Turnpike Trusts and Property Income: New Evidence on the Effects of Transport Improvements and Legislation in Eighteenth-Century England[1]

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Summary

Numerous acts of Parliament changed the financing of transport infrastructure in eighteenth century England. This paper examines the economic effects of turnpike acts, which greatly improved road infrastructure by introducing tolls. It shows that turnpike trusts increased property income or land rents in local areas by at least 8 percent. The findings shed light on why local property owners promoted and managed turnpikes. They also show that turnpike trusts contributed to nearly a third of the total growth in real land rents between 1690 and 1815 and added at least 0.6 percent to national income in 1815.

Scholars have long debated which factors contributed to economic growth in eighteenth century England. The most commonly cited factors are an abundance of coal, a skilled workforce, an entrepreneurial landowning class, high urbanization, greater access to colonial markets, and favorable political institutions. Recently there has been renewed interest in how local legislation affected investment and productivity.[2] Between 1690 and 1830, numerous acts of Parliament changed the financing of infrastructure or altered property rights in land. Enclosure acts are perhaps the most well known type of legislation because they eliminated common pastures and collective decision-making in agricultural villages. Canals acts are also well known because they fostered the most celebrated transport improvement before the railways.

Turnpike acts were another type of legislation that dealt with transportation infrastructure. Turnpike acts created a body of trustees and gave them authority to finance road improvements by levying tolls and issuing secured bonds. The trustees were typically local landowners and merchants who had a direct interest in the improvement of roads. The literature has shown that turnpike trusts generally increased road investment and helped to reduce transport costs.[3] Their effects on land rents or property income are not well established however. Contemporaries suggested that some turnpikes increased land rents, but there is no econometric evidence which establishes this point.

In this paper, I measure the effect of turnpike trusts on local property income using several data sets. I combine information on the location of turnpike trusts with the 1815 Real Property Assessment and the eighteenth century Land Tax in over 3000 parishes. Turnpike locations are also linked with more than 1600 observations on plot-level land rents in the Charity Commission Records. I analyze the effects of turnpikes trusts using panel data and instrumental variables techniques. The instruments are location on a major London route or cross route in the

seventeenth century. Both of these variables are highly correlated with turnpike adoption, and are arguably unrelated to unobserved productivity differences. The panel data estimates show that property income or land rents increased by 7 to 10 percent after turnpike trusts were established in a parish. The two-stage least squares estimates imply that turnpike trusts increased local property income by as much as 27 percent. Overall the results show that turnpikes contributed to higher property income and land rents.

The findings have several implications for the literature on turnpike trusts and the English economy during the eighteenth century. First, there is a puzzle as to why local landowners and merchants promoted and managed turnpike trusts when the acts forbade trustees from earning direct profits through the tolls. My results show that the potential to earn indirect benefits through higher property income provided one motivation.

The findings also show that turnpike trusts contributed to economic growth. The estimates imply that turnpikes were responsible for at least 9 percent of the total growth in land rents between 1690 and 1815, and likely more. They also show that turnpikes generated a social savings of at least 0.6 percent of national income in 1815. More generally, the findings suggest that acts changing property rights and the financing of infrastructure were a contributing factor to English economic growth during the eighteenth century.

The paper is organized as follows. Section I provides an overview of turnpike trusts and the related literature. Section II introduces the data. Section III discusses the methodology. Section IV shows estimates of the effect of turnpike trusts on property income and land rents. Section V checks the consistency of the results using other information. Section VI concludes and further discusses the implications.

I.

There was a great need for transport improvements at the beginning of the eighteenth century. The road network, in particular, was in poor condition because of increasing traffic, limited expertise in road maintenance and construction, and most importantly, an ineffective system for road financing. According to the Statute for Mending Highways, passed in 1555, all parishes or townships were responsible for road maintenance in their jurisdiction.[4] Parish and county officials could force local inhabitants to work on the roads for up to six days per year. Later acts gave officials the right to levy taxes on property income. Despite these legislative expedients, parishes spent little, and roads were often described as 'ruinous' or 'impassible.' The main problem was that parishes could not tax road-users, and therefore they could not appropriate any of the benefits from through-travelers. Parishes also had difficulties borrowing to pay for the high costs of widening and resurfacing.

The turnpike act emerged as a solution to the problems of the parish system. Turnpike acts named a body of trustees and gave them authority over a road that was previously maintained by several parishes. Trustees were granted a number of new rights. They were allowed to levy tolls, issue secured bonds, and purchase land. Turnpike acts also placed restrictions on trustees. For instance, they could not levy tolls above a maximum schedule, and they could not earn profits from the tolls. Instead, trustees had to devote all the revenues to road maintenance, salaries, interest, and debt payments.

Turnpike acts became very common during the eighteenth century. Figure 1 plots the annual number of acts creating new turnpike trusts between 1663 and 1836. The first turnpike act was in 1663, but they were not passed regularly until the 1690s and early 1700s. The first burst of turnpike acts occurred during the 1720s and included the establishment of 46 trusts. The second

and largest burst occurred during the 1750s and 1760s. It included the passage of over 300 turnpike acts and applied to over 10,000 miles of road. By the 1830s there were over 900 trusts managing approximately 20,000 miles or 17 percent of the entire roadwork.[5]

By 1770 turnpike trusts proliferated throughout the road network. Eric Pawson's map shows there was a dense network of turnpike roads near cities in the West and North (see Figure 2). Some of these cities were undergoing the early stages of the Industrial Revolution, like Birmingham, Manchester, and Sheffield, but others were growing more slowly, like Frome, Gloucester, and Hereford. In the Southeast, the turnpike network was less dense and largely consisted of the major roads leading to London.

Figure 3 provides a more detailed perspective by illustrating the turnpike network in Bedfordshire. The dashed lines represent parish boundaries and the dark lines represent turnpike roads. Individual turnpike trusts usually passed through 5 to 10 parishes, or between 10 and 15 miles. It was also common for several turnpike roads to link the largest city, in this case Bedford, with its hinterland and other cities in neighboring counties. Lastly, it was common for major turnpike roads to pass through counties on their way to London. In Bedfordshire, two major turnpike roads passed through the southwestern and eastern part of the county.

A large body of research focuses on whether turnpike trusts affected road investment and transport costs. Most studies find that turnpike trusts raised road expenditure and reduced transport costs. For instance, there is evidence that turnpike trusts contributed to around half of the 40 percent reduction in freight charges and passenger travel times between 1750 and 1820.[6] There has been less research on whether turnpike trusts increased local property income. Some contemporaries argued that turnpike trusts increased land rents. For example, Arthur Young claimed that land rents increased from 7 to 11 shillings per acre once the Horsham to Epsom

turnpike trust was established in 1755.[7] However, beyond statements like this, there is little evidence that turnpikes raised property income in the locations where they were established.

There are several reasons why turnpikes trusts may have raised land rents. First, turnpikes gave farmers greater access to markets by reducing transport costs. Greater access to markets allowed farmers to earn higher prices for their products, or to shift to higher value produce, such as meat or dairy products. Second, lower transport costs contributed to greater productivity in agriculture. For example, farmers generally did not pay tolls when carting manure or lime along turnpike roads. Thus it was more advantageous to use these fertilizers, and raise output per acre. Turnpikes also reduced communications costs, which gave farmers better information about market conditions and new techniques.[8] In short, if a parish had a turnpike road, then small holders may have realized higher income, or large landowners were able to charge higher rents.

Turnpikes may have also contributed to higher property income through the growth of manufacturing. Turnpikes were often established in areas that already had manufacturing, but they could have encouraged more firms to locate in a particular city because they offered greater access to markets, or because they lowered the cost of obtaining information. The addition of more manufacturing led to investment in buildings and housing which added to property income. It also raised population which increased land rents.

