A Small Price to Pay:

A Historical Perspective on Infrastructure Regulation during Britain's Industrialization

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Abstract

One of the most difficult challenges facing governments is to design good regulations. A key task for historical research is to understand what has worked best in the past and why. Britain had the world's largest privately funded and regulated toll road network during its industrializing era from 1700 to 1830. Although there was potential for large profits, toll authorities generally earned a modest rate of return on investment. Using a new GIS data set, this paper demonstrates that inter-modal competition from the river and canal network and binding toll caps set by Parliament kept rates of return low. Other regulatory policies, like mandated non-profit forms, are shown to have less impact. The results provide insights into Britain's regulatory policies and their impact on industrialization.

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I. Introduction

Infrastructure is crucial for the prosperity of economies, but as an economic sector infrastructure is subject to a number of market and government failures. Principally there is a twin-problem of commitment and natural monopoly. Entry into the sector requires investments that are large in scale, durable, and immobile. Infrastructure firms cannot simply 'pull-up' their capital and exit if regulatory authorities renege on commitments relating to fees and market structure. The natural monopoly problem arises because most markets are not large enough to support more than a single infrastructure provider and even in markets with multiple providers services are imperfect substitutes.

As one might expect, some societies have dealt with commitment and natural monopoly problems better than others. A key task for historical research is to understand how economies have successfully dealt with these problems in the past. During its industrializing era, Britain's regulatory institutions appear to have been relatively effective. A large network of roads, waterways, ports, and railways were constructed by private or local authorities. Britain's well developed transport network led to a highly integrated market as early as 1790 when the Industrial Revolution was starting (Shiue and Keller 2007). What is striking about the British case is that transport costs were low even though tolls were used to pay for infrastructure improvements. Britain's Parliament and the Crown regularly granted trusts and companies exclusive rights to charge tolls through legislative charters known as 'acts of Parliament' (Bogart and Richardson 2011). Of special importance to this paper, the rate of return on infrastructure capital investments was modest. Returns to railways and toll roads were on the order of 4 to 5 percent for most of the nineteenth century (Mitchell, Chambers, and Crafts 2010, Arnold and McCartney 2005, Bogart 2012). In general one could say that profits were sufficiently large to recoup investment costs, but not too large as to indicate monopoly pricing. In other words a balance was struck between providing credible commitment and restricting monopoly power.

In this paper, I investigate whether the modest rate of return on infrastructure investments was linked with policies introduced by the British government, especially Parliament. In what appears to have been a conscious aim to reduce monopoly power, Parliament often required infrastructure authorities to operate as non-profit organizations called trusts. There was no ownership stake in such entities and the trustees could be sued if they personally profited. The

assumption was the trustees would serve without direct remuneration because they were often local landowners or merchants who benefitted indirectly from improved infrastructure. A similar policy of assigning ownership or control to local property owners was used for joint stock companies, the other organizational form used to improve infrastructure.

Price caps were another regulatory tool employed by Parliament. Acts of Parliament directly set a schedule of maximum tolls that infrastructure authorities could not exceed. The toll schedules were specific to each provider and were adjusted to match market conditions. Finally, Parliament adopted fairly permissive entry policies in the infrastructure sector. Most projects began with a petition submitted by promoters from local communities. Few projects were denied in the long-run, resulting in a multitude of individual authorities serving the same markets.

Although such regulatory policies could keep profits low in theory, there are reasons to doubt their practical effectiveness. Trustees might have evaded legal prohibitions making the non-profit trust effectively a for-profit entity. Toll caps might not have limited monopoly power because Parliament lacked the necessary information to set binding toll caps or worse because Parliament may have been captured by infrastructure authorities. Attempts at fostering competition may have been hindered by the costs of transiting between infrastructure authorities. If tolls were raised and users wanted an alternative often they had to travel on local roads which were lower in quality. Lastly, permissive entry policies by Parliament might have had unintended consequences. The most notable in this context was a 'double-marginalization problem' in which both an upstream and a downstream infrastructure authority each charged a monopoly toll on their part of the route, resulting in a combined toll higher than the monopoly price.

The problem of creating 'good' regulations has received a lot attention recently. Several scholars have argued that regulatory authorities often do not have the enforcement capacity to implement restrictions on firms (see Laffont 2005; Ibanez Gomez 2006, Estache and Wren-Lewis 2009). The main culprit is a lack of funding and expertise. Even well-funded and capable regulatory authorities can struggle because of asymmetric information. Infrastructure firms have private information about their cost and do not necessarily have an incentive to truthfully report it to regulators. There is also the problem of corruption. Regulators make act in their own self-interest taking bribes in exchange for favored policies. In Britain, all of these factors were potentially relevant. There was no separate regulatory agency in charge of infrastructure.

Members of Parliament determined the rules based on testimony of witnesses and advice from local government authorities. Corruption was openly practiced in Parliament according to Adam Smith and other critics of Britain's pre-reform government (see Mokyr 2009).

This paper examines the effectiveness of regulations using a new data set linking rates of return with the regulatory and spatial characteristics of toll roads also known as 'turnpike' trusts. Turnpike trusts are the most ubiquitous example of private, regulated infrastructure authorities in Britain's past. They spread throughout Britain from 1690 to 1830 and played a key role in improving the transport network (Albert 1972, Pawson 1977, Bogart 2005). Turnpike trusts are also well documented in terms of financial performance. Unlike canals, rivers, and ports, there is financial data on *all* turnpike trusts in a parliamentary report from 1821. The report gives information on revenues, debts, and expenses in 1820 from which I estimate the rate of return on capital invested and the payment to bondholders as a percent of debt. The 1821 report also gives information on the location of trusts, total mileage, and the source of wealth for trustees.

To investigate the role of regulation it is necessary to match turnpike trusts with market characteristics and regulations like maximum toll schedules. As there are approximately 1000 trusts in 1821, it was not possible to study the entire population. Therefore, this paper focuses on a sample of 120 trusts in the 'Home Counties' directly north of London and the East Midlands just to the north of the Home counties. Using maps and travel guides I am able to identify trusts serving the London trade and market towns. The London network radiated from the capital and extended throughout Britain. Some turnpike roads primarily served London travelers and carriers as they were not near any major cities. Turnpikes serving market towns were also radial in form but their users were generally local famers and manufacturers. They connected old cities and emerging industrial centers with their hinterland. In both types of markets, I use GIS techniques to create variables for the distance between turnpike roads and the distance to rivers or canals. A companion data set of parliamentary acts is also used to identify the maximum tolls facing each trust.

The empirical relationship between returns on infrastructure investment, regulation, and market structure is studied using cross-sectional data from 1820. A rate of return measure for each turnpike trust is regressed on a number of variables including the toll cap facing the turnpike trust, the distance to nearby turnpike roads or waterways serving the same market, and

whether the majority of trustees were landowners as opposed to merchants or manufacturers. A set of control variables, like local population size and distance to London, are also included. In the baseline model the identifying assumption is that regulatory variables are exogenous. It is most plausible for the market structure variables which were the result of decisions made by different actors over many decades beginning in the early 1700s. The exogeneity assumption is arguably least viable for toll caps because they were the outcome of a political process in the early 1800s. I propose an instrument to address this issue. The inflation rate in the year each trust was renewing their act—and hence their regulation—is shown to affect the toll cap, and as I argue below it is unlikely to differentially affect rates of return. The instrumental variables estimates are broadly consistent with OLS and support a causal interpretation of toll regulation.

The regression results yield a number of findings. First, the rate of return on turnpike capital was significantly higher if a trust serving the London market had a higher toll cap. These results suggest that toll regulation was a significant factor in keeping rates of return low. Using the standard monopoly model, one would expect that if the toll caps set by Parliament were binding then increases in the maximum toll should raise rates of return. As the regressions show a positive relationship, there is evidence that the tolls were generally binding. However, the same is not true for market-town turnpike roads. The absence of a 'toll cap' effect on market-town turnpike roads is arguably linked to problems of asymmetric information.

The second major finding concerns the role of market structure and competition. The Hotelling model predicts a positive relationship between rates of return and the distance between infrastructure authorities as long as the distances are not too large. Once a threshold distance is reached, there is no competition between providers and the regressions should indicate no relationship between returns and distance measures. The data indicate that Britain had a dense toll road market with many alternatives, but the regression results show a relatively weak relationship between rates of return and the distance between turnpike trusts. One explanation is that the costs of transiting between turnpike roads was high, and thus trusts still had high pricing power even though the distances between them was short.

There is a different conclusion concerning inter-modal competition. The regressions show that turnpike roads had a significantly lower rate of return if they were a shorter distance to a river or canal serving the same market town. Interestingly the distance to waterways serving

the London market had no effect on rates of return. Inspection of the London waterway network c.1820 shows that it was very circuitous and was not an effective competitor to turnpike roads. By contrast many of the waterways near market towns look like good substitutes. Many of these were canals constructed after turnpike roads. Thus it appears that the British Parliament was willing to sacrifice some of the returns for turnpike roads when it allowed the entry of a lower cost transport technology.

