Investing in Early Public Works:

Financial risks and returns in English and Welsh turnpikes 1820-1882

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Abstract

Private and local investors provided much of the capital to improve England’s infrastructure during its industrialization. This paper investigates the financial returns and risks to investors in turnpike road trusts. It draws on parliamentary reports which provide comprehensive data on trust finances. One key finding is that turnpike trusts paid investors a return above the yield on government bonds, especially before 1850. But financial returns varied at the individual trust level with most paying 4 to 5 percent and some paying zero. The latter were not the majority and in many cases resumed paying interest within a few years. Investors who diversified across trusts enjoyed lower risk and some, like charities, seem to have selected lower risk trusts. Turnpike interest payments were not as high as the profits and dividends paid by canals and railways, but there was little speculation in turnpike bonds which worked in their favor.

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All well-made plans can go awry. This famous maxim applies especially to infrastructure financing. Large capital expenditures are required for infrastructure projects and they are based on demand projections far into the future. Of course, projections can be wrong. Technology changes and economies evolve in unpredictable ways. There may be little surplus down the line to pay investors who risked their capital.

Turnpike road trusts in nineteenth century England and Wales provide an interesting historical context to study the risks and returns to investing in infrastructure. In the pre-railway era before 1830 approximately 1000 trusts were established to maintain and improve nearly 20,000 miles of road. They complemented similar authorities developing canals, rivers, and dock works. Turnpike trusts financed their projects almost entirely through tolls and by issuing bonds backed by the toll revenues. These bonds were largely purchased by local individuals with governments in Westminster providing no guarantees and very limited subsidies.

This paper calculates the size of interest payments made by turnpike trusts relative to mortgage debts. It starts with the period between 1820 and 1842 when turnpike debt peaked in England and Wales and when coaching traffic was in its golden age. It then extends the analysis of interest payments to 1882 when competition with railways forced many trusts to exit.

The percentage of interest payments in debt is a good metric for investor returns because few earned a capital gain or loss by selling turnpike bonds. There was a thin secondary market for these bonds and thus interest payments relative to the value of the debt largely captured investors’ rate of return. Data collected from parliamentary reports show that turnpike trusts paid competitive returns in the aggregate. Interest payments for all turnpike trusts as a percentage of debt were just over 4 percent for most years between 1820 and 1850. A good comparison is the
yield on Consols, a long-term government bond. Consol yields were under 3.5 percent for most of the early nineteenth century.

The financial returns for turnpikes deteriorated in the railway era. From 1850 to 1882 interest payments declined reaching less than 2 percent. The debts of many trusts were repaid but some were cancelled or reduced, implying losses for investors. Despite their inglorious end, trusts still paid a reasonable return over the long-run. The rate of return to a hypothetical investor holding all turnpike debt from 1837 to 1882 equaled 3.41 percent.

This paper also examines how much risk was involved in holding individual turnpike bonds. Distributions of interest payments across trusts and over time are constructed using newly digitized financial data for all turnpike trusts in 1823, 1834 to 1838, and 1850. The results show that most trusts paid between 4 and 5.5 percent and at most 13 percent of trusts paid zero interest in any year. Most surprising is that relatively few trusts were paying zero interest as late as 1850, when several important railways were running. Data across time reveals that many trusts were paying interest only a few years after they had paid zero interest. Trusts recovered from negative shocks and poor performance was not permanent.

The evidence on risks and returns suggests investors in turnpike bonds were paid a risk premium or a higher expected return over Consols. However, there is mixed evidence on whether investors were paid a premium if they held bonds from more risky trusts as measured by the standard deviation in interest payments or the likelihood of paying zero interest. Thus, the risk premium is evident only when considering turnpike trusts as a broad class of financial assets.

There were various types of investors in turnpike bonds and their holdings differed. I examine the risks and returns to four types. The generic investor held the bonds of a single turnpike trust. Assuming they drew randomly from the entire population of trusts between 1823
and 1850, their average mean return was 4.19 percent with a standard deviation of 1.69. The large landed investor is unique in holding two or more bonds in their county. Their average mean return is 4.46 percent with a standard deviation of 1.37. Large landowners experienced less risk than the generic investor because they were able to diversify their portfolio. Charities were significant investors in turnpike bonds. In the charity portfolio, the average mean return was higher at 4.72 percent and their average standard deviation was lower at 1.18. Charities seem to have selecting trusts that were less risky. The Public Works Loan Board (PWLB) was a government-funded body making loans to selected turnpike trusts in the 1820s. In the population of trusts to whom they made loans the average mean return was 4.01 percent and the standard deviation was 1.68. The PWLB seems to have invested in financially distressed trusts.

Turnpike trusts paid competitive returns relative to government debt, but was it wise to hold turnpike bonds rather than invest in farmland, canal, or railway securities? To answer this question, the returns per unit of risk (i.e. the Sharpe Ratio) are calculated for each portfolio type. The Sharpe Ratio for the generic turnpike portfolio is higher than the farmland portfolio, suggesting landowners who diversified into turnpikes gained financially. The evidence is mixed with respect to canals and railways. The latter two had a higher Sharpe ratio based on accounting profits relative to capital employed. However, based on total returns from the London stock exchange canals and railways had lower Sharpe Ratios than turnpikes. Canal and railway securities were subject to speculation which drove down their total returns. Turnpike bonds did not require market timing because there was no financial speculation.

The findings contribute to the literature studying turnpike road trusts.¹ There is a discussion in the literature on whether turnpikes paid investors well. Albert (1972, p. 89) finds

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¹ The impacts of turnpikes are discussed by Albert (1972), Pawson (1977), Gerhold (1996), Bogart (2005a, 2005b), and Guldi (2012) to name a few.
that 60 percent of trusts had at least three years of interest in arrears. Webster (2015, p. 75) studies the repayment of turnpike debts after 1850 and finds that after defaults investors lost 39 percent of what they were entitled to receive. This paper takes a different approach by focusing on what investors received rather than what they missed. It also provides the first comprehensive assessment of financial returns and risks in the turnpike sector. More broadly, the findings reveal that turnpikes contributed to higher incomes in England and Wales. The financial returns were an addition to increased property values. Most went to landowners, but significant financial returns were earned by merchants, small savers, and charities.

