some cases the old road had been enclosed within a property boundary and was retained as a path or drive (e.g. the turnpike had been moved further away from a large house and the old road incorporated into an enclosed park)

Analysis of Loans for road building.

The size of the outstanding loan made to the trust by the Exchequer (i.e. PWLB) as reported by trust in the questionnaire sheets of PP1840 (for 1838) are summarized along with the year in which the loan was taken.

Analysis of Traffic on Holyhead Road

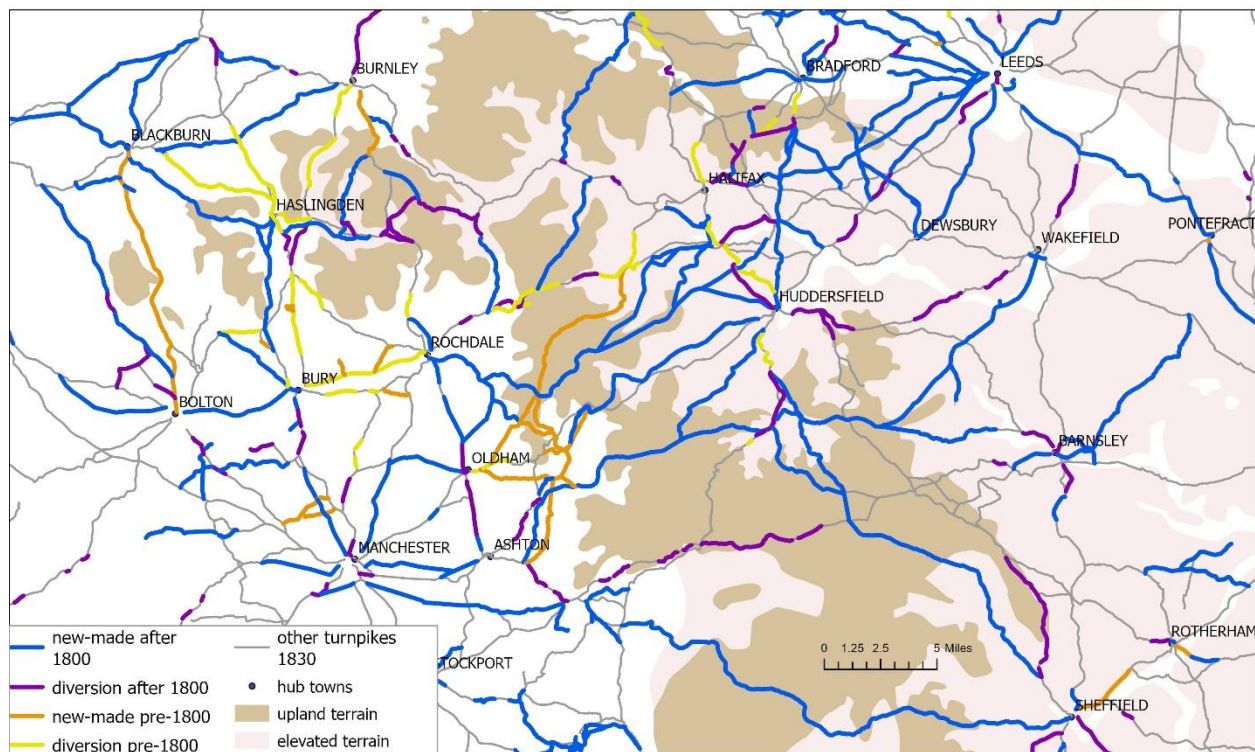
The series of reports associated with the creation and operation of the Holyhead Road Commission are listed in the study of industrial archaeology of the Holyhead Road in Wales by Quartermaine et al. (2003). The information given in the annual reports to the Holyhead Road Commission on income and number of vehicles passing through one of the gates" was used. Note the selected gate changed in 1817; there is uncertainty over which gates were chosen but they were probably on the mid-section near Corwen.