The third major finding concerns the role of landowner trustees. In the regressions there is a weak relationship between the wealth characteristics of trustees and rates of return. This finding speaks to the role of the non-profit form. All indications suggest that Parliament targeted local property owners to serve as trustees because they had an indirect interest in maintaining the road and in keeping the tolls low. One hypothesis is that landowners had a greater interest in keeping the tolls low because land as a factor of production generally captures greater rents from lower transport costs compared to more mobile forms of wealth. Contrary to this view, the results do not show any clear difference in rates of return for landowner-run trusts. It is not obvious therefore that targeting landowners or any other local property owners was an effective tool in keeping profits modest.

Lastly, I do not find any evidence of unintended consequences from Parliament's uncoordinated and permissive entry policies. One criticism commonly voiced by reformers in the 1820s is that trusts were too small is size, but I find no evidence that trusts with small road mileage had any lower rates of return. I also find weak evidence linking the size of trusts sharing long-distance routes and rates of return. The latter finding casts doubt on the significance of the 'double marginalization' problem in this context.

There are several implications of the results. First, they contribute to a larger literature on Britain's transport and infrastructure sector.[2] The most closely related is Casson (2009) who studies regulation of railways. Casson argues that Members of Parliament did not want to deny requests from local communities seeking a railway in their area. Something like a 'tragedy of the commons' resulted with too many railways being built to sustain profitability. In contrast, my evidence suggests that over-building was not a significant problem in the turnpike sector. If it

[2] See Aldcroft and Freeman (1983), Arnold and McCartney (2005, 2011), Freeman (1977, 1979), Kostal (1994), Mitchell, Chambers, and Crafts (2010), Pawson (1977), and Gauci (2011).

was, then a smaller distance between turnpike roads serving the same market should have yielded a lower rate return, but that was not the case. More research is needed to investigate the issue for canals, another key infrastructure sector in Britain.

Second, this paper helps to explain why Britain had highly integrated markets at the start of the Industrial Revolution (Shiue and Keller 2007). Contrary to some views in the literature, it was not that Britain had no barriers to internal trade like tolls (Hayek 1960, Weingast 1995, Ekelund and Tollison 1997). Britain had widespread tolls but crucially they were not high. Highway tolls were low in part because price caps set by Parliament limited market power and because Britain's large waterway network imparted a competitive discipline.

Third, the results speak to the general regulation literature. This study is one of the first to empirically demonstrate that toll caps can provide an effective tool for regulators. The tale is a cautionary one however. Lack of information can prevent regulators from setting binding toll caps, as it appears to have done in Britain's market towns. Britain's experience also suggests that regulators should encourage inter-modal as well as intra-modal competition to greater extent than is currently done. Relaxing no competition clauses in concession contracts can have beneficial effects if it is done gradually as in Britain's case.

II. Theoretical Framework

The rate of return on infrastructure investment reflects a complex inter-connection between economic and regulatory conditions. In this section, we use theory to generate predictions for the relationship between regulation and rates of return earned by turnpike trusts. We start with the legal framework associated with the 'trust.' As we mentioned earlier trustees could not legally profit from the tolls, but they might try to 'tunnel' the surplus revenues from the trust. For example, trustees might hire a favored contractor in exchange for a secret payment. We can model the trustees' decision to tunnel surplus revenues assuming they were self-interested and behaved rationally. Suppose that a trust had an annual surplus of S after making interest payments to bondholders. Trustees incur a cost $C(A)$ if they appropriate A pounds of the surplus. $C(\,)$ is an increasing, convex, and differentiable function in A and can be interpreted as the cost of avoiding detection by legal authorities. Trustees choose a level of appropriation A^* that maximizes their private returns $A - C(A)$ subject to the constraint that $A \leq S$. The basic model

suggests trustees will appropriate the entire surplus unless the marginal cost $C'(S)$ exceeds 1, in which case they will choose an appropriation A^* such that the marginal cost $C'(A^*)$ equals 1.

The cost of avoiding detection should increase if Parliament applied large penalties or was effective in enforcing regulations on trustees. In other words, it is less attractive to steal from the trust when regulatory authorities are watching closely. By extension trustees might choose to set low tolls and keep surpluses to a minimum when the cost of appropriation is large. Trustees were generally local users of the road and thus derived benefits from lower tolls. I model the tradeoff between appropriation and road use benefits using the same framework and lettig the surplus $S()$ be a function of the toll τ. Like a profit function, the surplus function achieves a maximum at some toll $\hat{\tau}$ and then decreases for lower or higher tolls. Trustees also derive some benefit B from the use of the road, which depends on the toll. $B(\tau)$ can be interpreted as land rents or profits from trustees' businesses that use turnpike roads. B is assumed to be a decreasing and concave function in τ. The trustees' objective is to choose a toll and level of appropriation which maximizes: $A - C(A) + B(\tau)$ subject to the constraint that surplus $S(\tau)$ cannot be negative and appropriation A is less than the surplus $S(\tau)$.

There is a continuum of equilibrium. In one extreme trustees gain little from lower tolls and appropriate the maximal surplus A^* given their cost $C()$. This case is displayed in figure 1, panel A. Notice trustees do not set the surplus maximizing toll because the costs $C()$ diminishes their net return and they lose indirect benefits $B()$ for additional tolls. The other extreme case is where trustees appropriate zero surplus and set the toll as low as possible. This case is displayed in figure 1, panel B.

Figure 1, Panel A

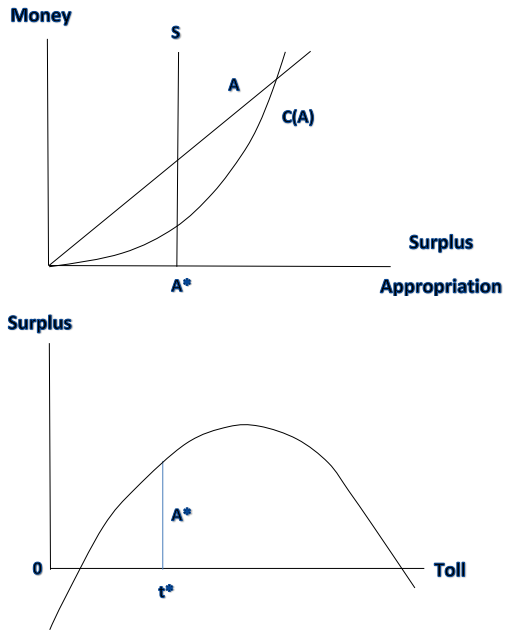
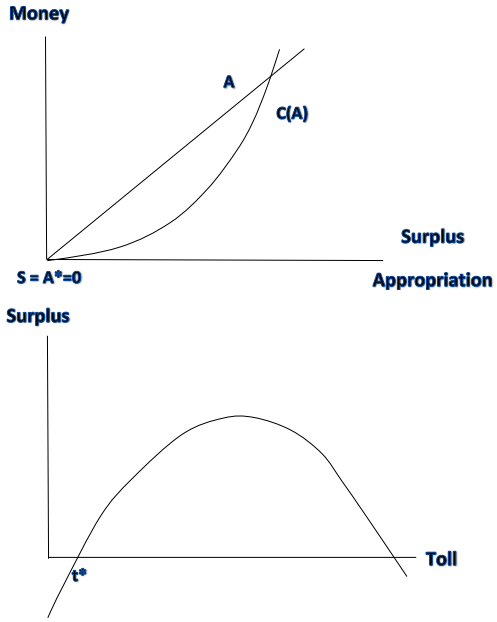


Figure 1, Panel B



The size of indirect benefits $B(\tau)$ is the distinguishing factor in panels A and B. If indirect benefits are low then trustees will want to increase the surplus as in panel A. Under this scenario, higher rates of return are expected absent competition or regulatory restrictions. If the indirect benefits were high, trustees will choose a lower toll and decrease the surplus as in panel B. Here low rates of return are expected.

To summarize, one hypothesis is that trusts earned low rates of return because trustees benefitted from lower tolls and legal restrictions on earning profits diminished the incentive to appropriate surplus revenues. As we shall see later it is difficult to test this theory in practice because there is no variation in organization form: all toll road authorities were trusts. However, we can get some testable predictions from this framework after incorporating the identity of trustees. Drawing on Ricardian trade theory, the landowner should capture more of the indirect gains from lower transport costs because land is a fixed factor (or at least its supply curve slopes upward more rapidly than other inputs), Therefore as the holders of immobile assets, landowners gained a lot from lower tolls. Merchants and manufacturers also gained, but as their assets were more mobile they gained relatively less from lower tolls.

Consider the example of a woolen merchant operating the putting-out system where raw wool was brought to households for processing and weaving into cloth. The merchant would

likely earn higher profits on their business if tolls were lower on their local roads, but their private gains might be attenuated due to entry by other merchants once the market for wool expanded. By comparison consider a landowner who raised sheep and sold wool in the same area. It would be impossible for another farmer to replicate their land and hence they were earn a higher rent. The general prediction is that trusts operated by landowners earned lower rates of return because they valued the indirect benefits more than other types of trustees.