Turnpikes could have also reduced manufacturing elsewhere by drawing firms away. Agglomeration economies encourage firms to locate near one another. If turnpike trusts decreased the attractiveness of one location in favor of another, then they would have contributed to depopulation and lower property income. The implication is that turnpikes may have increased property income in the parishes where they were located, but reduced property income in neighboring locations.

There is an opposite argument that parishes benefited from having more turnpikes in their general vicinity or region. Greater numbers of turnpikes allowed farmers and firms to access several markets, whereas a single turnpike provided access to only one. Therefore, property income may have increased in parishes that had a greater density of turnpikes in their area.

The effect of turnpike trusts on property income is relevant for a number of issues in the literature. Turnpikes were generally promoted and managed by local elites. For instance, in 1718, the Sheriff, Deputy Lieutenant, Justices of Peace, gentlemen, freeholders, and inhabitants near Stokenchurch promoted a turnpike bill along their segment of the London-Oxford road.[9] A Parliamentary survey in 1821 confirms that many trustees were locals who derived income from land. It also shows that some trustees earned income from 'general' or 'personal' sources, which meant they were involved in trade or possibly manufacturing.[10]

Several scholars have suggested that landowners and merchants served as trustees because they hoped to benefit through higher property income or profits. For example, Richard Wilson discusses how the merchant community in Leeds served as trustees because the woolen textile industry depended on a well-maintained road network.[11] Anne Thomas argues that pottery manufacturers, such as Josiah Wedgewood, served as trustees in Staffordshire because they needed good roads to bring their products to local markets or nearby rivers for shipment abroad.[12] William Albert shows that turnpike investors were generally local landowners. He discusses a particular case where an agent advised a landowner to invest in a proposed turnpike road because 'when it is executed twill be of Utility & Benefit to your estate'.[13] In this paper, I address what motivated local landowners by examining whether turnpikes increased property income in the locations where they were adopted.

Scholars have also examined the possibility that turnpike trusts had negative effects for some groups or locations. William Albert argues that riots against turnpike trusts were driven by concerns over the payment of tolls, and the potential loss of income.[14] Eric Pawson suggests that turnpike trusts contributed to the decline of some towns by reducing transport costs and increasing inter-city competition.[15] My analysis addresses the negative effects of turnpikes by studying whether they reduced property income in parishes within 5 or 7.5 miles.

Lastly, my analysis addresses whether the growing volume of acts of Parliament dealing with property rights and public goods contributed to economic growth. One study uses changes in transport costs to calculate the social savings from turnpike acts. The estimates imply that turnpikes generated a social savings between 0.5 and 1 percent of national income in 1800 and 1820.[16] The gains in property income provide another way of calculating the social savings from turnpike acts, and similar types of legislation.

II.

There are several data sources on land rents or property income across England. First, there is the 1815 Real Property Tax Assessment and the Eighteenth-Century Land Tax. The Real Property Assessment was based on the annual income derived from land, houses, quarries, and mines in 1815. The assessments for each parish and township are published in the Parliamentary Papers.[17] The Land Tax was levied in every year between 1692 and 1798. The relative contribution of each county remained fixed throughout the eighteenth century and was based on an assessment of the annual income from land, buildings, and moveable goods in 1692. Moreover, the relative quota paid by each parish or township within a county was fixed by the assessment of 1692.[18] This implies that the Land Tax quota for each parish or township in a

given year is proportional to the distribution of land rents across parishes and townships in 1692. I use the 1798 Land Tax Quota because there is published information on the contribution of each parish or township in the Parliamentary Papers.[19]

The Charity Commission Records provide another data source on land rents throughout England. Charities managed assets that supported local schools, the poor, and other causes. In a parliamentary report each charity provided a retrospective history of their portfolio. The report contains over 30,000 observations on the purchase price of land or the rental value of plots between 1500 and 1910. It also identifies the parish and county where the plot was located, and in some cases whether the plot was subject to common property rights.[20]

My analysis uses both the tax assessments and the Charity records. The Real Property Assessment and the Land Tax are the most comprehensive in terms of geographic coverage. There are concerns, however, about how accurately the assessments measure land rents and property income. The charity records are advantageous because they contain multiple observations on the same plot, but the observations are often spread across several decades or even centuries. There is an additional concern that Charity plots may not be representative of plots in the broader population. Below I show that the tax data and the Charity records produce similar results. This suggests that despite their problems, these two data sets contain useful information on land rents and property income.

I collected data on the 1815 Real Property Assessment and the 1798 Land Tax Quota for over 3000 parishes or townships in eleven counties. The eleven counties include Bedfordshire, Buckinghamshire, Cambridgeshire, Hertfordshire, Leicestershire, Lincolnshire, Somersetshire, Worcestershire, Shropshire, the North Riding of Yorkshire, and the West Riding of Yorkshire. The eleven counties capture a variety of characteristics. Bedfordshire, Buckinghamshire,

Cambridgeshire, and Hertfordshire are referred to as the 'Home Counties' because of their proximity to London. Leicestershire and Lincolnshire are located in the East Midlands, and were engaged in more pastoral agriculture than the Home Counties. Worcestershire and Shropshire are in the West Midlands and combined pastoral agriculture with coal mining and metalworking. Somersetshire is located in the Southwest and combined agriculture with woolen textile production. The West Riding of Yorkshire was a densely populated industrial county in the North, also specializing in woolen textile production. Lastly, the North Riding was a thinly populated pastoral region just north of the West Riding.

The Charity data come from Greg Clark's study of enclosures.[21] I analyze the observations for all plots in Bedfordshire, Buckinghamshire, Cambridgeshire, Hertfordshire, Leicestershire, Lincolnshire, Somersetshire, Worcestershire, Shropshire, the North Riding of Yorkshire, and the West Riding of Yorkshire. The counties were chosen to ensure comparability with the tax data. I also restrict the sample to plots where a rental value is observed more than once between 1690 and 1839.

The tax data and the Charity records are matched with another data set that identifies which parishes had turnpike trusts in their jurisdiction. There was a parliamentary survey in 1840 that identifies the name of each turnpike trust and the parishes where their road passed.[22] I identified the year when each trust was established using the same survey, as well as the list of turnpike acts in Albert and Pawson. My data set also includes latitude and longitude for parishes.[23] I use latitude and longitude to calculate the fraction of parishes within a 5 or 7.5 mile radius that had turnpike trusts. Specifically, I divide the number of parishes within 5 or 7.5 miles that had turnpikes by the total number of parishes with 5 or 7.5 miles. The size of the radius is small because I am interested in the local effects of turnpikes trusts. Moreover, as the radius increases

there is a greater likelihood of measurement error, because I don't have information on turnpike adoption in all bordering counties.

The tax data and Charity records are also matched with other parish characteristics, including land area, population in 1700, 1750, 1801, 1811, and 1841, the number acres enclosed through acts of Parliament, distance to London or the nearest town, and whether the parish had a canal in its jurisdiction. Distance to London or the nearest town is calculated using the latitude and longitude coordinates. The nearest town is defined as the closest parish, township, or borough with a population density above 0.5 persons per acre in 1801. The location of canals and their year of construction are identified using data from Mike Stevens, Jim Shead, and the Phillimore Atlas.[24] The population figures after 1801 are available in the Parliamentary Papers.[25] Before 1801 they come from Penelope Corfield, and are restricted to cities with a population above 2500.[26] Given the limited information on population in the eighteenth century, I proxy for urbanization using a dummy variable for population above 2500 in each year.