This paper also contributes to the literature by summarizing the profits and returns to investing in different assets in the early nineteenth century. Overall the infrastructure sector generated substantial financial returns, larger than the economy as a whole, which grew at 2 percent per year between 1820 and 1850. This was achieved without substantial government subsidies, which is notable because today risk sharing schemes between public and private sectors are often devised to support infrastructure financing.

The paper is organized as follows. Section I provides background on turnpike trusts. Section II reports the returns on investing in the turnpike sector and section III across individual trusts. Section IV studies the risk premium and V examines the returns for different types of

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3 For evidence on how trusts affected property values see Bogart (2009).
5 GDP growth is from Broadberry et. al. (2015).
Turnpike trust investors. Section VI compares financial returns for turnpikes with canals, railways, and land. Section VII concludes.

I.

Turnpike trusts are a prime example of the more general pattern of infrastructure financing in England starting in the eighteenth century. The following is a brief summary. Parliamentary legislation determined how infrastructure was financed and organized. So-called ‘turnpike acts’ transferred authority over a road to a body of trustees for 21 years. It was typical for the trustees’ authority to be renewed by subsequent acts and for trusts to be long-lived. Trustees had to meet property and income qualifications. Notably requirements to be trustees were often lighter on landowners making them the most common social group. Trustees had rights to levy tolls and rights to the labor of the residents in parishes near the road, known as statute labor. Turnpike trusts could also issue bonds secured on the toll income. Most turnpike acts forbade the creation of tradeable shares and collection of profits. The revenues were to be devoted to manual labor, materials, officers’ salaries, interest, and repayment of the principal on the debt. Surplus balances were held by the treasurer and applied to future expenses.

Turnpike trusts spread widely through England and Wales forming a network. The 1750s and 1760s were the two decades with the largest numbers formed. Turnpike trusts managed all the major roads leading into London and between major towns. They also managed the major roads between industrial towns and their hinterland, as well the market towns in rural areas. By the 1830s around 1000 trusts managed 20,000 miles or 20 percent of the total network. A map of the turnpike road network, the coalfields, and the largest towns in 1830 is shown in figure 1. The extraordinarily dense network is evident.
Trust revenues mainly came from tolls and statute labor contributions. The revenue sources of all turnpike trusts in England and Wales in 1834 are shown in panel A of table 1. There is also an estimate of the value of statute labor performed. Toll revenues equaled £1.4 million and total revenues equaled £1.6 million. To give some perspective on these figures, total British central government tax revenues in 1834 were about £50 million, making turnpike revenues about 3.2% of central government revenues.

How did turnpike trusts spend their money? Panel B of table 1 shows the expenditure categories for all trusts in England and Wales in 1834. Around two-thirds of expenditures were directly related to maintenance or improvement of roads, and 75 percent was at least indirectly related including trusts’ managerial costs. Interest and debt payments are just over 25 percent.

A prominent feature of turnpike trusts was their reliance on debt financing. Total borrowing for 1834 was £153,000, equating 9.5% of all revenues including the value of statute labor performed. There were two types of debt. The first were bonds secured on the tolls (so-called mortgage debt). The second were unsecured bonds and did not always pay interest (so-called floating debt). The mortgage bonds were by far the largest. They were often denominated in units of 50 or 100 pounds. They had no set maturity date and the trustees could repay the principal in full at any time. The interest rates on the mortgage debt could not exceed 5 percent because of usury laws, and most ranged between 4 and 5 percent. Importantly, for this study each bond for a trust was treated as equal, without first or second claims on the revenues. If any bondholder did not receive their scheduled interest within six months they could foreclose on the tolls and become the first claimant on the revenues.

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7 See Albert (1972, pp. 93-97) for a discussion of turnpike debts.
8 There is a caveat here. The bonds would expire when the trust was distinguished. The expiration date would have been a problem as most trusts operated under a temporary 21-year authority, but Parliament regularly renewed turnpike charters in order not to create defaults.
There are several stylized facts about turnpike bonds and finances. First, the overwhelming proportion of investors came from areas near the road. As one illustration, Buchanan’s (1985) detailed study of the Bath turnpike trust shows that many investors were resident in Bath with a minority having neighboring Bristol or London addresses. The usual explanation is that investors had an economic interest in financing the trust. Good roads increased their property or asset values.

A second fact is that turnpike investors came from all types of elites. Webster’s (2015, p. 67) analysis of 41 mortgage ledgers provides the best evidence on investor background. Webster classified 42 percent as landowners, 31 percent as commercial interests, and 27 percent as savers. Charities were a prominent type of saver. According to a parliamentary report they held 62,959 in turnpike bonds which represented approximately 10 percent of the debt in the 1830s.9

A third stylized fact is that most investors did not diversify their holdings of turnpike bonds. Albert (1972, pp. 100-108) discusses many prominent investors in turnpike bonds (1972, pp. 100-108). The most any individual lent to is three trusts and they were always in the same county. Most investors to multiple trusts were nobleman. Examples include the Duke of Norfolk, the Duke of Devonshire, the Marquis of Hertford, and the Earl of Guildford (Albert p. 105).10 The charity Returns contain more insights. A review of the Returns for Somersetshire suggests that most charities invested in just one turnpike trust if any.11

Albert’s description of the market also suggest most investors purchased the bond by directly lending to turnpike trusts. Many also held the turnpike bond until it was repaid by the trust. The secondary market for turnpike bonds was quite thin. Mortgage registers show that

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9 See BPP (1840, p. 9), Report of the Commissioners enquiring into the state of roads in England and Wales.
10 Nunn’s (1985) analysis of landowners in South Yorkshire yields a similar conclusion that many invested in at most two or three turnpike trusts.
11 Report of the commissioners appointed in pursuance of two several acts (BPP 1821 IV).
turnpike bonds sometimes changed hands, but not in large numbers. There was never a turnpike bond ‘mania,’ in which in the prices of bonds were bid up in anticipation of large returns.