Mandating the trust form clearly dulled profit-making incentives, but such restrictions may not have been sufficient. Another theory states that regulation of tolls was also necessary. Turnpike trusts were bound by a maximum toll schedule stated in the act of Parliament governing their rights. The tolls were set by the Members of Parliament working on the turnpike bill and were not necessarily restricted by a general rule. Some trusts could have relatively high maximum tolls and others could have relatively low tolls.

The variation in maximum tolls across trusts provides an opportunity for testing whether toll regulation limited profits. Toll schedules would have constrained profits if they were set below the toll that trustees would have like to have charged absent the regulation. Consider figure 2, panel A, which shows a demand curve for road services as a function of the toll and a constant marginal cost of providing road services. In panel A the toll cap is below the profit maximizing toll, T^*, identified by the intersection of marginal revenue and marginal cost. Here trustees are constrained and generate surpluses equal to the area of the clear-outline rectangle. Now imagine that the toll cap was increased, as illustrated by the dashed price cap. Trustees are still constrained from setting the profit-maximizing toll but they generate more surpluses equal to the area of the solid grey rectangle.

Figure 2, Panel A

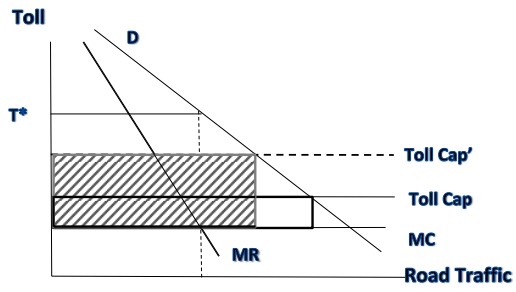
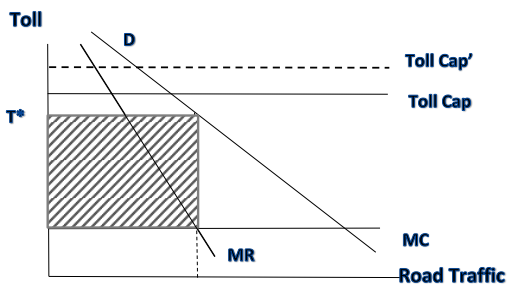


Figure 2, Panel B

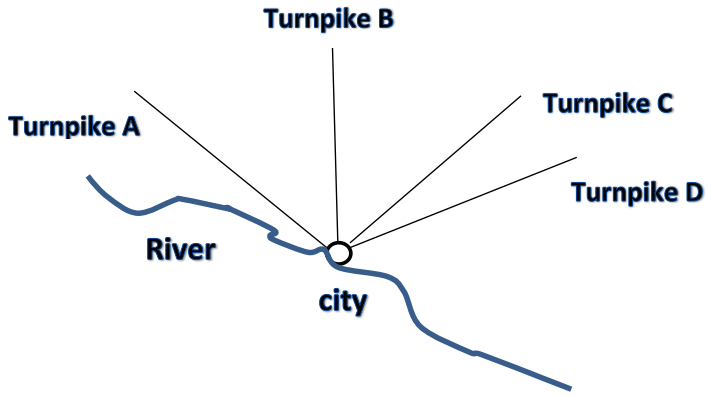


Now consider a different case illustrated by figure 2, panel B. Here the toll cap is set above the profit maximizing toll from the beginning. This could occur if Parliament did not know the demand and supply curves facing trusts. Or perhaps Parliament was 'captured' by trusts and toll caps were made irrelevant on purpose. In any case, if the toll cap is not binding and turnpikes are able to charge the monopoly toll and collect monopoly profits then increasing the toll cap will lead to no change in profits. Thus if maximum tolls were a binding constraint on profits then increasing the maximum toll is predicted to increase profits, but if tolls were not binding then increasing the maximum toll should have no effect.

Competition between turnpike trusts may have been another limiting factor on profits. I model competition using the Hotelling model, where firms and customers are located at points on a circle. In this context, firm locations would correspond to entry points or gates on a turnpike road and customers would choose which road to take based on their location. The model predicts that trusts with nearby competitors will be forced to charge lower tolls and will generate less surplus all else equal. As the distance between trusts expands, each will have more market power and will charge higher tolls. At some sufficiently large distance, trusts will face no competition and can charge the surplus maximizing toll provided they are not constrained by the regulated toll. A related argument concerns inland waterways and turnpike trusts. A nearby waterway posed a competitive threat to a turnpike, perhaps even more so than a neighboring turnpike road because transport costs by water were lower than by road.

Consider Figure 3 which illustrates four turnpike roads into a city as well as a river. Assume that farmers seek to ship goods to the city and are distributed evenly across space. In this market, Turnpike B's competitors are Turnpike A and Turnpike C. Turnpike C's competitors are Turnpike B and Turnpike D. Turnpike B's competitors are a greater distance on average than Turnpike C's competitors. Thus Turnpike B has greater pricing power than C and we might expect turnpike B to earn a higher rate of return. With respect to water competition, turnpike A is closer to the river than Turnpikes B, C, and D. Therefore, it may earn a lower rate of return. Also note that inland waterway competition is irrelevant for Turnpike B and C as farmers in their area would need to travel past the city by turnpike road in order to take water transportation to the city. The total costs would be larger and thus water transport is not a relevant option for them.

Figure 3: Distance and the potential for Inter-Trust and Inter-Modal Competition



A key parameter in this analysis is the cost of moving between turnpike roads (i.e. the transport cost parameter in the Hotelling model). In this context, parish roads were the 'feeders' to turnpike roads. In terms of figure 3 they would be short segments linking turnpikes or linking turnpikes with small settlements. If parish roads were sufficiently poor then even at small distances turnpike trusts will not compete with one another and rates of return will be unaffected by the distance between trusts. If on the other hand, parish roads are relatively good then the rate of return will be lower when neighboring trusts are closer in space. The relative quality between turnpike roads or between turnpike roads and rivers also matters. Bad parish roads may not deter a shipper near a turnpike road from using water transport alternatives because it was significantly cheaper.

There is a related argument concerning the multiple numbers of turnpike trusts on long distance routes. In industrial organization it is well know that if there is 'upstream' monopolist and a 'downstream' monopolist then the final price to consumers will be higher than if the upstream and downstream monopolists were integrated into a single firm. Moreover, total profits to the upstream and downstream monopolists will be lower than under integrated monopoly. There was the potential for a similar 'double-marginalization' problem on long distance routes where multiple trusts managed different sections separately. For example, on the London-Oxford-Birmingham road there were 8 different trusts managing 113 miles. Thus travelers between Birmingham and London had to pay tolls to 8 different turnpike trusts. If these trusts exercised market power and did not coordinate their pricing, then it is possible that the profits of each were lower than they could have been if there were fewer trusts along the road. The

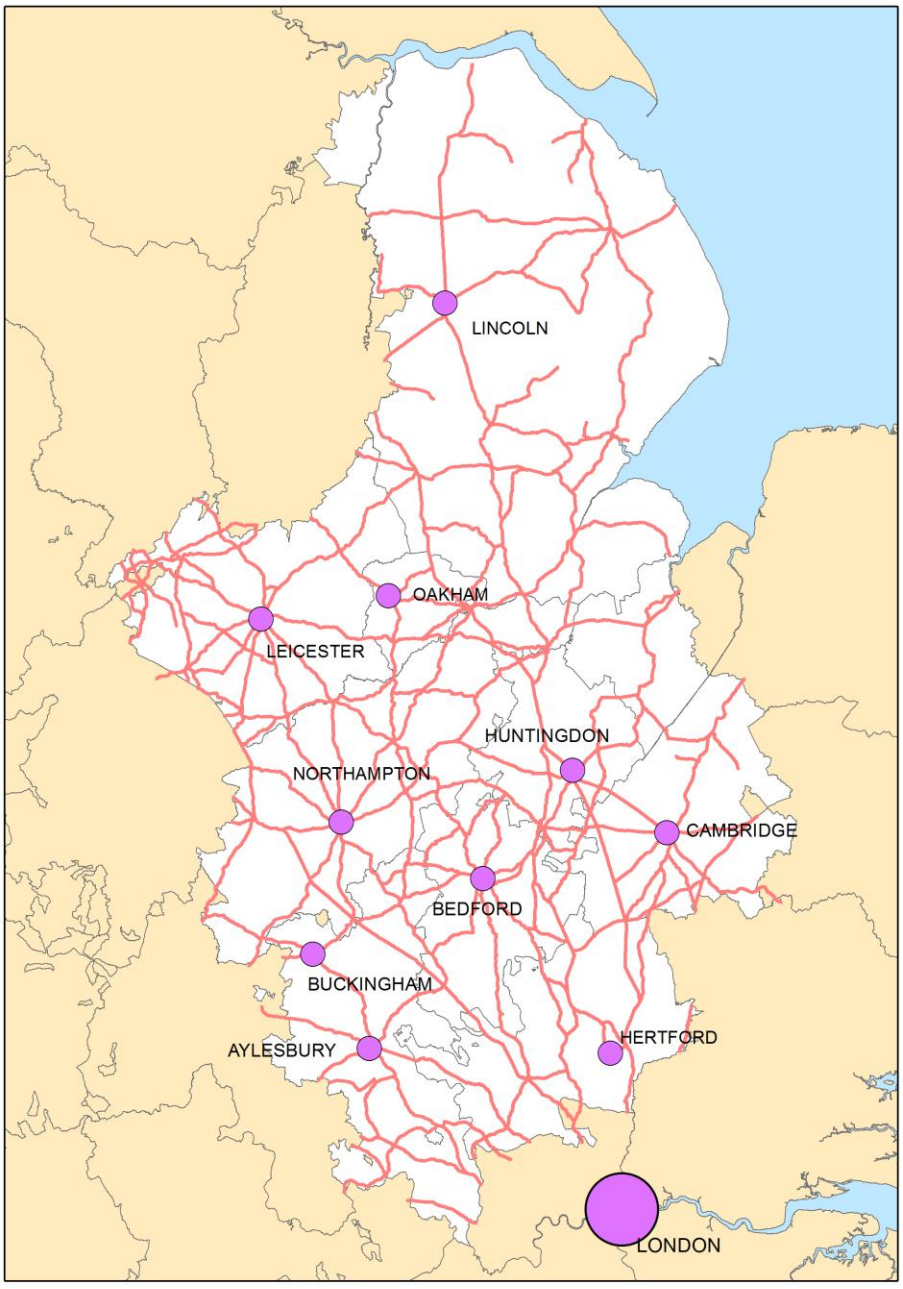
prediction is that if an 'upstream' trust shares its route with a larger number of trusts then its rate of return will be lower, again provided they are not constrained by the regulated toll.