My information on common rights is derived from W. Tate and Greg Clark.[27] The Charity records contain information on the fraction of plot acreage subject to common rights. To calculate a similar figure for the parish as a whole, I use information from enclosure acts. I assume that the fraction of acres enclosed between 1815 and 1875 represents the fraction of acreage subject to common rights in 1815. Similarly, I assume the fraction of acres enclosed between 1692 and 1815 represents the fraction of acreage subject to common rights in 1692.

I also identify whether a parish was located on a major London route or major cross route in the seventeenth century using the travel guide *Britannia*.[28] *Britannia* was published in a series of editions starting with John Ogilby's original version in 1675. Each edition provides a detailed description of the travel routes between London and most major cites. For example, *Britannia*

lists two major London routes which pass through Bedfordshire: the London-Holyhead Road and the Great North Road. The London-Holyhead passes through Dunstable, Houghton Regis, Chalgrave, Hockliffe, Battlesden, and Potsgrove (see Figure 3). I identify each of these parishes as being on a major London route in the seventeenth century.

Table 1 provides summary statistics on all the variables. The mean for the 1815 property assessment per acre is £2.05 and the mean for the 1798 Land Tax Quota per acre is £0.081. The 1798 Land Tax was set at 4 shillings in the pound. Multiplying the parish quota by 5 implies a mean property income of £0.405 per acre in 1692. In the charity records the average land rent per acre is £2.37 in 1815 and £0.8 in the 1690s. The lower property income implied by the tax data is likely due to the under-assessment of income in northern counties.[29] Moreover, charity plots rented for more because they were generally small in terms of acreage.[30] The high variance in property income is another important feature of the data. Most of the variance is due to the high income of urban parishes or boroughs. Below I check whether the results are sensitive to outliers by dropping parishes that were urban in 1700.

The turnpike dummy for 1815 has a mean of 0.542, which implies that 54 percent of parishes had a turnpike trust by 1815. The mean for the fraction of parishes within 5 or 7.5 miles that have turnpikes in 1815 is 0.541 and 0.547 respectively. The similarity is to be expected because the fraction of neighbors with turnpikes averages the turnpike dummy over a larger area.

III.

In this section, I describe my methodology for analyzing the effects of turnpike trusts on property income and land rents. The tax data provides information on property income per acre in each parish. Property income per acre is determined by a variety of factors, including soil

quality, distance to markets, population density, transport infrastructure, and property rights over land. The following equation describes a log-linear relationship between parish property income per acre and a set of variables in year t.

$$y_{it} = \alpha + \beta_1 pike_{it} + \beta_2 pikewithin5_{it} + \beta_3 canal_{it} + \beta_4 common_{it} + \beta_5 urban_{it} + d_t + u_i + \varepsilon_{it} \quad (1)$$

y_{it} is the natural log of assessed property income per acre for parish *i* in year *t*. $pike_{it}$ is a dummy variable that takes the value 1 if a parish has a turnpike in year *t*. $pikewithin5_{it}$ ($pikewithin7.5_{it}$) is the fraction of parishes within 5 miles (7. 5 miles) that have turnpikes. $canal_{it}$ is a dummy variable for whether the parish has a canal. $common_{it}$ is the fraction of acreage in the parish subject to common property rights. $urban_{it}$ is a dummy variable for whether the parish has a population above 2500. d_t is a dummy variable for the year *t*. Finally, u_i is a parish fixed effect and ε_{it} is an error term. The parish fixed effect captures a variety of factors which are constant over time, including soil quality, distance to markets, and location near the coast or navigable rivers. The dummy variable for time captures the general level of property income in each year.

To estimate equation (1) it is necessary to have observations in at least two years. I focus on 1815 and 1692 because the Real Property tax was assessed in 1815 and the 1798 Land Tax Quota was based on an assessment in 1692. Using these two years, one can rewrite equation (1) as the log difference in property income between 1815 and 1692:

$$\Delta y_i = \beta_1 \Delta pike_i + \beta_2 \Delta pikewithin5_i + \beta_3 \Delta canal_i + \beta_4 \Delta common_i + \beta_5 \Delta urban_i + \Delta d_i + \Delta \varepsilon_i \quad (2)$$

where Δ signifies the difference between a variable in 1815 and 1692. Notice also that the fixed effect u_i has been eliminated because of the differencing between the two years.

Equation (2) can be interpreted as a standard 'before-and-after' analysis. The coefficient β_1 identifies whether parishes that had turnpikes established between 1692 and 1815 had a higher growth in property income per acre over this period. The coefficient β_2 identifies whether parishes grew more or less if a higher fraction of neighboring parishes got turnpikes between 1692 and 1815.[31]

Equation (3) shows a log-linear relationship between land rents per acre in the Charity records and the same set of variables.

$$y_{it} = \alpha + \beta_1 pike_{it} + \beta_2 pikewithin5_{it} + \beta_3 canal_{it} + \beta_4 common_{it} + \beta_5 urban_{it} + d_t + u_i + \varepsilon_{it} \quad (3)$$

It is identical in form to equation (1), but now the subscript *i* refers to a plot rather than a parish.[32] The Charity records contain rental observations in most years between 1690 and 1840, but a particular plot is generally observed in only 2 or 3 years. Thus it is not possible to take differences of equation (3) and eliminate u_i. Instead I use a fixed-effects estimator with dummy variables for the plot and dummy variables for the year or groupings of years.

The coefficients in equation (3) have a similar interpretation as equation (2). Specifically, β_1 identifies whether plot-level land rents increased after turnpike trusts were established in a parish.[33] This is similar to estimating the log difference in property income per acre between 1815 and 1692 for parishes that got turnpikes.

The inclusion of plot or parish fixed effects controls for a variety of omitted factors, but the estimates could still be biased because of endogeneity and measurement error. The coefficient β_1 could be biased upwards, for instance, if turnpikes were adopted in parishes that were more likely to grow. This would be true, for example, if turnpikes tended to be in parishes that experienced some form of industrialization. The coefficient could also be downwardly biased because of measurement error. Some turnpike trusts undertook greater road improvements, and reduced transport costs by a higher amount. The variable $pike_i$ does not capture this variation and thus the estimated coefficient could be attenuated.[34]

I use two approaches to address endogeneity and measurement error. First, I include distance to London, distance to the nearest town, and dummy variables for each hundred as additional explanatory variables in equation (2). It is often suggested that growth rates varied substantially across and within regions during the eighteenth century. Moreover there is a belief that locations away from London were assessed differently in the Land Tax than the Real Property Income Tax. The distance variables help to minimize the bias from these factors. The hundred was a subunit of the county and usually included between 10 and 20 parishes or townships. Hundred dummies thus provide a good control for unobservable factors associated with location. For the charity data, I include county-specific time trends (i.e. the year interacted with a county dummy). The county time trends control for similar unobservable factors as the hundred dummies.

Second, I use instrumental variables to predict which parishes had turnpikes between 1693 and 1815. In other words, the probability that a parish got a turnpike is assumed to be a linear function of distance to London, distance to the nearest town, dummy variables for the hundred, and the instruments, which include dummy variables for whether the parish was on a major London route or a major cross route in the seventeenth century. The assumption that the

turnpike dummy can be modeled with a linear equation is potentially problematic because the predicted probability of turnpike adoption could be below 0 or greater than 1. Fortunately, the results are very similar when I use a probit model to predict whether parishes got turnpikes.

The instruments need to be correlated with turnpike adoption, but uncorrelated with changes in property income per acre, after controlling for their effect on turnpikes. Parishes on major London routes or cross routes had more external traffic, and thus they had a greater incentive to use tolls to finance road improvements. Moreover, the routes were presumably chosen based on the geographic location of parishes vis-à-vis major cities and not based on productivity differences between parishes. Below I use over-identification tests to confirm that location on a major London route or cross route in the seventeenth century should be excluded as a separate determinate of parish property income growth in the eighteenth century.