Another stylized fact is that foreclosures on the tolls were rare, even if a trust paid zero interest. In the parliamentary report published in 1821 there are only two mentioned cases of foreclosure.\(^\text{12}\)

There was a change in the level and character of trust borrowing after 1820. At this time, engineers like John Macadam and Thomas Telford developed new methods for making roads using crushed stones of different sizes. Their methods were more expensive than traditional approaches used by turnpike trusts, and required a new wave of financing.\(^\text{13}\) The coaching trade also grew substantially after 1820. As an illustration, toll revenues rose from 1.08 million in 1820 to 1.45 million by 1834. Turnpike trusts responded to these trends by borrowing. From 1820 to 1838 total turnpike debt in England and Wales increased by approximately 75 percent from £4.4 million to £7.3 million. They also spent more to improve roads. For example, in 1829 trusts spent 243,757 on improvements and 56,263 on land purchases (BPP 1840 XXVII).

Most of the lending to trusts in the 1820s and early 1830s came from local individuals, but for the first time a significant portion also came from the central government in Westminster. The Public Works Loan Board (PWLB) was founded in 1817 by an act of parliament.\(^\text{14}\) Its official aim was to provide financial stimulus to projects providing employment. Local authorities, like turnpike trusts, could apply for a loan, and if accepted the PWLB charged 5 percent interest and often insisted on the right of first payment among creditors. The PWLB lent

\(^{12}\) The evidence comes from the ‘observations’ column in the 1821 report (BPP 1821 IV). The Aldermaston and Basingstoke Second District trust in Hampshire and the Stockport and Marple trust in Cheshire are the only two cases. It is possible that some foreclosures were not noted in the observations, it is unlikely that it was prevalent. The absence of foreclosure could be rationalized by the high legal costs, or investors may have believed that by not foreclosing they would ultimately collect more interest payments in the long-term.

\(^{13}\) According to Guldi (2012, pp. 29-72), the civil engineers were partly successful because of earlier experiences with military roads in Scotland, and the building of the London Holyhead road in the late 1810s.

\(^{14}\) See Webster (2015, pp. 59-91) for an analysis of PWLB and its relation to turnpikes.
£401,000 to 107 trusts in England and Wales between 1817 and 1832. Most of the loans were granted in the years 1817, 1818, and 1826. PWLB loans look small compared to the £6.8 million in turnpike debt by 1829, but it did make a significant contribution to turnpike capital in the important decade of the 1820s (Webster 2015, p. 68).

Let us turn to what is known about the financial returns to turnpike investors. Most of the literature has focused on what investors did not get. For example, Albert (1972) and Webster (2015) study unpaid interest and defaults on turnpike bonds. Concerning the interest payments of turnpike trusts, only limited evidence has been provided. Albert lists interest rates for a sample of 100 trusts between 1730 and 1830 (pp. 247-261). The average interest rate was 4.66 percent. The Charity Returns provide additional information. Data collected by Clark (1988) implies that the average rate of return for 114 turnpike bonds between 1752 and 1844 was 4.74 percent. Based on this evidence, turnpike trusts seemingly made competitive interest payments. There are two problems in drawing this conclusion. First, it is not clear the interest rates reported in Albert and the Charity records are contracted rates, or effective rates paid to investors. The two may differ if trusts missed interest payments. Second, the two samples may not be representative of all trusts. If they are biased, then the effective rate of interest across the population might be less.

II.

The section identifies how much all turnpike trusts paid in interest as a percentage of their debt. This will summarize the financial returns to holding turnpike bonds in the aggregate and will not be biased by selected samples. The benchmark of comparison is the yield on the Consol.

The finances of turnpike trusts can be characterized in great detail thanks to a series of parliamentary reports and accounts.¹⁵ A report published in 1821 required the officers of each

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¹⁵ See Albert (1972) for a discussion of Parliament’s investigations of turnpike trusts in the early 1800s. It seems MPs were driven by the aim of improving roads and to investigate whether trusts were being mismanaged
turnpike trust to provide a financial summary and information on operations.\textsuperscript{16} In total 1020 trusts from England and Wales submitted returns on annual revenues and expenses averaged over the years 1818, 1819, and 1820. They also reported the balances held by the treasurer, interest due, and the amount of debt in 1820. More detailed financial reports on turnpike trusts were made for the years 1823, 1829 and annually from 1834.\textsuperscript{17} The reports in 1829 and after provide exact amount of debts, interest payments, unpaid interest, and net borrowing for all trusts in England and Wales.

Panel A of table 2 shows the mortgage debts, floating debts, and interest payments in selected years before 1850. Note the interest payments do not include repayments of principal and applied only to mortgage debt. Floating debt did not always pay interest. The main item in the table is the interest paid as a percentage of mortgage debt. It varies from 3.6 to 4.15 percent. Across the four years from 1829 to 1842 the average is 4.0 percent. For comparison, the average yield on Consols between 1820 and 1850 was 3.44 percent.

It is important to note however that 4 percent interest payments coincided with a large and growing stock of unpaid interest. As panel B in table 2 shows unpaid interest represented 12.5 percent of the mortgage debt in 1820 and 18.4 percent in 1842. The main reason is that most trusts contracted to pay 5 percent to their bondholders, but in practice some trusts paid less. When interest went unpaid it was rarely written off trusts’ books. Thus, the growing stock of unpaid interest represents an accumulation of past interest payments that fell short of the contracted levels.

The combination of unpaid interest with higher interest payment for turnpike trusts over Consols suggests that turnpike investors were paid a risk premium. Not all trusts paid the full

\textsuperscript{16} Select Committee to consider the Acts now in Force Regarding Turnpike Roads and Highways, published its report in the British Parliamentary Papers in 1821.