III. Data on Regulation and Turnpike Returns

Although the British toll road context is nearly 200 years old, the data sources are surprising rich. As we shall see the challenge comes in combining data from different sources. The ultimate goal is to explain the rate of return on capital invested in turnpike roads and the interest payments to bondholders as a percentage of debt. Both return measures are estimated using data from a parliamentary survey on turnpike finances around 1820, authored by the 'Select Committee to consider the Acts now in Force Regarding Turnpike Roads and Highways' (BPP 1821 IV). Henceforth it will be called the 1821 Report. It is the first major survey of all turnpike trusts in Britain and perhaps the first survey of an entire industry during the Industrial Revolution period. The 1821 Report required the officers of each turnpike trust to provide a financial summary and information on operations. In total 1020 trusts from England and Wales submitted returns. Elsewhere I describe how the data in the report can be used to measure rates of return (Bogart 2012).

The sample of turnpike trusts studied in this paper include all in the 'Home' counties near London (Hertfordshire, Bedfordshire, and Buckinghamshire) and the East Midlands (Northamptonshire, Rutlandshire, Leicestershire, Cambridgeshire, Huntingdonshire, and Lincolnshire). These counties are broadly representative of rural, land-locked areas in England. One can identify all the turnpike trusts in these nine counties and their geographic locations using three sources. The first is a parliamentary report from 1840 which lists the parishes traversed by each turnpike road (BPP 1840 XXXVI). Second, the Ordinal Survey provides latitude and longitude coordinates for each parish and by the previous source each turnpike trust. Third, the Phillimore Atlas & Index of Parish Registers provides county maps of major roads, rivers and cities (Humphrey-Smith 1984). Using these sources, I created digital maps of all turnpike roads in the nine counties. The nine-county map is displayed in figure 4.

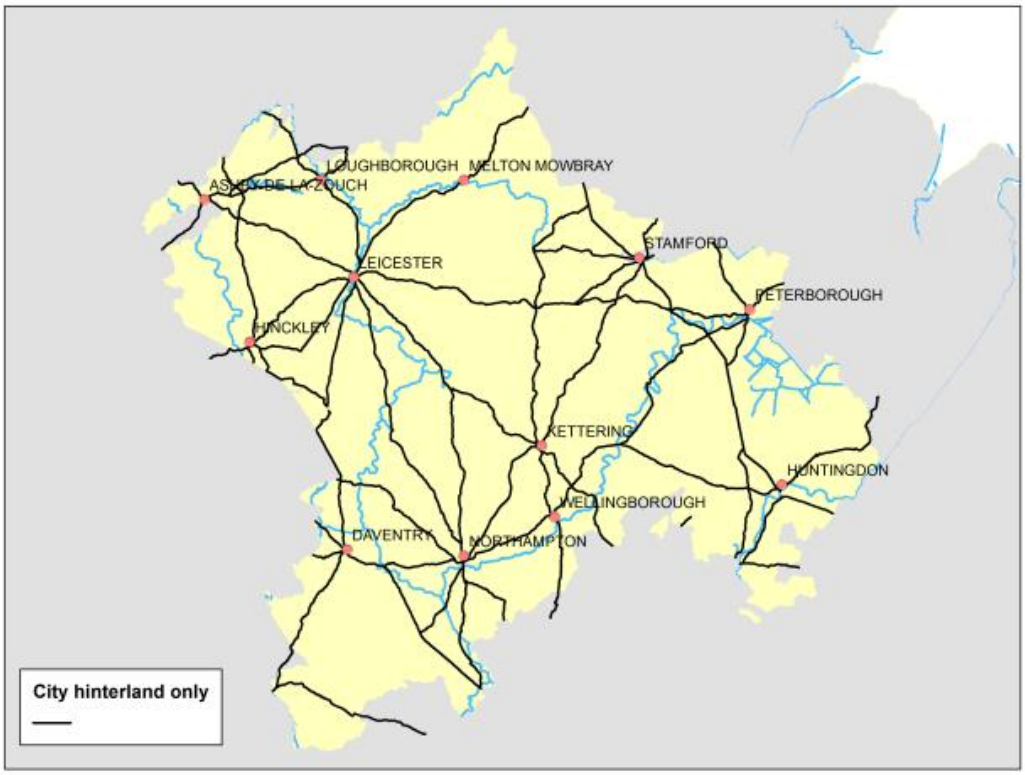
Figure 4: Turnpike Roads in the Home Counties and East Midlands



The next step is to matching the trusts in the 1821 report to their geographic locations in the map. Matching is difficult because some of the cities along the route are not well described in the 1821 report. Nevertheless I was able to match 128 out of 140 turnpike trusts listed as being in these counties in the 1821 Report. The missing turnpike roads are dropped from the analysis because there is no financial data. The total mileage of the 128 trusts was 2351 or around 12 percent of the total in England and Wales.

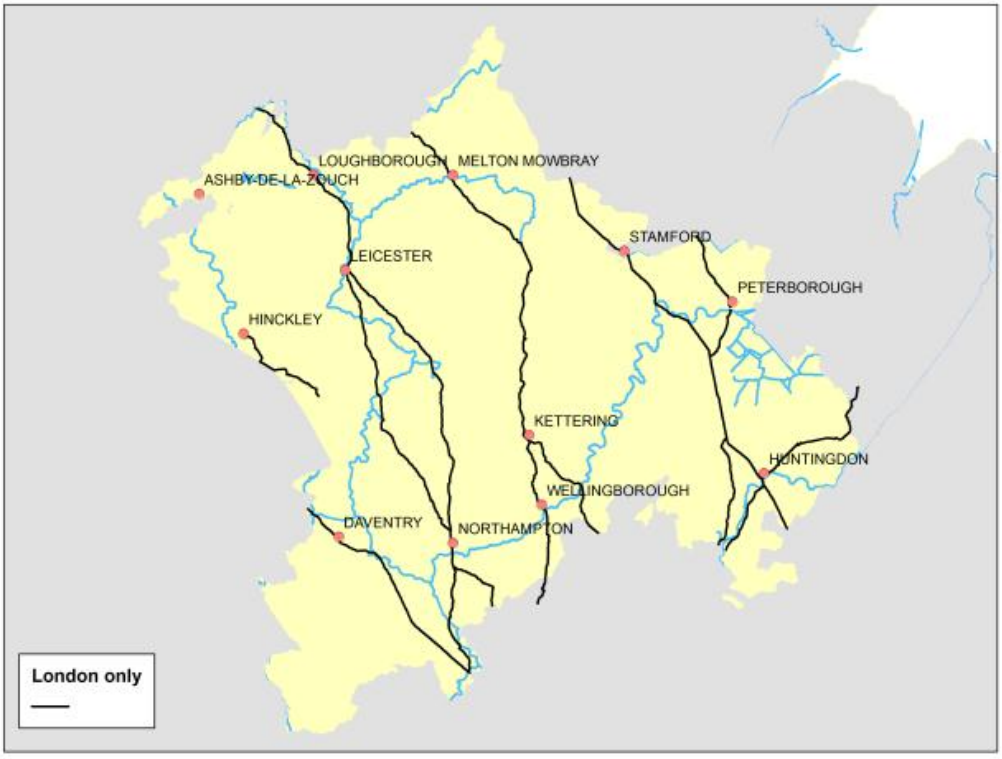
In studying Britain's turnpike roads, it becomes immediately clear that each served a different set of markets. The most important distinction is between trusts serving local trade between market towns and nearby villages or farms and trusts serving long-distance trade between London and large cities. In the sample counties, I identify 74 turnpike roads directly leading into cities with a population of 2000 or greater in 1801 (henceforth known as market-town trusts). As an illustration, the turnpike roads serving the market towns of Leicestershire, Northamptonshire, Huntingdonshire, and Rutlandshire are shown in Figure 5 below.