IV.

In this section, I discuss the regression estimates. In general, they show that turnpike trusts increased property income and land rents in the parishes where they were located. There is some evidence that turnpikes trusts also increased property income in nearby parishes, but this result does not hold in all cases. Table 2 reports estimates for various specifications of equation (2). The first column includes the control variables and the turnpike dummy only. The second column includes the fraction of parishes with turnpikes within 5 miles only. The third and fourth columns combine both turnpike variables. In all specifications, the hundred dummies are included, which is the main reason why the R-square is fairly high.

The main finding is that turnpike trusts are associated with an 8 percent increase in property income per acre. There is no relationship between the log difference of property income and the

fraction of parishes with turnpike trusts within 5 or 7.5 miles. The coefficient is larger when the variable is included alone, but it is not statistically significant. Distance to London does not have an effect in most specifications, presumably because much of its impact is captured by the hundred dummy variables. Distance to the nearest town is negatively related to property income. This finding suggests that there were gains from proximity to population centers.[35]

Before discussing the estimates of other variables, I first compare the results for the turnpike variables in the Charity data. Table 3 reports estimates for various specifications of equation (3). Each includes plot fixed effects and dummy variables for each 5-year time period starting with 1695-99 and continuing to 1835-39. The results are similar if year dummies or decade dummies are used instead of 5-year periods. The first column reports the estimates when the turnpike dummy is included without county-specific time trends (i.e. the year interacted with county dummies). It shows that land rents per acre increased by around 10 percent after turnpikes were adopted in the parish where a plot was located. The second column reports the same estimate after including the county-specific time trends. In this case, the estimated effect of turnpikes is reduced to approximately 8 percent, but it is still significant at the 90 percent confidence level. The third and fourth columns show the estimates when the variables for the fraction of parishes with turnpikes within 5 or 7.5 miles are included. Here turnpikes are associated with a 7 to 10 percent increase in land rents per acre within the parish, but there is no statistically significant relationship between land rents and greater numbers of turnpikes within 5 or 7.5 miles.

In general, the estimated effects of turnpike trusts are very similar in the Charity data and the tax data, even though they are entirely different sources. Moreover, the estimated effect of enclosures is also similar in the two data sets. In the tax data, property income per acre was 35 to 40 percent lower for parishes with all of their acreage subject to common rights. In the charity

data, land rents per acre were 31 to 36 percent lower on plots with all of their acreage subject to common rights. Both of these estimates are consistent with the findings from Greg Clark.[36] The results differ with respect to the urban and canal dummies. In the tax data, urbanization and canals have a large positive effect on property income, but not in the Charity data. The small sample size may be an explanation for this anomaly, because among the counties studied in the Charity data, there were few plots in large cities or in parishes where canals were built.

I now address whether endogeneity or measurement error significantly bias the results. Table 4 reports two-stage lease square estimates using the tax data. The first column shows first-stage estimates for a linear regression of the turnpike dummy on distance to London, distance to the nearest town, hundred dummies, and dummies for whether the parish was located on a major London route or cross route in the seventeenth century. The second column shows the second-stage estimates of the log difference in property income on distance to London, distance to the nearest town, hundred dummies, and the predicted probability of having a turnpike by 1815. The urbanization, common acreage, and canal variables are all dropped from these equations because they are endogenous, and there are no available instruments. For the moment, I also drop the fraction of parishes with turnpikes within 5 or 7.5 miles because they are also endogenous.

The two-stage least square estimates show that turnpikes increased property income by approximately 27 percent. In other words, the effect of turnpike trusts increases substantially after addressing endogeneity and measurement error problems. The results also show that parishes on major London routes or cross routes in the seventeenth century were much more likely to get turnpikes. These findings confirm that the instruments are strongly correlated with the turnpike dummy. I also use over-identification tests to check that the instruments are independent of property growth except through turnpikes. The over-identification test regresses

the residuals from the second stage property growth regression on the instruments and the other exogenous variables. The results are reported in table 5. As expected, the R-square is very small and the dummy variables for whether the parish was located on a major London route or cross route are insignificant. These results provide additional confirmation that the instruments should not be included as separate determinates of the log difference in property income.[37]

Other specifications also show that turnpikes caused property income to increase. If the two-stage lease squares model is estimated with the other endogenous variables like canals, the fraction of common acreage, and urbanization, then turnpikes increase property income by approximately 24 percent. If the two-stage model is estimated after dropping parishes or boroughs that were urban in 1700 then turnpikes increased property income by 28 percent. Finally, if a probit equation is used in the first-stage, instead of a linear equation, then turnpikes increased property income by 25 percent.

I also use a two-stage least squares model to determine whether a higher fraction of parishes with turnpikes within 7.5 miles caused property income to increase or decrease. In this case the instruments are the fraction of parishes on major London routes or cross routes within 7.5 miles and the fraction of parishes within 7.5 miles that were urban in 1700. Table 6 reports the estimates where the turnpike dummy is now dropped from the analysis. The fraction of parishes on major London routes or cross routes within 7.5 miles continues to be strongly correlated with turnpike adoption, and like before, over-identification tests confirm they should be excluded from the property income equation. The main finding is that property income increased by 20.5 percent if half of the parishes within a 7.5 mile radius had turnpikes. In other words, the instrumental variables estimates show there was a large positive effect on property income from having more turnpikes in the vicinity of a parish. This result is quite different from the results in

table 2. It appears that endogeneity and measurement error tend to reduce the ordinary least squares estimate of having greater numbers of turnpikes nearby.

The last regression simultaneously addresses endogeneity and measurement error for both turnpike variables. Table 7 reports results from a three-stage least squares estimation. The equations in the first and second columns are similar to the first stage equations in tables 4 and 6. The third column reports estimates for the property income equation. The main finding is that property income increased by 24 percent if a parish had a turnpike and by 14 percent if half of the parishes within 7.5 miles had turnpikes.

The two-stage least squares estimates suggest several conclusions about the relationship between turnpikes and property income. First, they confirm that turnpike trusts caused property income to increase. In other words, the positive relationship between turnpikes and high property income does not simply reflect the fact turnpikes were adopted in more productive locations. Second, turnpike trusts did not increase the income of their local parishes at the expense of lowering income for neighboring parishes. This suggests that turnpikes did not draw firms away neighboring locations, at least within 7.5 miles. Instead, greater numbers of turnpikes in an area added to parish property income by providing access to multiple markets.

V.

The econometrics show that turnpike trusts increased property income in the parishes where they were located by at least 8 percent and as much as 27 percent. How plausible are these estimates? The results from another study show that turnpike trusts reduced real freight charges by approximately 20 percent between 1750 and 1820.[38] To check whether those findings are consistent with the estimates in this paper, I calculate the percentage change in prices received by

farmers when freight charges declined by 20 percent. Economy theory suggests that land rents at any location should be proportional to the price received by farmers at that location.[39] Therefore, if freight charges decline, then the percentage change in the price received by farmers should approximate the percentage change in land rents.

I carry out this exercise for wheat prices in the 1730s and 1740s, which is just before turnpikes became common and freight charges declined (see Table 8). I approximate the price received by farmers with the difference between wheat prices per bushel and the total freight charge per bushel between 0 and 40 miles from the market. The average price of wheat was 3.5 shillings per bushel between 1730 and 1749.[40] In the same period, freight charges averaged 0.033 shillings per-bushel, per-mile.[41] These figures imply that the average price received by farmers was 2.83 shillings per bushel. If freight charges fell by 20 percent and market prices remained constant, then the average percentage change in prices received by farmers is 5.2 percent. This implies that turnpike trusts' contribution to lower freight charges should have increased land rents by approximately 5 percent, if the market area was 40 miles.