\textsuperscript{17} A summary of the reports up to 1838 is given in BPP (1840 XXVII).
interest, exposing investors to risk, but on average they paid a higher rate than Consols, which compensated investors to a degree. Additional evidence in favor of this argument is the negative and significant correlation between the yield on Consols and the number of new turnpike trusts being established between 1780 and 1830.\textsuperscript{18} One plausible interpretation is that demand to lend to newly established trusts paying higher interest increased when the yield on the Consol declined, and demand fell when the yield on the Consol increased.

Before moving on it is useful to summarize the repayment of principal on total debt. Panel C in table 2 shows that in 1838 and 1842 trust’s net borrowing, or borrowing minus repayment was negative at -35,412 and -33,292. This meant more was repaid than borrowed. These figures are relatively small compared to the total debt which implies that repayments were not significant in this period. Notice also that the net change in debt in 1838 and 1842 was smaller in absolute terms than net borrowing. The difference is explained by unpaid interest being converted into mortgage debt. Unfortunately, conversions are not recorded in every year, but we know they were common in the mid-1830s (see BPP 1840 XXXVII).

We now turn to the long-term perspective. It is generally thought that trusts finances deteriorated after 1850. How bad they get and when did this happen? Figure 2 shows the interest payment as a percentage of mortgage debt over the long-run from 1829 to 1882. With the exception of 1829 the figures all come from the ‘Abstract of General Statements of Income and Expenditure of Turnpike Trusts in England and Wales,’ published annually in the parliamentary papers. The interest payment as a percentage of mortgage debt remains above 4 percent until 1850 and then begins a long decline reaching a low of 1.55 percent in 1879. One factor was the rising competition of railways. But changing composition of trusts was another factor. On

\textsuperscript{18} See Bogart and Richardson (2011) for more details. This finding can be replicated using the Consol yields from Neal 1990 and the number of new acts from Albert (1972).
average 52 trusts exited per year between 1865 and 1882. In the latter year there were only 40 turnpike trusts remaining.\(^{19}\) The characteristics of the trusts which exited later is not well understood, but there is some evidence that the worse performing trusts exited later because they still had unpaid interest.

The long-run trends in net borrowing and net changes in the stock of debt are shown in figure 3. For comparison the stock of unpaid interest and its share in total debt is also reported in figure 4. After 1838 trusts repaid more bonds than they borrowed resulting in negative net borrowing. The greater repayments continued for the next 42 years and totaled 5.1 million by 1882. The net change in debts shows another perspective. They were also generally negative indicating that total debt was declining. The exceptional year was 1849 when the net change in debts was close to zero. It is likely that debt stayed constant in 1849 because substantial unpaid interest was converted into debt. Trends in unpaid interest are consistent with this view. Unpaid interest was rising up to 1849 when it declined sharply.

After 1850 the general pattern was for the net change in total debts to be greater than the net change in borrowing in absolute terms. Why was this so? It is likely that trusts and their creditors agreed to cancel some of their debts, which would account for the greater absolute decline in debts compared to net borrowing. Unfortunately, cancellations of debts are not recorded in the Abstracts published in the parliamentary papers. But the trends in unpaid interest shown in figure 4 support this interpretation. Unpaid interest as a share of debt declined rapidly in the 1860s and 70s. It seems unlikely that trusts repaid unpaid interest so quickly.

\(^{19}\) These figures are taken from the Fourteenth annual report of the Local Government Board. 1884-85 (BPP 1884-85 XXXII.1, p. 66).
By the early 1880s the process of repayment or cancellation was largely finished. Only 255,141 in mortgage and floating debt remained and there was little unpaid interest left. At this point the records stop and the fate of this debt is not easily determined. It was likely cancelled.

Do the trends after 1850 imply that trusts yielded poor financial returns in the long-run? To address this question consider a large investor who held all 7,260,903 in turnpike mortgage debt in 1838. Suppose they also received all of the interest payments and repayments of principal net of new borrowing during the 44 years from 1838 to 1882 and that any remaining principal after 1882 was cancelled. The internal rate of return on this investment, $r$, is obtained by solving the following expression which equates the value of debt in 1838 with the discounted value of the future stream of interest payments and principal repayments:

$$7,260,903 = \sum_{t=0}^{44} \frac{\text{interest payment}_t}{(1 + r)^t} + \frac{\text{principal payment}_t}{(1 + r)^t}$$

The solution to this equation is $r=0.0341$, which implies an internal rate of return equal to 3.41 percent. Thus, the investor who held all turnpike debt in 1838 would have received a similar return over the next 44 years as an investor in Consols. Summarizing aggregate returns for the whole period, turnpikes paid a small premium over Consols before competition with railways. After 1850 the returns declined but over the long run they were similar to Consols. The next section examines risks.

### III.

The degree of risk is a crucial factor in determining the value of a security to investors. This section characterizes the risks by studying the distribution of interest payments at the individual trust level. The central question is how many trusts paid a lower interest rate versus
rates of 4 to 5 percent. I use newly digitized data on payments for all trusts in eight years: 1823, 1834 to 1838, and 1850. The 1823 data come from a parliamentary report in 1824 publishing detailed returns on revenues and expenditures made to county clerks. The 1824 report is especially valuable because it provides the first comprehensive source on trust level interest payments. However, it is incomplete in that 72 trusts did not provide a return and 20 trusts provided incomplete information. In total interest payments are observed for 820 trusts in 1823. The trust-level data for 1834 to 1838 and 1850 are from the annual edition of the Abstract of General Statements of Income and Expenditure of Turnpike Trusts in England and Wales. They measure finances for the entire population and are mostly complete. For example, in 1836 interest payments are reported for 1130 trusts and in 1850 interest payments are reported for 1117 trusts.

Figure 5 shows the distribution of interest payments in 1823, 1836, and 1850. In all years, the distribution is bimodal, with most trusts paying between 4.5 and 5.5 percent and another group paying zero percent. For example, in 1823, 38.5 percent of trusts paid between 4.5 to 5.5 percent and 13 percent of trusts paid zero interest. In terms of total turnpike debt, the 38.5 percent paying 4.5 to 5.5 percent accounted for 32.8 percent of the debt. The 13 percent paying zero accounted for 12 percent of the debt.