Figure 5: Market Town Turnpike Roads in the East Midlands



I also identify 44 turnpike trusts in the nine sample counties that served long distance trade and travel to London. Figure 6 below shows the 'London trusts' in the East Midlands. They are identified using Paterson's Travel guide (Mogg 1826). It indicates how a traveler would get from London to any city in England c.1820. In constructing the London trust network, I restrict to roads connecting London to cities with populations over 10,000 in 1820. These large cities like Leeds, Manchester, and Norwich generated the most traffic and clearly defined the long distance network in Paterson's travel guide.

Figure 6: London Turnpike Roads in the East Midlands



As one would expect the rate of return measures are higher for the London trusts compared to market town trusts or other types. The top panel in table 1 summarizes the dependent variables, the rate of return on turnpike capital invested and the interest payment to bondholders as a percent of debt in different sub-samples. The average return on capital invested in the full sample of 128 trusts is 2.61 percent and the average interest payment to bondholders is

3.51 percent.[3] The London trust sample has significantly higher returns for both variables. For the remainder of the analysis I focus on the London trusts and the market town trusts. The remaining trusts are difficult to study because their market is not well defined.

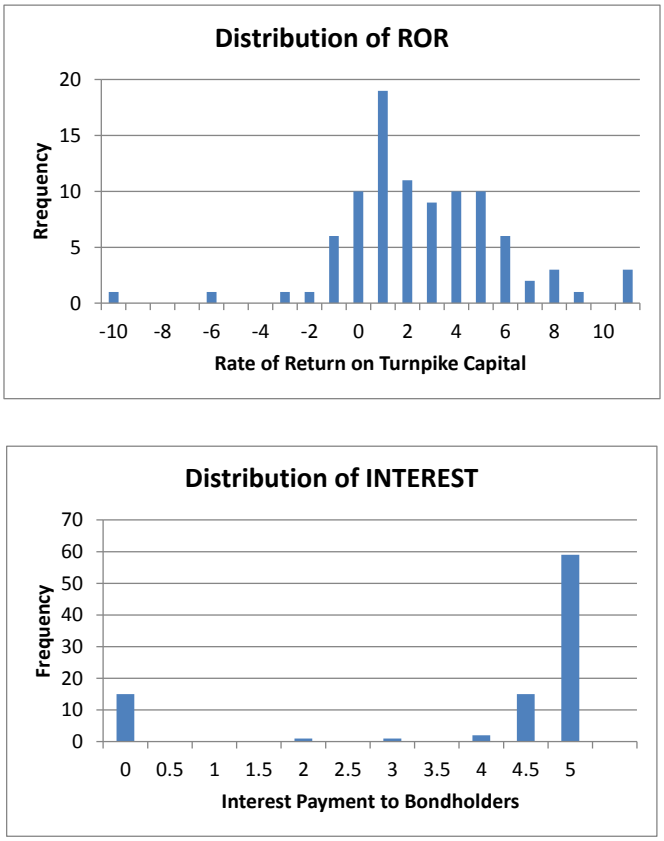
Table 1: Summary Statistics

Variable and Description	Obs.	Mean	Std. Dev.
Rate of return on capital	128	2.61	7.66
London trusts	44	3.34	11.99
Market town trusts	74	2.35	3.39
Interest payment as % of total debt	127	3.51	1.85
London trusts	44	4.16	1.41
Market town trusts	73	3.61	1.88
Regulatory and Market Structure Variables			
Length of Trust in Miles	94	18.64	9.23
Indicator if Trustees are mostly Landowners	83	0.385	0.49
Toll cap per coach horse, per mile	93	0.034	0.017
Toll cap per wagon horse, per mile	93	0.03	0.017
Turnpike miles within 5-mile radius of Market Town	74	30.1	7.51
Distance to nearest turnpike, London Trusts	44	6.78	5.94
Distance to nearest turnpike, market town trusts	73	5.12	1.54
indicator if trust is only one serving market town	74	0.013	0.116
Distance to nearest river or canal, London trusts	44	11.53	16.9
Distance to nearest river or canal, Market Town trusts	67	3.64	2.26
Indicator if Market town has no river or canal	74	0.094	0.294
Average Mileage of Trusts on Same Route & Closer to London	44	9.95	3.54
Control Variables			
Total Population with 10 miles Radius of trust	94	47391	60015
Average distance from London in KM	94	108.9	49.9
Year Trust was formed	94	1752	28
Indicator if Trust was formed since 1809	94	0.031	0.176
Population of Market Town served by trust	74	5454	3130
Indicator if trust serves two market towns	74	0.162	0.371

[3] In general 1820 was not a great year. For all trusts, the average rate of return on invested capital was lower than in subsequent years. Bondholders did not fare as badly in 1820 as their return (on the face value of the debt) was similar to the average yield on long-term government bonds.

Figure 7 shows the distribution for the rate of return on capital (ROR). It resembles a normal distribution, but with a skew to the right. By contrast, the distribution for the rate of return to bondholders (INTEREST) is bounded by 0 and 5 percent. The regression analysis for bondholder returns incorporates the upper limits on interest payments.

Figure 7: The Distribution of Rates of Return on Capital (ROR) and Returns to Bondholders (INTEREST)



The main regulatory and market structure variables are summarized in middle panel of table 1. The first variable is the size of the trust measured in miles. It is recorded in the 1821 Report. The average in the sample is 18.5 miles which is typical of most turnpike trusts in England. The second identifies whether trustees were primarily landowners using information in the 1821 Report. In some cases, the Report gives a brief description stating that trustees' income came from land or from general sources. In other cases, the number of trustees with landed income and the number with personal income (i.e. financial or moveable property) are given. To ensure a strict measure of landowner control, a trust is coded as a landed trust if more than two-

thirds of trustees are landowners or simply ‘Land’ was reported. In the sample around 38 percent of trusts were landed. The percent is slightly higher for market town trusts.

The toll caps are measured using the maximum toll per horse drawing a wagon or coach per mile. The data comes from individual acts of Parliament regulating each trust. Acts of parliament dealing with turnpike trusts were usually valid for 21 years. After 21 years turnpike acts needed to be renewed unless the trust had renewed an earlier act before its term expired. By 1820 most trusts had been regulated by 3 to 4 acts, including an original act and subsequent renewal acts. What is most crucial for rates of return in 1820 is the maximum schedule defined in the most recent act prior to 1820. All turnpike trusts in the 1820 sample could be matched to their most recent act of Parliament using clerical summaries of legislation (see Bogart and Richardson 2011). The acts were then obtained using the Chadwyck Healy online collection or the Parliamentary archives. In a number of cases the most recent act did not state the tolls. In these cases, the next most recent act specifying toll caps is used. In the end, I have a measure of the maximum tolls applicable to every trust in my sample.

The raw data consist of the maximum tolls chargeable to different types of wagons and coaches. The types include wagons with 6, 4, or 2 horses, coaches with 6, 4, or 2 horses, and sometimes separate tolls for wagons with wheels greater or less than 9 inches. Often there was a provision in the acts forbidding trusts from charging more than two tolls a day, which implied one toll for each direction in a daily round trip. I summarize the maximum toll schedule with a single variable, the toll per horse, which is calculated as the average per horse toll across all wagon or coach categories (a simple average is all that can be done, as there is no systematic data on traffic distributions across types).

Turnpike trusts differed in terms of mileage with longer trusts usually getting higher toll caps. As a result, I standardize to the toll per-horse per-mile on a typical journey. A typical journey is easy to define for London trusts because users would travel the entire length of the road on their way to London. In general, the toll per-horse per-mile for London trusts is simply the maximum toll per horse divided by the total mileage of the trust. For market-town trusts defining the typical journey is more complicated. Here I divided the toll per-horse by the total mileage managed by the trust or if multiple turnpike roads were involved by the distance from the market town to the largest city along the turnpike road. As there is likely to be some error in

defining a typical journey for market town trusts, I also consider the maximum toll per horse without standardizing for distance as an alternative.

The average toll cap per wagon horse, per mile is 0.03 shillings (see table 1). The magnitude of the tolls can be compared with data on freight rates. The evidence from land carriage rates suggest that freight rates were no more than 1.66 per shillings per ton mile in the 1810s (Bogart 2005b). A typical wagon drawn by four horses would carry 2.8 tons in the early 1800s, earning 4.8 shillings per mile. Thus the average toll per ton per mile was thus less than 1 percent of the total freight charge. By any standard this represents an extraordinarily low toll.