The preceding calculations suggest that changes in transport costs can explain some of the increase in property income associated with turnpikes, but not all. The remainder may be due to their effects on land use, agricultural productivity, urbanization, or the attraction of inns serving the road transport sector. Such effects have been highlighted by a number of scholars who study transport improvements. E. H. Hunt and S. J. Pam, for example, show that farmers shifted from cereals to meat and dairy following the introduction of the railway in the nineteenth century. Rick Szostak argues that canals and turnpike trusts raised productivity by encouraging innovation. Lastly, Eric Pawson argues that turnpikes contributed to higher urbanization.[42]

There are no estimates of how much turnpikes specifically contributed to changes in land use, productivity, and urbanization, but it is likely that their impact was non-trivial.

VI.

The results have several implications for the literature on turnpike trusts and the English economy during the eighteenth century. The finding that turnpike trusts increased property income shows that local landowners had an economic incentive to promote and manage turnpikes. Many statutory authorities in eighteenth century England were 'non-profit' organizations and relied on the voluntary participation of local elites.[43] There is a commonly-held view that elites served because they earned economic benefits through higher property income or profits from trade. The results here suggest that landowners recognized that turnpikes increased their property income, and that it encouraged them to serve.

Of course there may have been other motivations as well. It is possible that landowners served as trustees because they wanted to extract a portion of the toll revenues through interest payments or procurement contracts. It is also possible that a sense of civic duty drove them to participate. While these alternative motivations cannot be ruled out, they are less compelling than the inducement of higher property income. Interest rates on turnpike bonds were capped at 5 percent, which is less than the gains in property income. The effective interest may have exceeded 5 percent if turnpike bonds were traded below their par value, but even so the likelihood of an 8 to 10 percent return was low. There was almost certainly some extraction of toll revenues through the procurement of land and materials, but these emoluments went to a few, and were not large enough to motivate most landowners. A sense of civic duty likely

motivated some members of the landed elite, but such values would have to be extremely common to explain the widespread adoption of turnpikes.

The lure of higher property income may have provided the main motivation, but it was not sufficient for landowners to serve as trustees. Landowners faced a free-rider problem because no individual could be excluded from earning higher land rents. Daniel Klein suggests that for U.S. turnpike trusts the free-rider problem was solved by social pressure, such as community gatherings where individuals publicly stated their stock pledges.[44] Social pressure may have played a similar role in England, where landed families were often linked through marriage and political organizations. The high concentration of landownership also helped to alleviate the free-rider problem. It is generally believed that landownership became more concentrated during the eighteenth and early nineteenth century. It is likely therefore that the local benefits from English turnpikes went to a smaller number of landowners, who had a relatively easy time cooperating with one another.

The econometric results also show that turnpikes did not reduce property income in nearby parishes. This could explain why there was relatively little opposition to turnpike petitions in Parliament. Pawson found that before 1750 only 15 percent of all new turnpike bills faced formal opposition. Based on these figures he argued that turnpike trusts were uncontroversial.[45] My results are consistent with this assessment, because they show that turnpikes did not have negative effects at distances less than 7.5 miles. It is worth noting that negative effects could still be present at distances greater than 7.5 miles. For instance, the woolen textile industry in the West Country and East Anglia may have suffered once turnpikes opened their markets to greater competition from northern producers.

My results also imply that turnpike trusts made a significant contribution to economic growth in England. In the sample counties, 54.2 percent of parishes had turnpike trusts by 1815. Multiplying the percentage of parishes with turnpike trusts by the percentage change in property income implies that turnpikes increased total property income by between 4.3 and 14.6 percent (see table 9). Is this a large effect?

The impact of turnpike trusts can be gauged by their contribution to the total growth in land rents. Greg Clark estimates that real land rents grew by approximately 50 percent between 1690 and 1815.[46] Robert Allen finds are relatively similar change in real rents in the South Midlands.[47] Clark's figures combined with my estimates imply that turnpike trusts contributed between 8.6 and 29 percent of the total growth in real land rents (see table 9). In other words, turnpike trusts made a significant contribution to the overall growth in land rents.[48]

The effects of turnpikes can also be compared with enclosures. In my sample, the fraction of common acres between 1693 and 1815 fell by an average of 18.7 percent.[49] If the elimination of common rights increased land rents by 35 percent as the estimates suggest, then enclosures increased property income by 6.5 percent and account for 13 percent of the total growth in land rents between 1690 and 1815. Thus turnpike trusts had a similar aggregate impact as enclosures.

A final way of gauging the contribution of turnpike trusts is to calculate their social savings, or the percentage of national income that would be lost if turnpike trusts had not been established. Economic historians usually measure the social savings from transport innovations by multiplying the change in transport costs with the volume of traffic. Here I measure social savings using the income side of national accounts, specifically property income. If property income represented 15 percent of national income, then turnpike trusts would have generated a social savings between 0.6 and 2.2 percent of national income in 1815 (see table 9).[50] The social

savings are large considering that few technological changes were involved. In addition they are large relative to total factor productivity growth, which is estimated to be around 0.3 percent per year between 1770 and 1800.[51]

In conclusion, this paper adds to the broader literature on the economic effects of legislation in eighteenth century England. Throughout this period, landowners and merchants promoted acts that changed property rights to land or created new organizations with the right to provide infrastructure and public services. Legislation like this was fairly unique among European countries before the nineteenth century. The only exception is the Dutch Republic, which passed similar legislation at the provincial level during the seventeenth century. Understanding why England began using legislation to improve its economy will help to resolve the larger puzzle of why England became the first country to industrialize.

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[2] See Langford, *Public Life*, and Hoppit, 'Patterns of Parliamentary Legislation,' and Bogart and Richardson, 'Parliament, Property Rights, and Public Goods' for a discussion of the role of legislation.

[3] For evidence on transport costs see, Jackman, *Development*, Albert, *Turnpike Road System*, Pawson, *Transport and Economy*, Gerhold, 'Productivity Change,' and Bogart, 'Turnpike Trusts and the Transport Revolution.' For evidence on road expenditure see Ginarlis and Pollard, 'Roads and Waterways' and Bogart, 'Did Turnpike Trusts Increase Transport Investment?'

[4] See 2&3 Philip & Mary, c. 8.

[5] For an overview of diffusion process see Albert, *Turnpike Road System*, and Pawson, *Transport and Economy*.

[6] For evidence on transport costs see, Gerhold, 'Productivity Change,' and Bogart, 'Turnpike Trusts and the Transport Revolution.'

[7] Quoted in Pawson, *Transport and Economy*, p. 318.

[8] Rick Szostak in his book, *the Role of Transport*, provides a more general argument that better roads and canals led to greater productivity growth in Britain.

[9] Details on this petition are available in *the Journals of the House of Commons*, Jan. 18, 1719.

[10] See *Report from the Select Committee Appointed to Consider the Acts now in force regarding Turnpike Roads and Highways in England and Wales* (P.P. 1821, IV).

[11] Wilson, *Gentlemen Merchants*, pp. 148-149.

[12] Thomas, 'Geographic Aspects,' pp. 63-73.

[13] Albert, *Turnpike Road System*, pp. 100-108.

[14] Albert, 'Population Opposition,' pp. 11-13.

[15] Pawson, *Transport and Economy*, p. 323-329. Anne Thomas studied opposition to the Lawton and Stoke-upon-Trent turnpike by the inhabitants of Newcastle-under-Lyme. One of the main issues was that the proposed turnpike bypassed Newcastle, and thus reduced trade and services in the city. See Thomas, 'Geographic Aspects,' p. 68.