The proportions of trusts paying different levels of interest are similar in 1836 and 1850, except more trusts pay 4.5 to 5.5 percent and fewer paid zero interest. This finding may be surprising given that several important railways began offering services by 1850. It appears that in the short-run railways did not undermine turnpike interest payments.

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20 See ‘Turnpike Trusts. Copies of the Several Accounts Transmitted to the Clerks of the Peace of the Different Counties of England and Wales; from the Clerks of the Trustees of the Several Turnpike Trusts in Each County,’ BPP (1824 XX).
A natural next question is how many trusts paid zero interest regularly. To investigate this issue, I match individual trusts reported in 1823, 1834 to 1838, and 1850 to a ‘master’ list of all trusts ever formed. The matches are based on trust name and location information from their regulating acts.\textsuperscript{21} The match rates in each year are very high, over 98%. But the matched sample is unbalanced over time as some trusts exited, entered, merged with other trusts, or reported districts separately or together. 1114 trusts have interest rate observations in at least two of the eight years 1823, 1834 to 1838, and 1850. 607 have observations in all eight years.

The matched samples show a partial recovery in financial performance for trusts paying zero interest. Figure 6 shows the distribution of interest payments in 1836 separately for trusts paying zero interest in 1823 and those paying some interest. Trusts paying zero interest in 1823 were more likely to pay zero interest in 1836. 29 percent of trusts were still paying zero interest in 1836 compared to 5 percent for trusts that paid some interest in 1823. But many zero interest trusts recovered. 54 percent of trusts paying zero interest in 1823 were paying 4 percent or more in 1836. Thus, the losses incurred by some bondholders were not permanent. Also notable is that more trusts paying zero interest in 1823 were paying the highest levels of interest in 1836. These trusts must have been repaying some of their unpaid interest accumulated from the 1820s.

The rate at which zero interest paying trusts returned to paying interest is also revealing because it speaks to whether the finances of trusts experienced short-term or medium-term shocks. Here I focus on the trusts paying zero interest in 1834 and analyze their interest payments in the next four years 1835, 1836, 1837, and 1838. Figure 7 shows the distribution. 66 percent of trusts paying zero interest in 1834 were still paying zero interest in 1835. By 1836 this share falls to around 60 percent and is similar until 1838. Thus within 1 year there was a 36 percent chance of paying some interest following zero and within 2 years there was a 40 percent

\textsuperscript{21} I thank Alan Rosevear for creating the master list of turnpike trusts ever formed.
chance of paying some interest following zero. It appears that just over one-third of trusts experienced short term shocks, which temporarily forced them to pay zero interest.

IV.

The evidence from previous sections shows that holding turnpike bonds carried some risk and that on average investors were paid an interest rate above the rate on government bonds. These findings raise the question of whether the risk premium applied across turnpike trusts. In other words, were expected returns for individual turnpike bonds higher if they were associated with more risk? One could compare the average interest payment between 1823 and 1850 with the standard deviation over the same period. However, this is not an ideal test because average interest payments partly capture the behavior of trustees and creditors. A better approach studies the relationship between the contracted rate of interest agreed to by the lender and the standard deviation in interest payments. If trusts associated with the higher contracted rate also had higher volatility that would be consistent with a risk premium on holding more risky turnpike bonds.

This test is conducted using the sample of 986 trusts with interest rate observations in all 5 years between 1834 and 1838 and using data on the contracted rate of interest reported in 1838.\textsuperscript{22} The vast majority of trusts had one of three contracted rates 4 percent (12.2 percent of trusts), 4.5 percent (12.5 percent of trusts), or 5 percent (75 percent). We don’t know when the contracted rates were set, however, it is likely that most predated 1834 and were not renegotiated annually. The average standard deviation of interest payments in the trusts with 4, 4.5, and 5 percent contracted rates were 1.24, 1.38, and 1.30 respectively. The differences between the three groups are not statistically significant in any case.\textsuperscript{23} A similar analysis shows no significant

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\begin{itemize}
\item \textsuperscript{22} Contracted rates in 1838 come from the Appendix to the report of the commissioners for inquiring into the state of the roads in England and Wales BPP 1840 (XXVII, p. 647.).
\item \textsuperscript{23} The t-statistic comparing the mean standard deviation for trusts with contracted rates of 4 and 4.5 percent is 0.63, comparing trusts with 4 and 5 percent the t-statistic is -0.33, and comparing 4.5 and 5 percent it is 0.42.
\end{itemize}
relationship between the probability of a trust ever paying zero interest between 1834 and 1838 and contracted rate categories in 1838 (4, 4.5, or 5 percent).

Thus, the evidence does not support a risk premium operating within the turnpike lending market. One potential explanation is that investors could not easily evaluate the risks of one trust versus another. It was easier to evaluate the risks of all turnpike trusts compared to Consols.

V.

In this section, the financial risks and returns for four types of investors are characterized. Turnpike investors differed in their portfolios due to wealth, risk tolerance, and social standing. Many had an important place in the economy and so their experiences are of broader interest. The first is the so-called generic investor, who held a single turnpike bond. Often, they were local landowners or merchants. Recall that their interest in owning a turnpike bond was partly economic. Nearby lands or trading businesses could increase in value if they lent to the trust and roads were improved.

Outcomes for the generic investor are examined using the matched sample of 1114 trusts with observations in at least two years in 1823, 1834 to 1838, and 1850. For each of these trusts I calculate the mean interest payment and standard deviation from 1823, 1834 to 1838, and 1850. One can think of the generic investor as randomly drawing from this distribution of trusts and getting its mean and standard deviation interest payment as a percentage of debt. Figure 8 shows a three-dimensional histogram of the mean and standard deviation of interest payments for each trust. On average, the generic investor got a mean return of 4.2 percent and a standard deviation of 1.69. Many realized close to the average outcome. 47.6 percent had a mean return between 4 and 6 percent and a standard deviation between 0 and 2. There was a small chance, 6 percent, of getting a mean return below 1 percent and a standard deviation below 1 percent. These were the
trusts consistently paying zero interest. Thus, the generic investor faced a small risk of a very bad outcome and moderate risk getting a return just below 5 percent.