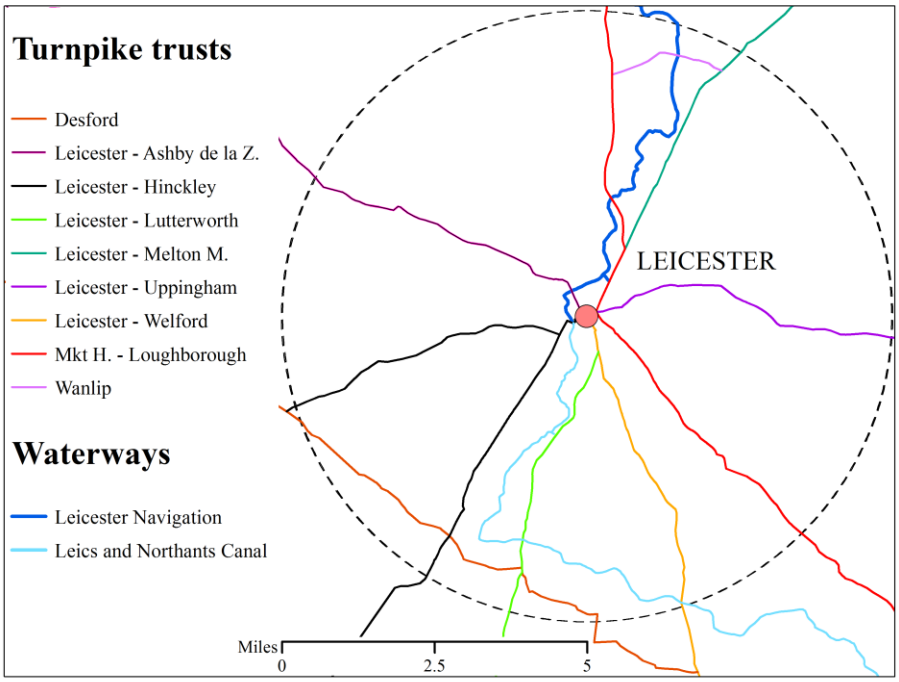
The average toll cap per coach horse, per mile is similar at 0.034 shillings. The average passenger fare per mile in the 1810s was 0.327 shillings. The average maximum coach toll per passenger mile for a typical coach drawn by four horses and carrying six passengers would be 0.023 shillings or 7 percent of the total fare. These figures are also broadly consistent with Barker and Gerhold (1995), who argue the tolls equaled between 10 and 15% of total costs for passenger firms in the 1820s.

The Hotelling model outlined earlier suggests that the distance to alternative turnpike roads may be a key factor in determining rates of return. Market towns had a radial network of independent turnpike roads as illustrated in Figure 8 for Leicester, the largest city in the East Midlands. If the distance from a turnpike to its neighbors serving the same market town was short then there was greater potential for competition. I test this theory by identifying a 5-mile radius around each market town (see Figure 8 below). I then calculate the distance to the nearest independent turnpike road serving the same market town. The average is 5.12 miles across all 73 turnpike trusts serving a market town. There was one market town with a single turnpike trust managing all roads into the city. I identify this trust with an indicator variable.

The total number of turnpike miles with a 5-mile radius of the city is also potentially relevant. If a market town has many turnpike miles then its traffic will be distributed across more roads and hence rates of return may be lower on average. Notice that distance to the nearest turnpike road already captures some of this effect, but there are some trusts that controlled multiple roads into the city. In the extreme case where there is a single trust serving the market town then its profits will depend on the total number of roads into the city, not the distance to

alternatives. The average market town trust served a market with 30.1 turnpike miles within a 5-mile radius. Leicester shown in Figure 8 had 45 turnpike miles within a 5-mile radius suggesting it was somewhat atypical.

Figure 8: Radial Network of Turnpike Roads near Leicester

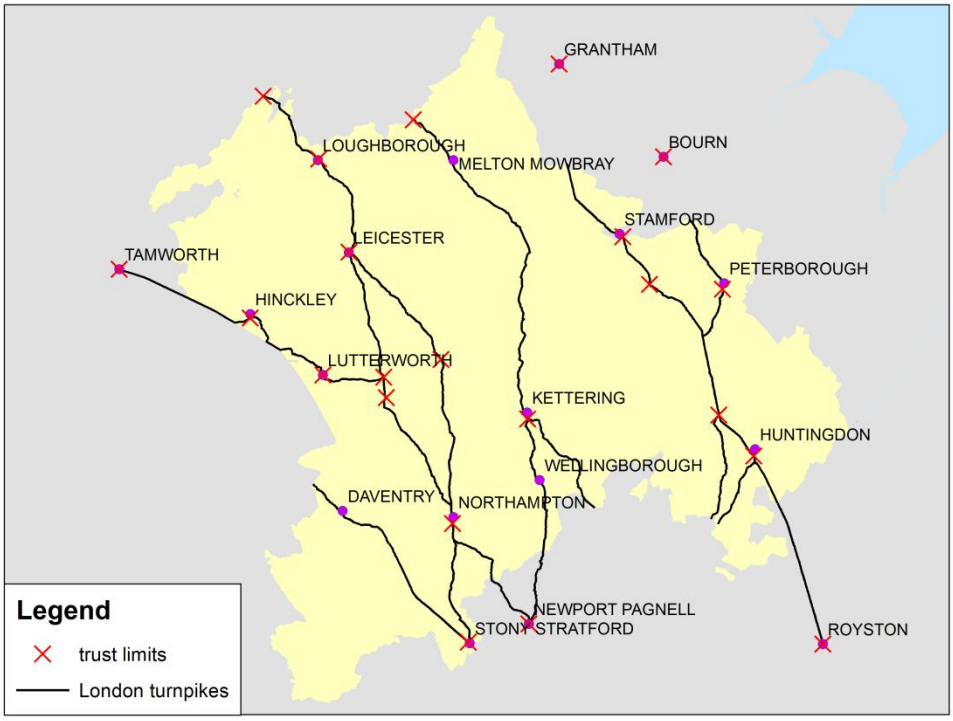


For each market town turnpike, I also calculate the distance to the nearest river or canal connecting to the same market town. The resulting variable has a mean of 3.64 miles for market town turnpike trusts. For some trusts, users at the 5-mile marker would need to travel more than 5 miles by road to use a waterway making the water alternative less viable. An example is the Leicester-Uppingham trust in Figure 8. It was more than 5 miles from the Leicester navigation and the Leicester and Northamptonshire canal. I identify trusts greater than 5 miles from a waterway with an indicator variable. There are also some cities with no water transport. Around 9 percent of all trusts serving market towns were in this situation. I test whether their returns were higher as a result of no water competition.

For the 44 turnpike trusts serving the London market, I identify the locations where a traveler would enter the turnpike on their way to London. At that point, the shortest distance to the nearest turnpike road serving the London market is calculated. The idea is that a London traveler

considering whether to enter a turnpike would consider the distance to the nearest turnpike that served the London market. Figure 9 illustrates the points where a traveler in the East Midlands entered a new London-bound turnpike road with an "x." At that point the distance to any point on the nearest turnpike road is calculated. The average distance across all London trusts was just under 7 miles. I also calculate the distance to the nearest river or canal that connected with the Thames in London. The average distance was 11.5 miles. As with market town trusts, there is some threshold distance at which water competition is irrelevant. I use an indicator for distances greater than 10 miles to capture the effect.

Figure 9: Trust limits in the East Midlands Region



The last regulatory variable calculates the average mileage of the other turnpike trusts sharing the same route and closer to London. According to double marginalization theory, having more downstream firms worsens the coordination problem for the upstream firm and increases the likelihood of prices exceeding the optimum for the unified monopolist. A lower average mileage would indicate more trusts sharing the same route with the upstream trust and greater potential for double-marginalization. The prediction is that rates of return should be negatively related to the average mileage of trusts on the same route and closer to London.

Several control variables enter the analysis (see the bottom panel of table 1). To control for local economic effects, I calculate the total population within a 10-mile radius. The total population within 15 miles is also calculated but it gave less precise results. Population data comes from the 1801 census and locations are identified using the average latitude and longitude coordinates for the parishes along the road. I also calculate the distance to London using the same location information. Note that being closer to London is not necessarily better. London's hinterland was largely agricultural and the economic density within 100 kilometers of London was lower compared to areas more than 100 km. For market town trusts I also calculate the population of the market town. The average trust served a market town with a population of 5454 in 1801. Sixteen percent of market town trusts also served multiple cities and are identified with an indicator variable.

Another control variable is the age of the trust, specifically whether it was formed between 1809 and 1820. The returns for new trusts are likely to be different because of the noise in the data. Ideally, we want to relate net returns on capital, or revenues minus operating expenses divided by capital. Expenditures in the 1821 report do not distinguish between investment and operating expenditures. For the older trusts in 1820 most expenditure reflects operating expenses because they have already improved the road. Expenditures for new trusts include improvements so the error in measuring their returns is larger. Also new trusts may have come to an agreement with bondholders to defer payments over the first few years as they get the turnpike road running. The return to bondholders is thus likely to be lower for new trusts.

IV. Empirical Specification

There are a number of issues in specifying the model. First, some variable are calculated for market town trusts only and others for London trusts only. For example the distance to the nearest turnpike road is defined differently for market town trusts and London trusts. On the other hand, several variables are common across the trusts. One example is total population within 10 miles. Thus there is a choice between running two separate regressions or pooling all the observations and using indicator variables and interactions to capture variables constructed in one sub-sample only. I choose to pool all the observations and create an indicator variable for London trusts and market town trusts along with interactions. To give an example, the distance to the nearest turnpike for London trusts is measured for 44 trusts. All market town trusts that are

not London trusts are given a common arbitrary value for this variable and then it is interacted with an indicator for London trusts. The market town dummy variable captures this arbitrary value. The pooling approach should maximize the information contained in the common variables when estimated sample-specific variables.