[16] Bogart, 'Turnpike Trusts and the Transport Revolution,' p. 499.

[17] *Accounts and Papers* (P.P. 1830-31 XI), 'Estimate of the Annual Value of Real Property Assessed April 1815 for the purpose of the Property Tax,' p. 227.

[18] According to Donald Ginter, "the county land tax quotas were subdivided by local authority into quotas for each individual parish or township….these local quotas also became traditional and ossified." This quote is taken from Turner and Mills, *Land and Property*, p. 180. Also see Ginter, *A Measure of Wealth*, for a detailed discussion of the eighteenth century land tax.

[19] *Accounts and Papers* (P.P. 1844, XXXII), 'Quota of Land Tax Assessed to each Parish 1798,' p. 451.

[20] See Clark, 'Land Rental Values,' and Clark, 'Common Sense' for more information on the Charity Records.

[21] I thank Greg for kindly sharing his Charity data with me.

[22] See *Report of the Commissioners for inquiring into the State of Roads in England and Wales* (P.P. 1840 XXVII).

[23] I thank Greg Clark for providing the longitude and latitude data.

[24] See Mike Stevens, 'Waterways of England and Wales,' Jim Shead, 'Waterways Information', and Humphrey-Smith, *Phillimore Atlas*.

[25] See *Accounts and Papers* (P.P. 1831, XVIII), Comparative Account of the Population of Great Britain in 1801, 1811, 1821, 1831, with the Annual Value of Real Property, 1815.

[26] Corfield, *The Impact of English Towns*, p. 12-13.

[27] Tate, *A Domesday of Enclosure*, and Clark, 'Common Sense.'

[28] Bowen, *Britannia*.

[29] See Mills and Turner, *Land and Property*.

[30] See Clark, 'Land Rental Values' for more discussion of the size of Charity plots and its effects on rents.

[31] The other coefficients also reveal whether the construction of canals, the elimination of common rights, and urbanization contributed to higher property income per acre.

[32] Specifically, y_{it} is the natural log of land rents per acre for plot *i* in year *t*. $pike_i$ is a dummy variable for whether the plot is in a parish with a turnpike in year *t* and $pikenear_i$ is the fraction of parishes within 5 or 7.5 10 miles that have turnpikes. $canal_i$ is a dummy variable for whether the plot is in a parish with a canal. $common_i$ is the fraction of plot acreage subject to common rights. $urban_i$ is dummy variable for whether the plot is in a parish with a population above 2500. Finally, d_t is a dummy for the year, u_i is a plot fixed effect, and ε_{it} is an error term.

[33] For instance, my sample includes land rents for two plots in Aspley Guise parish and Biddenham parish in 1720 and 1819. Biddenham had a turnpike trust adopted between these two dates whereas Aspley Guise did not. The coefficient on the turnpike dummy in equation (3) measures the percentage difference in the growth of land rents per acre between plots located in parishes such as Biddenham and Aspley Guise.

[34] Another concern is that the log-linear functional form is incorrect, resulting in misleading conclusions. Box-Cox tests show that the log-linear model is preferred against the linear-linear model.

[35] Patricia Rice and Anthony Venables, in 'Spatial Determinants of Producivity,' find a similar relationship between wages and population density in the late twentieth century. This finding suggests that agglomeration forces were operating already in the eighteenth century.

[36] Clark, 'Common Sense'.

[37] I also experimented with other instruments like urbanization in 1700 and the log of the land tax per acre. A similar over-identification tests show that both of these variables are not valid instruments, and therefore they were not used.

[38] See Bogart, 'Turnpike Trusts and the Transport Revolution'.

[39] In their book, *Spatial Economy*, Fujita, Krugman, and Venables, develop a model of the monocentric city. On page 136, they show that rents equal output times the price received by farmers. In their model, the price received by farmers at any location is equal to agricultural prices in the city multiplied by exp[-

(transports cost per mile)*(distance to the market)]. I approximate this function by the per bushel price in the city minus (average transports cost per mile)*(distance to the market).

[40] The price of wheat comes from Greg Clark's data on agricultural prices.

[41] See Bogart, 'Turnpike Trusts and Transport Costs,' for estimates of land carriage rates per ton-mile.

[42] See Hunt and Pam, 'Managerial Failure,' Szostak, *the Role of Transport*, and Pawson, *Transport and Economy*.

[43] For instance, several Acts created Courts of Small Requests, which adjudicated disputes on credit contracts worth less than 40 shillings. The judges were local merchants who benefited indirectly through the expansion of credit and trade.

[44] See Klein, 'Voluntary Provision of Public Goods.'

[45] Pawson, *Transport and Economy*, pp. 118-119.

[46] See Clark, 'Land Rental Values.'

[47] Allen, *Enclosure and the Yeoman*.

[48] It is worth noting that Clark's estimates of the growth in land rents are lower than Turner, Beckett, and Afton, and thus the proportional contribution of turnpike trusts would be lower using the latter series.

[49] Greg Clark finds a similar figure for the national level. See Clark, "Common Land".

[50] These estimates are similar to the social savings estimates from turnpike trusts' contribution to lower freight charges and faster travel times. See Bogart, 'Turnpike Trusts and the Transport Revolution.'

[51] See Crafts and Harley, 'Output Growth,' and Antras and Voth, 'Factor Prices.'

Table 1: Summary Statistics

Tax Data	Mean	St. Dev.	Min	Max
1815 Property Assessment per Acre	2.05	10.60	0.06	333.73
1798 Land Tax Quota per Acre	0.081	0.602	0.001	22.368
Turnpike Dummy for 1815	0.542	0.498	0	1
Fraction of Parishes within 5 mi. with turnpikes in 1815	0.541	0.320	0	1
Fraction of Parishes within 7.5 mi. with turnpikes in 1815	0.547	0.257	0	1
Urban 1700	0.008	0.091	0	1
Urban 1801	0.041	0.199	0	1
Fraction of Acres Enclosed, 1693-1815	0.188	0.308	0	1
Canal Dummy	0.071	0.258	0	1
Distance to London	196.04	85.56	15.26	561.94
Major London Route Dummy	0.129	0.335	0	1
Major Cross Route Dummy	0.067	0.240	0	1
N	3108			
Charity Records	Mean	St. Dev.	Min	Max
Land Rent Per Acre	1.620	1.752	0.057	32.83
Turnpike Dummy	0.520	0.499	0	1
Fraction of Parishes within 5 miles with turnpikes	0.489	0.368	0	1
Fraction of Parishes within 7.5 miles with turnpikes	0.479	0.309	0	1
Urban	0.125	0.331	0	1
Fraction of Acres Common	0.1284	0.302	0	1
Canal Dummy	0.106	0.3085	0	1
Distance to London	168.81	84.63	16.12	358.9
N	1695			

Table 2: Turnpikes and the Growth of Parish Property Income per Acre between 1693 and 1815: OLS Estimates

Variable	(1) Coefficient (stand. error)	(2) Coefficient (stand. error)	(3) Coefficient (stand. error)	(4) Coefficient (stand. error)
Turnpike Dummy	0.0845		0.0826	0.0792
	(0.0163)*		(0.0171)*	(0.0167)*
Fraction of Parishes with	___	0.0477	0.0112	__
turnpikes within 5 miles		(0.0328)	(0.0340)	
Fraction of Parishes with	___	___	___	0.0399
turnpikes within 7.5 miles				(0.0494)
Urban Dummy	0.2791	.2838	0.2671	0.2893
	(0.0608)*	(0.0646)*	(0.0644)*	(0.0603)*
Fraction of Acres with	-0.3964	-0.4044	-0.3960	-0.3964
Common Rights	(0.0251)*	(0.0251)*	(0.0250)*	(0.0250)*
Canal Dummy	0.0812	0.0718	0.0671	0.0759
	(0.0330)*	(0.0328)*	(0.0327)*	(0.0331)*
Distance to London	0.0025	0.0002	0.0004	0.0006
	(0.0011)*	(0.0012)	(0.0012)*	(0.0012)
Distance to Nearest Town	-0.0096	-0.0125	-0.0118	-0.0116
	(0.0023)*	(0.0024)*	(0.0024)*	(0.0024)*
Hundred Dummies	Yes	Yes	Yes	Yes
N	3108	3028	3028	3099
R squared	0.63	0.63	0.63	0.630

Notes: the dependent variable is the difference between the log of parish property income per acre in 1815 and the log of the land tax per acre in 1692. Robust standard errors are reported.
*indicates statistical significance at the 90% level and above.