Illustration of road building in Lancashire and West Riding of Yorkshire

Appendix Figure 2 focuses on the relationship between new roads and the existing turnpike network stretching from Leeds to Manchester. This region grew rapidly in economic importance and population during the industrial revolution. It is bisected by the high Pennine hills with deep incised valleys so had a poor endowment of old roads suitable for wheeled transport. This combination of factors meant that the response to increased traffic was different from that in the intensively settled areas around London, where existing lines of road were normally upgraded.

The majority of new turnpike roads were constructed between 1800 and 1835, with a particularly large mileage running westwards from Leeds and north-eastwards from Manchester. There were several new roads across the Pennines uplands between the textile towns of Halifax, Elland, and Huddersfield towards Oldham. One paralleled an older road, but two others were completely new routes. West of Leeds a radial web of new turnpikes was built, dramatically increasing the road capacity into the expanding industrial area. Manchester had new turnpike roads along its important corridors of commerce, with long straight roads running to the west, north and east paralleling the older turnpikes.

Appendix Figure 2; New sections of road constructed by turnpike trusts in the area around Manchester and Leeds in the northwest of England

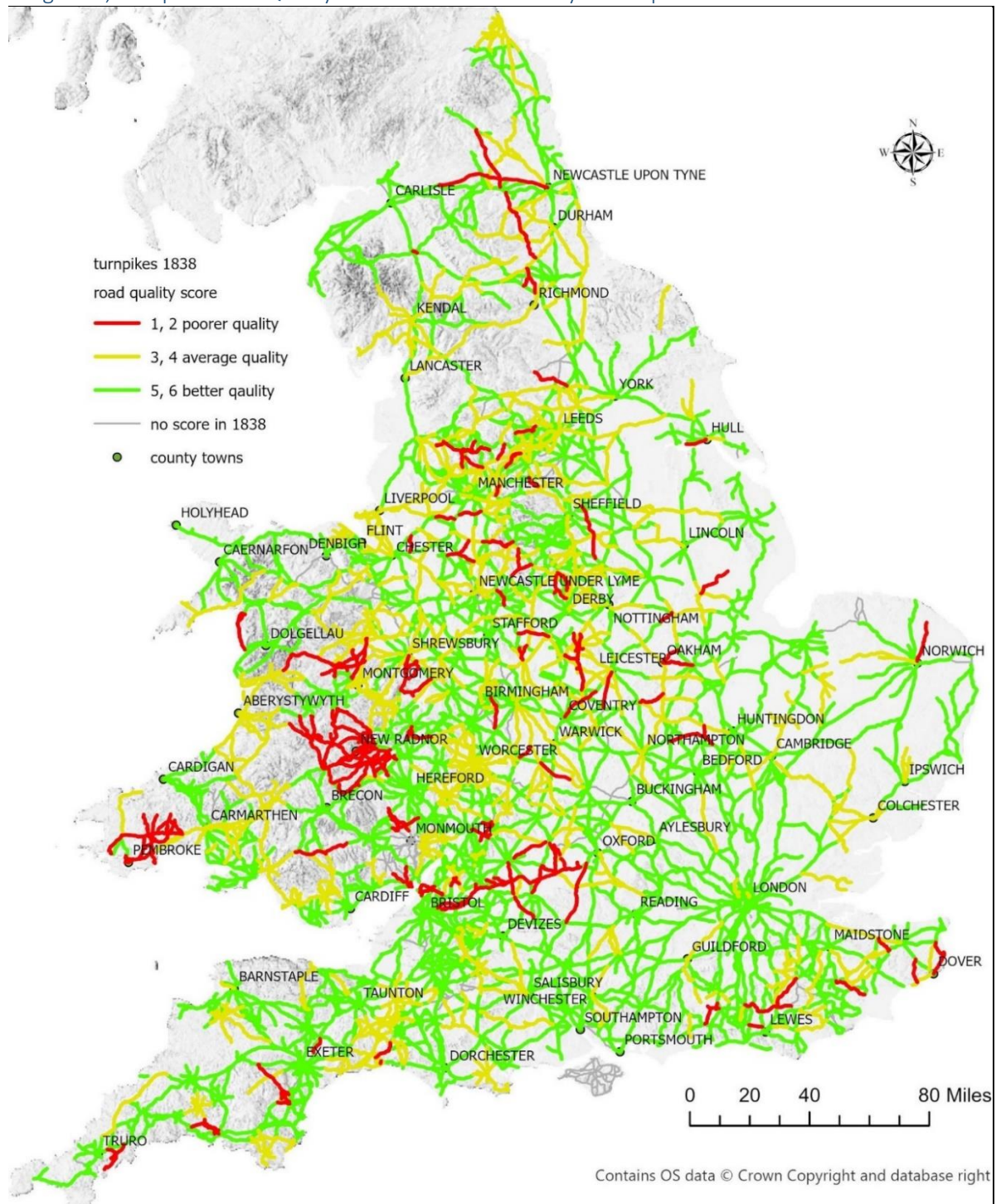


Sources: Authors calculations.

Illustration of Road quality on Turnpike Roads in England and Wales

Appendix Figure 3 maps the simplified quality score for the turnpike roads of 1838. Top quality ratings were common throughout England & Wales, including some upland areas, suggesting turnpike roads were generally good. The lowest quality turnpikes were more common in mid and West Wales as well as on rural English turnpikes NW of a line from Oxford to Leicester. This would suggest that the complaint that poor turnpikes were impeding rural economies, expressed through the Board of Agriculture to the Parliamentary Committee on Turnpike roads, had not been fully addressed through the policy of working through the reformed turnpike trust. These rural cross roads generally had small traffic volumes, local pressure to keep tolls low and were beyond the purview of Telford's surveyors. They were not well suited to toll financing and lacked the political leverage for the Irish Mail Road so it may be inevitable that some would fade to be maintained mainly by the parishes while the tolls covered the interest payments. (examples in Wales on BPP 1844 map)

Appendix Figure 3; Turnpike Road Quality scores from 1838 survey of turnpike trusts