A second issue is the functional form. My analysis is motivated by theoretical models such as the Hotelling model or the standard monopoly model, but I am not estimating a structural model. I chose to estimate a simple linear regression with most variables entering without any interaction terms derived by theory. For example, a variable like the wagon toll cap is included without any interactions other than with indicators for London trusts or market town trusts. There are some exceptions. The distance to neighboring turnpikes and rives includes a threshold variable, like distance greater than 5 miles, because the Hotelling model has a threshold characteristic: beyond some distance competition is entire absent.

The third issue concerns endogeneity. In the baseline model all the regulatory and market structure variables are assumed to be exogenous. One could pick on this assumption variable by variable, but it should be pointed out that market structure was largely a function of decisions made other actors than the trust. For instance, take the Leicester market illustrated in figure 8. Entry decisions by turnpikes and canals were made over a period of 75 years from 1726 to 1800 by numerous individuals. No individual trust dictated the market form. Perhaps the most troubling assumption is that toll caps were exogenous. Later we address this issue by constructing an instrument. To begin I analyze what can be termed the ‘correlates’ of rates of return.

V. Baseline Results

The correlation between rates of return on capital and several variables is reported in table 2. As expected the variables for the population within 10 miles and the distance to London are positive and significant. Greater local population and greater distance from the metropolis, capturing greater economic density outside the London hinterland, both lead to higher returns. Greater population of the market town served by the trust and serving more than one market town are also positive as expected, but neither has a statistically significant relationship with the rate of return on capital. The indicators for serving the London market or serving market towns

are not mutually exclusive categories as some trusts did both. The coefficients do not have a direct interpretation as they capture the arbitrary choices of variables missing in either sample. One could test for a London market effect using a different specification, but it is not the main focus here.

Table 2: Correlates with Rate of Return on Capital

	coefficient	Robust standard. error
Total Population with 10 miles Radius of trust	0.0001294	(0.0000152)***
Average distance from London in KM	0.045	(0.02)**
Population of Market Town served by trust	0.000019	(0.00022)
Indicator if trust serves two market towns	0.908	(1.209)
Indicator if Trust was formed since 1809	5.39	(5.71)
Indicator if trust served London	-4.06	(5.69)
Indicator if trust served market town	15.78	(6.25)
Length of Trust in Miles	-0.148	(0.071)**
Indicator if Trustees are mostly Landowners	-4.44	(2.77)
Indicator if Trustees info. is missing	-42.66	(24.95)*
(London Indicator)*(Landowner trust indicator)	-0.01	(0.259)
(market town Indicator)*(Landowner trust indicator)	0.501	(0.495)
Toll cap per wagon horse, per mile	326.1	(105.5)***
Toll cap missing	-742.9	(519.5)
(London Indicator)*(toll cap wagon)	6.97	(86.1)

(Market town Indicator)*(toll cap wagon)	-400.5	(104.1)***
Turnpike miles within 5-mile radius of Market Town	-0.091	(0.12)
Indicator if trust is only one serving market town	-9.37	(11.66)
Distance to nearest turnpike, London Trusts	0.152	(0.127)
Distance to nearest turnpike, market town trusts	-0.595	(0.545)
Average Mileage of Trusts on Same Route & Closer to London	0.224	(0.554)
Distance to nearest river or canal, London trusts	-0.018	(0.11)
Distance to nearest river or canal >10, London trusts	4.79	(4.65)
Distance to nearest river or canal, Market Town trusts	0.626	(0.451)
Distance to nearest river or canal >5, Market Town trusts	-2.17	(1.95)
Indicator if Market town has no river or canal	9.23	(5.21)*
Constant	-13.4	(5.45)**
N	94	
RSQUARE	0.79	

Standard errors are clustered on constituencies. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% level respectively

One of the first interesting results concerns the average size of the trust in miles. Greater mileage is negatively and significantly associated with rates of return. Thus larger trusts fared worse in terms of returns. The result runs counter to the arguments of some parliamentary committees in the 1820s who believed that smaller trusts were cost inefficient. If that were so one would think that size was associated with higher rates of return because operating costs would be lower.

The difference in returns between trusts dominated by landowners and trusts controlled by a mixture of groups, like merchants and landowners, is interesting in its own right but it also

has implications for effects of the non-profit form. Landowners potentially earned higher indirect benefits from good roads and low tolls, and thus were more willing keep net revenues low. The results are consistent with this theory, at least in terms of the sign. Landowner dominated trusts earned lower returns (4.4 percent according to the results), but the coefficient is not statistically significant. The results also show little difference in the landowner effect depending on whether trusts served the London market or local markets. The variable for trusts where information on trustees is missing is negative and highly significant.

The next variables of interest relate to the toll caps. Wagons toll caps and coach toll caps are highly correlated in the sample and they test the same theory that Parliament set binding toll caps. Therefore both types of caps are not included in the same regression. The results for wagon toll caps are reported in table 2. Wagons tolls per mile are positively and significantly associated with rates of return. However, the interaction effects show a positive association only for trusts serving the London market. For market town trusts there is no relationship between wagon toll caps and rates of return. The result is very similar when coach toll caps are used instead of wagon toll caps. On these findings, Parliament appears to have been a more effective regulator in the London market by setting binding toll caps. Later we will consider why regulatory outcomes were different in the London market.

Market structure is another potentially important factor. One hypothesis is that rates of return are lower for trusts serving for market towns with more turnpike mileage. In other words, there might have been some 'over-building.' The negative sign on the variable for the total number of turnpike miles within a 5-mile radius of the market town is consistent with this theory but it is not statistically different from zero. The distance to nearest turnpike road gives a more precise test of the market structure argument. For trusts serving the London market the coefficient on the distance to the nearest turnpike road is positive as expected. For trusts serving market towns the coefficient has the 'wrong' sign. In both cases the coefficients are not significant suggesting there is no clear effect from proximity to other trusts serving the same market.

Competition could also occur between turnpike trusts and rivers or canals. Distance to the nearest river or canal serving the same market is one indicator for potential competition, but it does not have any strong relation with rates of return in table 2. Perhaps a more stark measure for

competition is whether there was or was not a river or canal that could act as a competitor. Using this metric there is some evidence for competition. The coefficient on the indicator for trusts serving markets with no river or canal is positive and significant. Overall the evidence suggests some role for competition between waterways and turnpikes, but not between turnpike trusts. Inland waterways were common throughout England and Wales. Most towns of 2000 or more had a navigable river or canal. Of the sixteen cities in the nine counties studied here, only two did not have water link. Thus competition from waterways was factor in many markets. It is important to note though that inland waterways were probably less effective in the London market because of its circuitous form. The river network in the east midlands and the Grand Union canal provided a water route to London via the Thames, but it was far from direct. Internal water transport to London does not appear to be a viable substitute to turnpike travel in this region.

A final factor to consider is the fragmentation of authority along the London routes. Following the theory of double marginalization trusts that had a large number of other trusts between them and London may have lower rates of return because the tolls were set above the monopoly rate. According to this view, a higher average mileage for trusts on the same route to London should mitigate the coordination problem. The theory is based on an unregulated market which is now questionable given the results for toll caps. Nevertheless there may still be some residual effect of route fragmentation. The results however show no such effect. The coefficient on the variable for the average mileage for trusts on same route and closer to London is positive but statistically insignificant. Given the results, it appears that either trusts did cooperate or some other factor mitigated the effects of fragmentation. Toll regulation is one candidate factor.

The interest payment to bondholders as a percent of debt is another type of return variable. If the preceding variables have a similar relationship with the returns to bondholders as they do with the rate of return on capital then there is powerful evidence that they affected returns more generally. Table 3 reports tobit regressions using the interest payment to bondholders as a percent of debt as the outcome variable. The upper bound is 4.75 corresponding to the maximum interest rate in the sample.