Table 3: Turnpikes and the Growth of Land Rents per Acre between 1690 and 1839: Fixed Effects Estimates using the Charity Commission Records

Variable	(1) Coefficient (stand. error)	(2) Coefficient (stand. error)	(3) Coefficient (stand. error)	(4) Coefficient (stand. error)
Turnpike Dummy	0.1041	0.0797	0.0762	0.1049
	(.0426)*	(0.0419)*	(0.0467)	(0.0460)*
Fraction of Parishes with	___	___	0.0747	___
turnpikes within 5 miles			(0.0688)	
Fraction of Parishes with	___	___	___	-0.0135
turnpikes within 7.5 miles				(0.0496)
Urban Dummy	0.0908	0.0853	0.0842	0.0982
	(.0602)	(0.0600)	(0.0644)	(0.0600)
Fraction of Acres with	-0.3132	-0.3518	-0.3489	-0.3630
Common Rights	(.0544)*	(0.0553)*	(0.0557)*	(0.0553)*
Canal Dummy	-0.0290	-0.0418	-0.0634	-0.0911
	(.0639)	(0.0642)	(0.0690)	(0.0664)
Plot Fixed Effects	Yes	Yes	Yes	Yes
Dummies for 5-year intervals	Yes	Yes	Yes	Yes
County-Specific Trends	No	Yes	Yes	Yes
N	1695	1695	1609	1671
R squared	0.7474	0.7702	0.771	0.770

Notes: the dependent variable is the natural log of land rents per acre for each plot. * indicates statistical significance at the 90% level and above.

Table 4: Turnpikes and the Growth of Parish Property Income per Acre between 1693 and 1815: Two-Stage Least Squares Estimates

	Dependent Variables	
Variable	Turnpike Dummy	Log Difference in Property Income Per Acre
Turnpike Dummy	___	0.2728
		(0.0512)*
Distance to London	0.0001	0.0029
	(.0009)	(0.0009)*
Distance to Nearest Town	-0.0083	-0.0093
	(0.0022)*	(0.0023)*
Urban in 1700	-0.0244	0.5058
	(0.0991)	(0.1006)
Major London Highway	0.4567	___
Dummy	(0.0257)*	
Major Cross Highway Dummy	0.3639	___
	(0.0351)*	
Hundred Dummies	Yes	Yes
N	3108	3108
R squared	0.31	0.59

Notes: the dependent variable is the difference between the log of parish property income per acre in 1815 and the log of the land tax per acre in 1692. * indicates statistical significance at the 90% level and above.

Table 5: Over-Identification Tests for the Instrumental Variables

Variable	Dependent Variable: Residuals from Second-Stage Regression in Table 4
Distance to London	-0.00001
	(0.0009)
Distance to Nearest Town	0.00005
	(0.0022)
Urban in 1700	0.0015
	(0.1007)
Major London Highway Dummy	-0.0106
	(0.0261)
Major Cross Highway Dummy	0.0277
	(0.0357)
Hundred Dummies	Yes
N	3108
R squared	0.0003

Notes and sources: see text.

Table 6: The Density of Turnpike trusts in Nearby Locations and the Growth of Parish Property Income per Acre between 1693 and 1815: Two-Stage Least Squares Estimates

Variable	Dependent Variables	
	Fraction of Parishes with turnpikes within 7.5 miles	Log Difference in Property Income Per Acre
Fraction of Parishes with turnpikes within 7.5 miles		0.4112 (0.1222)*
Distance to London	-0.0017 (0.0004)*	0.0015 (.0012)*
Distance to Nearest Town	-0.0044 (0.0008)*	-0.0130 (0.0025)*
Urban in 1700	-0.0197 (0.0351)	0.4395 (.1027)*
Fraction of Parishes on Major London Routes within 7.5 miles	0.4697 (0.0242)*	
Fraction of Parishes on Major Cross Routes within 7.5 miles	0.4825 (0.0323)*	
Fraction of Parishes that were urban in 1700 within 7.5 miles	-0.0330 (0.0924)	
Hundred Dummies	Yes	Yes
N	3099	3099
R squared	0.69	0.59

Notes: the dependent variable is the difference between the log of parish property income per acre in 1815 and the log of the land tax per acre in 1692. * indicates statistical significance at the 90% level and above.

Table 7: Turnpikes, Density, and the Growth of Parish Property Income per Acre between 1693 and 1815: Three-Stage Least Squares Estimates

	Dependent Variables		
Variable	Turnpike Dummy	Fraction of Parishes with turnpikes within 7.5 miles	Log Difference in Property Income Per Acre
Turnpike Dummy	___		0.2435
			(0.0511)*
Fraction of Parishes with	___		0.2781
turnpikes within 7.5 miles			(0.1209)*
Distance to London	-0.0014	-0.0017	0.0017
	(0.0011)*	(0.0004)*	(0.0011)
Distance to Nearest Town	-0.0105	-0.0044	-0.0103
	(0.0023)*	(0.0008)*	(0.0025)*
Urban in 1700	-0.0459	-0.0191	0.4359
	(0.0980)	(0.0340)	(0.0997)*
Major London Highway Dummy	0.4560	___	___
	(0.0246)*		
Major Cross Highway Dummy	0.3636	___	___
	(0.0335)*		
Fraction of Parishes within 7.5	___	0.4704	___
Miles on Major London highway		(0.0232)*	
Fraction of Parishes within 7.5	___	0.4761	___
Miles on Major Cross highway		(0.0309)*	
Fraction of Parishes within 7.5		-0.02687	
Miles that were urban in 1700		(0.0883)	
Hundred Dummies	Yes	Yes	Yes
N	3099	3099	3099
R squared	0.31	0.69	0.59

Notes: * indicates statistical significance at the 90% level and above.

Table 8: Hypothetical changes in the Price Received by Farmers for a Bushel of Wheat in 1730s and 1740s:

	(1)	(2)	(3)	(4)	(5)
Distance to Market in Miles	Market Price of Wheat (s./bu.),	Total Freight Charge (s./bu.)	Price Received by Farmers, (s./bu)	Price Received if Freight Charges Fall by 20 percent	Percentage Change in Prices Received
10	3.5	0.27	3.17	3.23	2.1
20	3.5	0.54	2.86	2.96	4.7
30	3.5	0.80	2.50	2.70	8.0
40	3.5	1.07	2.16	2.42	12.3
Average, 0-40	3.5	0.54	2.83	2.96	5.2

Notes: column (3) equals (1) -(2). Column 5 is ((4)-(3))/(3)*100. There are small differences due to rounding errors.
Sources: see text.