Next consider the large landowning investor. They were similar to the generic investor in holding the bonds of turnpike trusts in their area. However, they were wealthy enough to hold bonds from two or three turnpike trusts. An interesting question is whether large landowners faced less risk because they were more diversified. The returns to large landholders are studied using the matched sample of trusts with observations in all reports from 1823, 1834 to 1838, and 1850. It is necessary to simulate their portfolios because we don’t know exactly which trusts they lent to. The method is as follows: For each county 100 portfolios are simulated based on a random selection of two turnpike trusts. The 3900 resulting portfolios are equally weighted between the two turnpike bonds drawn at random. The mean is simply the average return between the two turnpike bonds. The standard deviation is given by the following formula:

\[
\text{Standard deviation two trust portfolio} = \sqrt{0.25 \times \text{Var}(\text{trust 1}) + 0.25 \times \text{Var}(\text{trust 2}) + 0.5 \times \text{Covar}(\text{trust 1}, \text{trust 2})}
\]

The large landowner realizes a lower standard deviation by spreading the risk across two trusts. They gain even more if their two trusts have negative covariance. In the simulations, a negative covariance was observed in 42 percent of the two trust portfolios.

A 3D histogram of the mean and standard deviation for simulated large landowner portfolios is shown in figure 9. The average mean return is 4.46 percent and the average standard deviation is 1.36. A high percentage realized close to the average outcome. 58.1 percent had a

---

24 We don’t know why large landowners held a particular set of turnpike bonds, but it is probably related to their landholdings. A large landowner would have an incentive to invest in the turnpikes near where they had significant land. If their landholdings were scattered randomly in a county then their holdings of turnpike bonds would be random in a county as well.

25 Note some counties had one trust with complete observations and so they are not relevant in this analysis. I examine 39 counties in England and Wales.
mean return between 4 and 6 percent and a standard deviation between 0 and 2. Less than 1 percent had a mean and standard deviation less than 1. Large landowners with two or more trusts rarely received zero interest continuously. The evidence suggests that the ability to diversify had a significant impact in reducing the risk of holding turnpike bonds even if the diversification occurred within a county.

Charities held just under 10 percent of turnpike debt by the 1830s. They were different investors because of their mission to fund local schools or churches. To study charities I use Clark’s digitization of the Charity records (see Clark 1998 for details). There are 114 turnpike bonds listed as assets held by charities in Clark’s data. I was able to match 88 of these turnpike trusts to the master list. Among these 88 some of the bonds refer to the same turnpike trust which leaves 58 unique trusts that I can confirm had at least one charity investor at some point. I focus on this set of 58 trusts to get a better understanding of the financial returns earned by charities.

Figure 10 plots the 3D histogram of the mean and average standard deviation for trusts in the charity portfolio. The average mean interest payment for charity investors was 4.72 and the standard deviation was 1.18. Note the mean charity return is higher than the mean for the generic investor and the standard deviation is lower. Moreover, 67.7 percent had mean interest payments between 4 and 6 percent and a standard deviation below 2. None paid zero interest regularly. Assuming charities did not have inside information, which seems reasonable, they likely selected less risky turnpike bonds or they were gifted less risky trusts.

The final investor of interest is the Public Works Loan Board or PWLB. Recall it was a government funded body whose official aim was to provide employment by making loans for projects in the 1820s. One interesting question is whether the PWLB made loans to trusts that

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26 For comparison, I also analyze 100 portfolios based on random draws of one turnpike trust for each county. The average mean return in the portfolios with one trust is 4.46 percent and the average standard deviation is higher at 1.7. This further suggest that large landowners realized lower risk.
were financially distressed and had difficulties getting loans from regular investors. This issue can be investigated by comparing the financial returns of trusts they lent to versus all turnpike trusts. The turnpike trusts indebted to the PWLB are listed in the appendix to a report by a House of Lords committee published in 1833.\textsuperscript{27} I matched 101 of the turnpike trusts listed as receiving PWLB loans to the master list of all turnpike trusts. The 3D histogram for these 101 trusts is shown in figure 11. The average mean return is 4.02 percent and the average standard deviation is 1.68. Their returns were also more widely dispersed: only 36.7 percent had mean interest payments between 4 and 6 percent and a standard deviation below 2. It appears the PWLB earned lower returns on average and experienced more risk. This is consistent with the view that the PWLB lent to more financially distressed trusts.\textsuperscript{28}

VI.

This section compares the financial returns on turnpike bonds with a broader range of securities available to the early nineteenth century investor, including land, canals, and railways. I calculate the Sharpe ratio for a portfolio of each type of investment. The Sharpe ratio is the average return in the portfolio $r_{portfolio}$ minus the risk free return $r_{risk\ free}$ divided by the standard deviation of the portfolio $\sigma$, or $Sharpe\ Ratio = \frac{r_{portfolio} - r_{risk\ free}}{\sigma}$. A higher Sharpe Ratio generally implies a superior portfolio because it offers more return per unit of risk (see Sharpe 1994 for more details). In all cases below, the risk free asset is the Consol with a return of 3.44 percent.

The portfolio of turnpike bonds includes all trusts with at least two observed interest payments in 1823, 1834 to 1838, and 1850. It is equivalent to the fully diversified portfolio

\textsuperscript{27} See the Second Report from the Select Committee of the House of Lords Appointed to Examine the Turnpike Returns.

\textsuperscript{28} There could be other interpretations. The PWLB insisted on being the first creditor repaid at 5 percent. It is possible this ordering of its credit made it hard to raise other capital and hence weakened borrowing trust’s overall performance. Further research is needed to sort this out.
available to the generic investor shown in figure 8. I use the average unweighted mean and standard deviation across 1114 trusts.

The comparison land portfolio is based on rates of return on properties held by charities reported by Clark (1998). The Charity records contain the price paid and the rental value of 53 farmlands between 1823 and 1850. While not perfect, the charity records contain the best available information on the return to investing in land. They also appear to be randomly distributed across counties in England.