Most of the variables have the same sign and statistical significance as in the analysis of the rate of return on capital. Higher toll caps are significantly associated with higher returns to

bondholders, but only for London trusts. Trusts serving market towns without rivers or canals have significantly higher returns to bondholders. Consistent with this finding, greater distance to rivers or canals serving the same market town is significantly associated with higher returns to bondholders. The only difference is that greater trust mileage is not significantly related to returns to bondholders. This variable had a negative relationship to the return to capital. On the whole, the analyses of returns to bondholders and returns on capital invested give the same conclusions with respect to the regulation and market structure variables

Table 3: Correlates with the Interest Payment to Bondholders

	coefficient	Robust standard. Error
Total Population with 10 miles Radius of trust	0.000091	(0.0000389)**
Average distance from London in KM	0.026	(0.01)***
Population of Market Town served by trust	0.0000038	(0.00011)
Indicator if trust serves two market towns	-1.48	(0.776)*
Indicator if Trust was formed since 1809	-4.68	(1.41)***
Indicator if trust served London	-0.496	(2.14)
Indicator if trust served market town	2.54	(3.64)
Length of Trust in Miles	-0.033	(0.034)
Indicator if Trustees are mostly Landowners	-0.759	(0.708)
Indicator if Trustees info. is missing	-6.74	(6.54)
(London Indicator)*(Landowner trust indicator)	0.11	(0.15)
(market town Indicator)*(Landowner trust indicator)	0.153	(0.206)
Toll cap per wagon horse, per mile	290.5	(140.4)**
Toll cap missing	-370.1	(253.2)

(London Indicator)*(toll cap wagon)	-11.06	(44.83)
(Market town Indicator)*(toll cap wagon)	-327.5	(136.4)**
Turnpike miles within 5-mile radius of Market Town	0.041	(0.057)
Distance to nearest turnpike, London Trusts	0.1008	(0.095)
Distance to nearest turnpike, market town trusts	0.264	(0.221)
Average Mileage of Trusts on Same Route & Closer to London	0.072	(0.144)
Distance to nearest river or canal, London trusts	0.049	(0.053)
Distance to nearest river or canal >10, London trusts	-0.85	(1.5)
Distance to nearest river or canal, Market Town trusts	0.447	(0.215)**
Distance to nearest river or canal >5, Market Town trusts	-1.16	(1.05)
Indicator if Market town has no river or canal	5.29	(2.78)*
constant	-6.64	(4.46)
N	93	
RSQUARE	0.19	

notes: results are obtained using a tobit model with 4.75 as the upper bound. Standard errors are clustered on constituencies. *, **, and *** indicate statistical significance at the 1%, 5%, and 10% level respectively

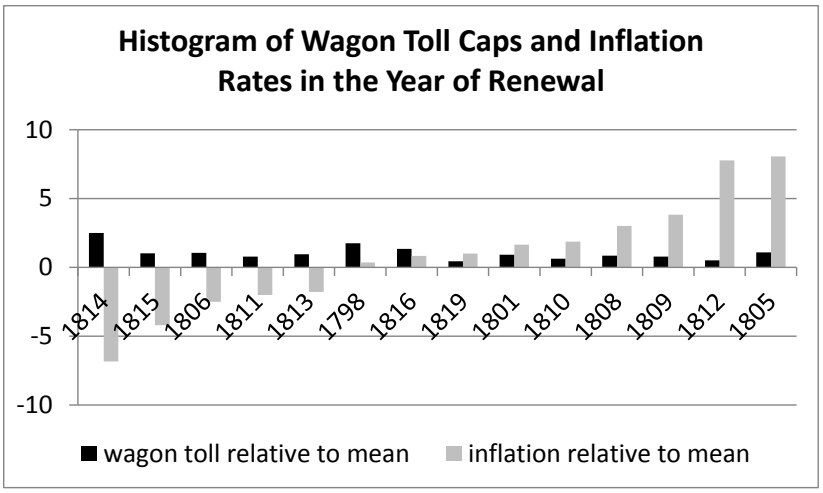
One of the most intriguing results concerns the relationship between toll caps and rates of return. It would appear that parliament kept rates of return low by setting binding toll caps on turnpike trusts in the London market. The finding is intriguing as it suggests a direct role for Parliament in reducing rent-seeking. However, before accepting this conclusion we need to address the potential endogeneity of toll caps. The toll caps were part of the regulations Parliament imposed on turnpike trusts in their act. The provisions of acts, including the tolls, are something of a black-box. We know that Members of Parliament (MPs) approved provisions, but they did not necessarily author them. Interest groups, including trustees, had some input. Of

concern for my empirical analysis is the possibility that MPs set the tolls based on their expectations of rates of return. For example, if MPs granted higher tolls to trusts with characteristics they thought would lead to lower surpluses then the estimated effect of toll caps would be biased downwards. A similar bias could result if interest groups lobbied for lower toll caps on trusts that had more market power and hence would otherwise earn higher surpluses. IN the following section, we address the endogeneity problem using the inflation rate and the consumer price index in the year each turnpike trust had its last renewal act.

VI. Did toll caps really constrain trustees?

Turnpikes trusts operated under a temporary authority. Trusts had to renew their original act after 21 years. Some renewed earlier in order to alter their rights, in which case they had to renew a second time in 21 years plus whatever time they had remaining on their original act. Thus trusts might renew around 21 years and again at 42 years, while others might first renew at say 10 years and again at 42 years. By 1800 most trusts had at least one renewal act and sometimes more. Most had to renew in the 1800s or their authority would be suspended. Macroeconomic and political conditions at the time of their renewal had an effect on the types of regulations trusts received. Of particular interest to this study, there is a negative correlation between toll caps and the inflation rate in the year of renewal. The pattern is strongest for wagon tolls. Figure 10 orders years from the lowest to the highest inflation rate relative the sample mean from 1798 to 1819. As can be seen, the early 1800s were a time of great price volatility. The figure also graphs the average wagon toll per horse per mile in each year relative to the sample mean. There is a tendency for the wagon toll to be higher in low inflation years and for it to be lower in high inflation years (the correlation coefficient is -0.54).

Figure 10: The correlation between Wagon Toll Caps and Inflation



The source of this variation could be political. In years of high inflation workers suffered because their wages were more rigid than food prices. When real wages fall workers can threaten to riot—a real concern in the early 19th century. Thus politicians might have tried to appease the working classes by keeping the tolls low. Tolls were quite visible in local communities and perhaps it would have been impolitic to increase a disliked tax in a time of crisis and dearth.

The inflation rate and consumer price index at the time of renewal are potentially good instruments as they have some explanatory power for toll caps set by Parliament (below we establish the correlation in more detail). The inflation rate and CPI are also likely to be independent of unobserved characteristics of a trust, our main source of endogeneity. By the date of their original acts many trusts were forced to renew their authority at a particular date. Trusts likely had some long term plan of renewing at intervals of 21 years and when inflation unexpectedly hit they could not alter renewal schedule. In other words, some trusts were 'unfortunate' in that they had to renew in times of inflation.

The two-stage least squares results are shown in table 4. The inflation rate and consumer price index are negatively correlated with the toll cap as suggested above. The first stage F-statistics for the instruments are not as large as one would hope, but they are not overly small. The second stage results show a positive and statistically significant effect of wagon tolls on rates of return. The coefficient on coach tolls is positive but is not significant at conventional levels (the p-value is .103). Also telling the coefficients in the 2SLS are not significantly smaller than OLS. The coefficient for wagon tolls decreases from 333 to 235 but it is within a 90 percent

confidence interval of the OLS estimate. Somewhat surprisingly given my earlier argument about potential biases, OLS appears to be upward biased.

Table 4: the effect of toll caps on rates of return in the London Sample, IV results

Variable	wagon tolls coeff. (Stan. Err.)	coach tolls coeff. (Stan. Err.)
	first stage	
INFLATION_RENEWAL	-0.1070	-0.066
	(0.028)**	(.021)**
CPI_RENEWAL	-0.003	-0.0003
	(0.011)	(0.008)
	second stage	
TOLL_WAGON	234.9	
	(96.1)**	
TOLL_COACH		382.9
		(229)
all controls included	Yes	Yes
F-stat first Stage	6.99	4.57
N	44	44

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level respectively.

Overall the results generally confirm the earlier finding that tolls were a binding constraint on rates of return for London trusts. As we have seen, the same conclusion does not hold for trusts serving market towns. Why did toll caps have a different effect on market town trusts than London trusts? Although it is difficult to give a precise answer it is likely that Parliament had better information on the London market. There were several long distance routes into London all of which shared similar characteristics. They were all managed by turnpike roads and passenger traffic was a significant component in all cases. Within each long-distance route there were also multiple trusts operating in similar demand and cost conditions. It is conceivable that if Parliament experimented with the toll caps on London routes, it could learn what the effects

could be given that many other factors were held constant. By contrast, there were relatively few turnpike roads into any single market town and conditions could vary across market towns quite substantially. Parliament would have had a hard time learning about such idiosyncratic market conditions.

One could also argue that Parliament had a greater incentive to limit rates of return in the London market because it was important politically. As the largest city, greater attention was paid to London than any other city. By acting as a good regulator in the London market, Parliament could credibly show its ability to govern at a time when the Napoleonic wars were creating turmoil in Britain.

VII. Conclusion

The Britain pursued a unique infrastructure policy during its industrializing era by granting monopoly rights to improve or construct roads, rivers, canals, bridges, and ports. The policy might have contributed to substantial rent-seeking through the exploitation of monopoly power. It did not. Why? This paper argues that regulation mattered. It shows that inter-modal competition from the river and canal network and binding toll caps set by Parliament contributed to modest returns.

The results offer lessons for regulation of public private partnerships today. Current theories of regulation suggest that price caps can be an effective tool for regulators to reduce monopoly power (see Laffont 2005). History shows that maximum tolls can indeed limit monopoly power. However, they also point to the importance of ownership policies and competition. Regulators should consider these alternative mechanisms.

A broader implication concerns the sources of integration in Britain's markets. A key factor in keeping tolls low—and hence in keeping markets integrated—was the regulatory system. Without effective toll caps, competition, and creative ownership policies, the advantages of Britain's infrastructure and transport network would have been partially offset by higher tolls. If so, Britain's industrialization might have been delayed or hobbled altogether.

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