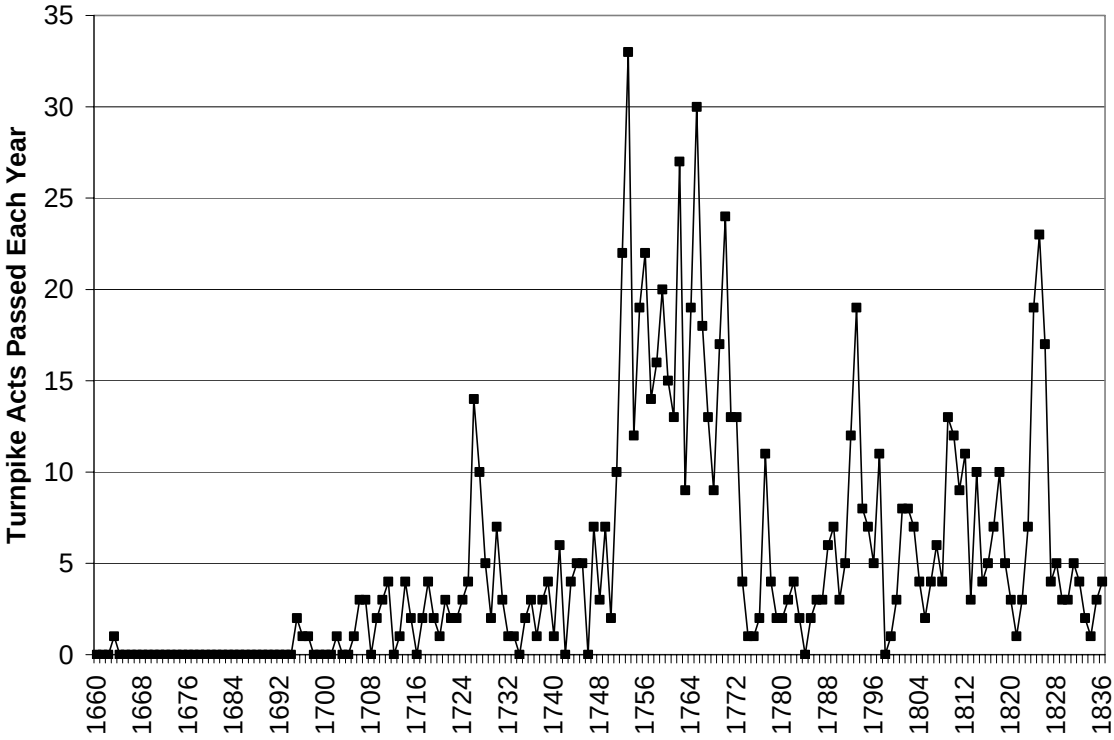
Table 9: Turnpike Trusts and the Growth of Property Income and National Income in England

	Low Estimate	High Estimate
(1) Percentage of Parishes with Turnpike Trusts by 1815	54.2	
(2) The Estimated Percentage Increase in Property Income for parishes with Turnpike Trusts	8	27
(3) Percentage Increase in Total Property Income Due to Turnpike Trusts, 1690-1815 = (1)*(2)/100	4.3	14.6
(4) Percentage Change in Real Land Rents between 1690s and 1810s	50	
(5) Percentage Contribution of Turnpikes to the Growth in Real Land Rents between 1690s and 1810s = ((3)/(4))*100	8.6	29
(6) Percentage of Property Income in National Income c1815	15	15
(7) Percentage Increase In National Income in 1815 Due to Turnpike Trusts = (3)*(6)/100	0.6	2.2

Notes: All figures are rounded and expressed in percentages.

Sources: See text.

Figure 1: The Annual Number of Acts Creating Turnpike Trusts, 1660-1836.

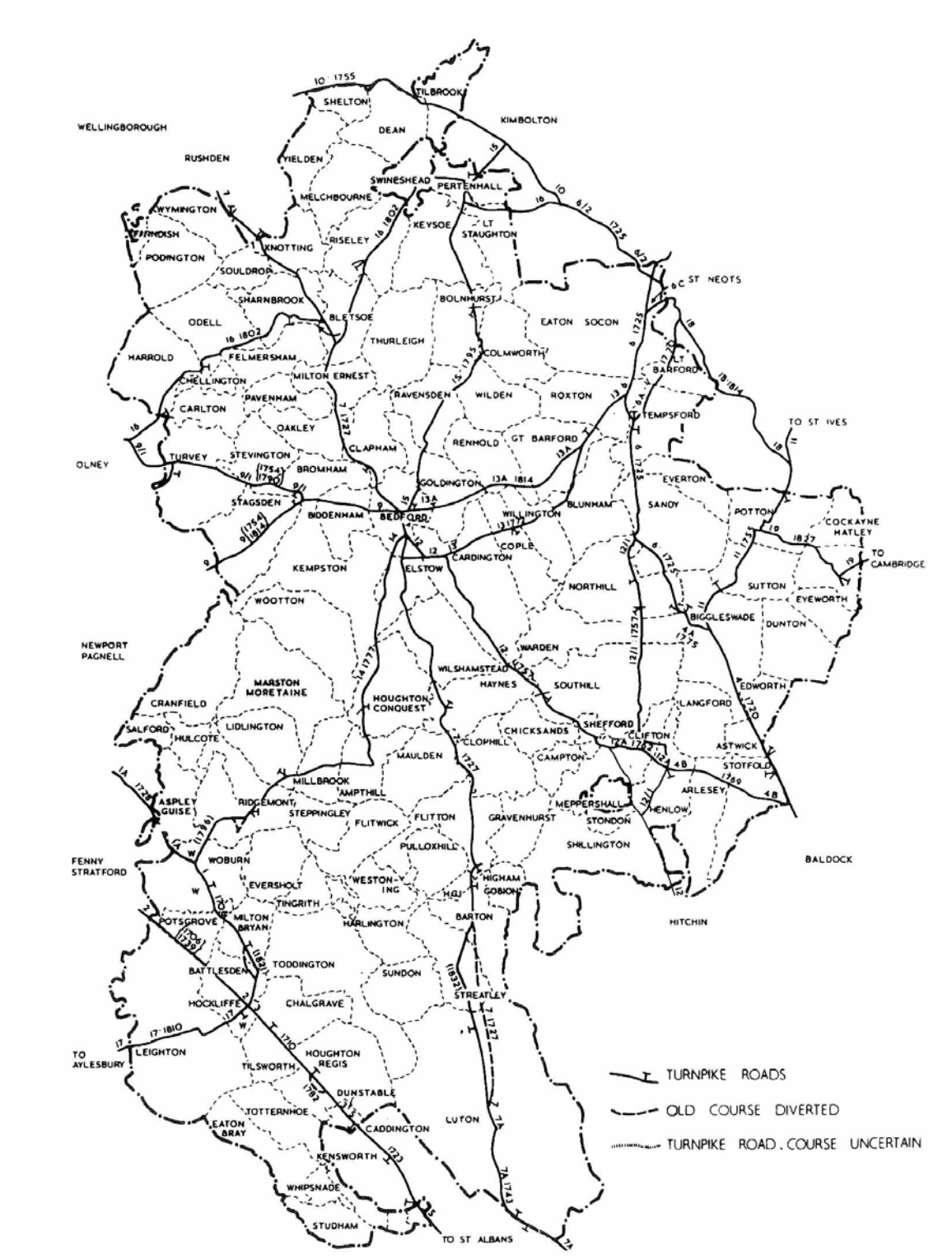


Source: Albert, *Turnpike Road System*, pp. 202-223.

Figure 2: Eric Pawson's Map of the Turnpike Network in 1770.

Sources: Pawson, Transport and Economy, p. 151.

Figure 3: Turnpike Network in Bedfordshire



Source: Bedford and Luton Archives and Records Office.