Returns to railways and canals can be estimated in two ways. First, one can look at accounting profits, specifically the rates of return on capital employed (ROCE) which is net earnings or revenues minus operating expenses divided by paid in capital plus debt. Arnold and McCartney (2005) use surviving accounting statements to measure ROCE for the top 5 railway companies from 1838. I use their unweighted average and standard deviation over the years 1838 to 1850. Unfortunately, there is no estimate for the ROCE on canals across the entire population. But Arnold and McCartney estimate the rate of return on equity (ROE), which is net earnings deducting interest payments divided by paid in capital plus retained earnings. The sources are limited and so they calculate ROE for five important canals. I use the unweighted average ROE and standard deviation across the five canals for the years 1821 to 1850.

The second approach is to use the total return for canal and railway securities traded on the London stock exchange. The total returns (capital gain or loss plus the dividend yield) are volatile mainly because of the capital gain or loss. Nevertheless, the total return is relevant in evaluating how investors benefitted from railways and canals because these securities were actively traded. The data on total returns come from Acheson, Hickson, Turner, and Ye (2009) who analyze the London stock market from 1825 to 1875. They have kindly provided the
unweighted mean total return and dividend yield for all canal and railway securities from 1825 to 1850.

Table 3 summarizes the mean and standard deviation for each portfolio, the method of calculating returns, and the Sharpe ratio. The turnpike portfolio had a higher Sharpe ratio than the farmland portfolio. Thus, landowners who diversified into turnpikes earned a higher return per unit of risk. The largest landowners would have experienced even lower risk because they were more diversified.

Compared with canals the relative performance of turnpike bonds depends on whether one considers accounting profits, the dividend yield, or the total return. Turnpikes had a lower Sharpe ratio than canals based on the ROE for the five canals. The same is true for the dividend yield, which reflects all canal securities traded on the London exchange. However, the total return for canals implies that turnpike bonds generated a higher Sharpe ratio. In fact, canal securities between 1825 and 1850 generated an average total return less than the risk-free Consol, which implies a negative Sharpe ratio. Thus, from an accounting point of view, canals were a better investment, but investors generally overpaid for canal securities and as a result earned a much lower total return. This suggests that the lack of speculation in turnpike bonds provided an unexpected advantage to its investors.

The story is similar for railways. The Sharpe ratio using the ROCE of the top five railways is much higher than for turnpikes. However, the total return and dividend yield for all listed railways shows they generated lower returns and were associated with more risk than turnpike bonds. This conclusion comes with caveats because railways were a new industry in the 1830s and 40s and there was tremendous speculation in shares prices associated with the railway mania.
VII.

Turnpike road trusts in nineteenth century England and Wales provide an interesting context to examine the financial returns to investing in early public works. This paper calculates the size of interest payments made by all turnpike trusts relative to their mortgage debts. The results show that turnpike trusts paid competitive returns in the aggregate. Interest payments as a percentage of debt equaled approximately 4 percent up to 1850. This can be considered a broadly competitive return considering the yield on Consols was just over 3.4 percent for most of the nineteenth century. It also shows that turnpike trusts generated additional income to the English and Welsh economy besides increased property values.

Matters changed after 1850 when competition from railways increased. Nevertheless, investing in turnpike bonds still yielded a reasonable return over the long-run. The internal rate of return to a hypothetical investor holding all turnpike debt from 1838 to 1882 equaled 3.41 percent.

This paper also examines how much risk was involved in holding in turnpike bonds. Risk is first measured by plotting the distribution of interest payments across trusts and over time. The distributions are calculated using newly digitized interest payments for all turnpike trusts in 1823, 1834 to 1838, and 1850. In each year studied, interest payments varied and at the lower end some trusts paid zero interest. The financial losers were not numerous however. Further analysis shows that some trusts recovered quickly from negative shocks and poor performance in one year was not permanent.

Risks and returns are also measured for different types of investors. The generic investor earned a mean return of 4.19 percent with a standard deviation of 1.69. Large landowners got similar returns but with less variance. Charities earned slightly higher returns and experienced
the lowest variation. Lastly, the Public Works Loan Board earned the lowest returns, suggesting their aims and experiences were different.

Overall turnpike bonds had a place in the financial market of the early nineteenth century. They offered a better return than land which was the dominant investment before the industrial age. They offered lower returns than canals and railways based on net earnings and the value of capital, but they were not subject to speculation and so investors rarely overpaid for turnpike bonds. Eventually, as we know, turnpike bonds were superseded by the new securities of the mid-nineteenth century, like banks, manufacturing companies, and insurance companies, which paid handsomely over the long run.

The general lesson is that infrastructure financing can pay well. England in the early nineteenth century had a favorable economic and legal environment for private investment in infrastructure. Turnpike trusts, canals, and railways yielded good returns with little financial assistance from the government. That being said, it took many decades for English infrastructure networks to be built. Nearly 100 years in the case of turnpike trusts. The private risks of investing probably contributed to the slow improvement of infrastructure.
Official Sources

Report from the Select Committee appointed to consider the acts now in force regarding turnpike roads and highways in England and Wales, British Parliamentary Papers 1821 IV, p. 343.

Report of the commissioners appointed in pursuance of two several acts of Parliament; the one made and passed in the 58th year of His Present Majesty, cap. 91, intituled,"an act for appointing commissioners to inquire concerning charities in England, for the education of the poor;" and the other, made and passed in the 59th year of His Present Majesty, cap. 81, intituled,"an act to amend an act of the last session of Parliament, for appointing commissioners to inquire concerning charities in England, for the education of the poor, and to extend the powers thereof to other charities in England and Wales." British Parliamentary Papers 1821 IV.

Turnpike Trusts. Copies of the Several Accounts Transmitted to the Clerks of the Peace of the Different Counties of England and Wales; from the Clerks of the Trustees of the Several Turnpike Trusts in Each County,’ British Parliamentary Papers 1824 XX.