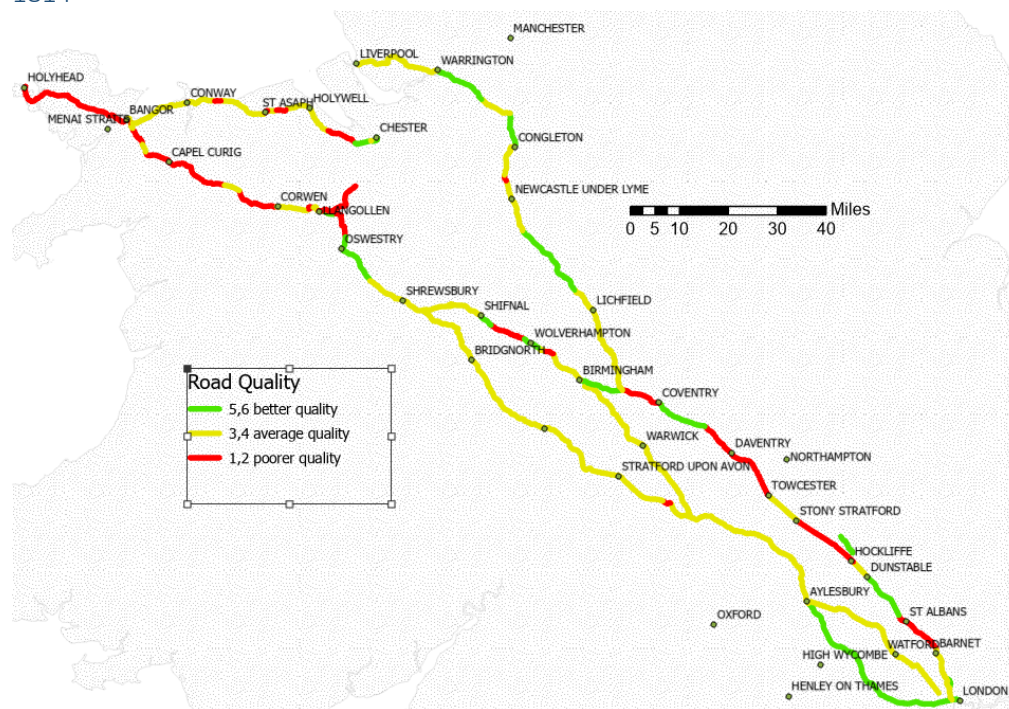


Sources and notes: see text.

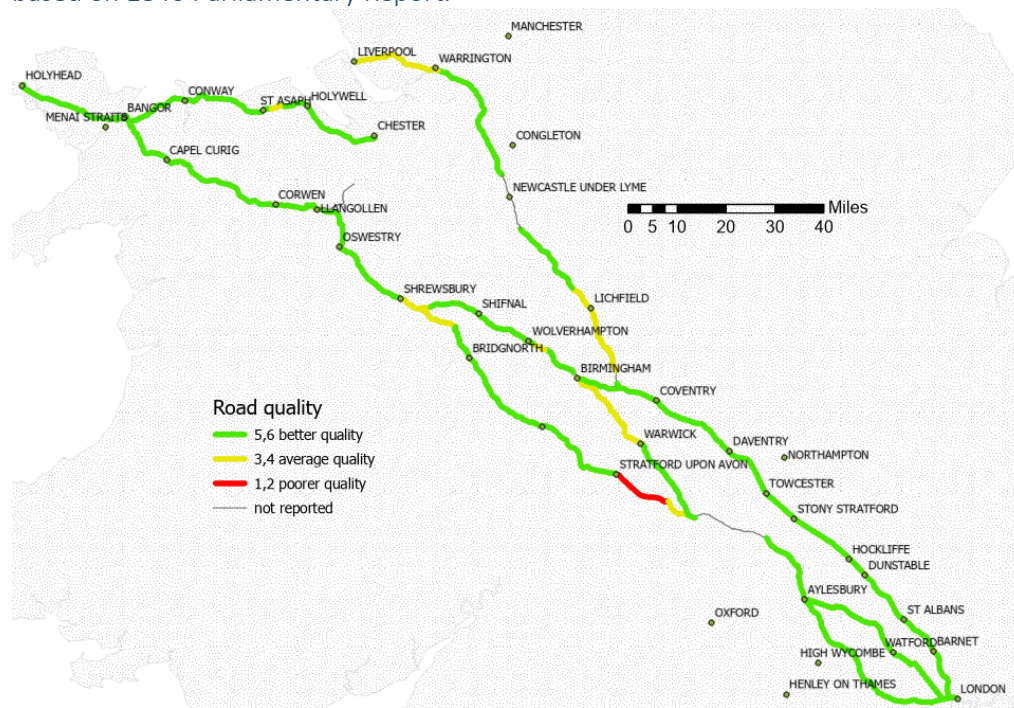
Illustration of changes in road quality on the Holyhead Road

Appendix Figure 4a shows road quality reported by Telford on potential routes ca. 1814. This map gives a starting point against which to judge success for improvement along the Holyhead route selected by Telford. Appendix Figure 4b shows Road quality reported in 1838 on the improved roads; including the Government sponsored and funded Holyhead Road. It shows the marked success of the Holyhead Road Commission.

Appendix Figure 4a; Telford's evaluation of road quality on Mail roads in northwest England and Wales, in 1814



Appendix Figure 4b; Evaluation of road quality on Mail roads in northwest England and Wales in 1838 based on 1840 Parliamentary Report.



Sources: Authors calculations.