Appendix to the report of the commissioners for inquiring into the state of the roads in England and Wales, British Parliamentary Papers 1840 XXVII, p. 15.

Turnpike trusts. An abstract of the general statements of the income and expenditure of the several turnpike trusts in England and Wales, All years, 1836-1883, British Parliamentary Papers.

Second Report from the Select Committee of the House of Lords Appointed to Examine the Turnpike Returns Now Upon the Table and the Abstract Thereof, and to Consider, Whether Any Alterations Can be Made in the Law Relative to Turnpike Trusts: With the Minutes of Evidence Taken Before the Committee and an Index and Appendix. 1833.

Fourteenth annual report of the Local Government Board. 1884-85, British Parliamentary Papers 1884-85 XXXII.1, p. 66.

References


Nunn, P.J. 'The management of some south Yorkshire landed estates in the eighteenth and nineteenth centuries, linked with the central economic development of the area,' University of Sheffield Ph.D. thesis 1985.


Figure 1: A map of the English and Welsh turnpike network in 1830
Sources: Map produced by the transport, urbanization, and economic development in Britain, 1670-1911 project. See http://www.campop.geog.cam.ac.uk/research/projects/transport/

Figure 2: Interest payments as a percentage of mortgage debt for all turnpike trusts
Sources: Authors calculations based the Abstract of General Statements of Income and Expenditure of Turnpike Trusts in England and Wales, British Parliamentary papers, various years.

Figure 3: Net borrowing and net change in debt for all turnpike trusts
Sources: Authors calculations based on the Abstract of General Statements of Income and Expenditure of Turnpike Trusts in England and Wales, British Parliamentary papers, various years.

Figure 4: Unpaid interest all turnpike trusts
Sources: Authors calculations based on the Abstract of General Statements of Income and Expenditure of Turnpike Trusts in England and Wales, British Parliamentary papers, various years.

Figure 5: Distribution for interest payments across turnpike trusts in 1823, 1836, and 1850
Figure 6: Distribution for interest payments across trusts in 1836 depending on whether zero interest was paid in 1823.
Sources: Authors calculations based on and BPP (1824 XX) and BPP (1837-38 XLVI).
Figure 7: Distribution for interest payments in 1835 to 1838 for trusts paying zero interest in 1834

Sources: Authors calculations based on BPP (1836 XLVII), BPP (1837 LI), BPP (1837-38 XLVI), BPP (1839 XLIV), and BPP (1840 XLV).
Figure 8: Distribution for mean and standard deviation of interest payments across all turnpike trusts with at least two observed payments between 1823 and 1850

Sources: Authors calculations based on BPP (1824 XX), BPP (1836 XLVII), BPP (1837 LI), BPP (1837-38 XLVI), BPP (1839 XLIV), BPP (1840 XLV), and BPP (1852-53 XCVII).
Figure 9: Distribution for mean and standard deviation of simulated interest payments to large landowners, 1823-1850

Sources: Based on author’s calculations. See text.
Figure 10: Distribution for mean and standard deviation of interest payments to turnpike bonds held by charities, 1823-1850

Sources: Based on author’s calculations. See text.
Figure 11: Distribution for mean and standard deviation of interest payments by turnpike trusts receiving loans from the Public Works Loan Board, 1823-1850

Sources: Based on author’s calculations. See text.
Table 1: Categories of turnpike revenue and expenses in England and Wales, 1834

<table>
<thead>
<tr>
<th>Panel A: Revenues</th>
<th></th>
<th>Value in pounds sterling</th>
<th>% of monetary revenues</th>
<th>% of all revenues</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tolls</td>
<td></td>
<td>1,434,069</td>
<td>93.9</td>
<td>89.4</td>
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<td>Parish payments in lieu of statute labor</td>
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<td>58,077</td>
<td>3.8</td>
<td>3.6</td>
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<tr>
<td>Incidental receipts</td>
<td></td>
<td>35,494</td>
<td>2.3</td>
<td>2.2</td>
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<tr>
<td>Total monetary revenues</td>
<td></td>
<td>1,527,640</td>
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<tr>
<td>Estimated value of statute labor performed</td>
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<td>75,758</td>
<td></td>
<td>4.7</td>
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<tr>
<td>Total revenues, including statute labor</td>
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<td>1,603,398</td>
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<table>
<thead>
<tr>
<th>Panel B: Expenses</th>
<th>Value in pounds sterling</th>
<th>% of total expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor (manual and team)</td>
<td>516,376</td>
<td>30.3</td>
</tr>
<tr>
<td>Materials for surface repairs</td>
<td>217,048</td>
<td>12.8</td>
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<tr>
<td>Salaries to trust officers</td>
<td>92,954</td>
<td>5.5</td>
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<tr>
<td>Tradesman’s bills</td>
<td>67,098</td>
<td>3.9</td>
</tr>
<tr>
<td>Damages in obtaining materials</td>
<td>10,018</td>
<td>0.6</td>
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<tr>
<td>Incidental expenses</td>
<td>59,045</td>
<td>3.5</td>
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<tr>
<td>Legal</td>
<td>28,889</td>
<td>1.7</td>
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<tr>
<td>Estimated value of statute labor performed</td>
<td>75,758</td>
<td>4.5</td>
</tr>
<tr>
<td>Improvements</td>
<td>217,152</td>
<td>12.8</td>
</tr>
<tr>
<td>Land purchased</td>
<td>20,184</td>
<td>1.2</td>
</tr>
<tr>
<td>Interest</td>
<td>289,376</td>
<td>17</td>
</tr>
<tr>
<td>Debt Payments</td>
<td>107,810</td>
<td>6.3</td>
</tr>
<tr>
<td>Total expenses, including statute labor</td>
<td>1,701,708</td>
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Source: BPP (1836 XLVII).
Table 2: Debt and Interest Payments to Turnpike Bondholders, 1820-1842

<table>
<thead>
<tr>
<th></th>
<th>1820</th>
<th>1829</th>
<th>1834</th>
<th>1838</th>
<th>1842</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Debt and interest payments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Mortgage debt</td>
<td>4,516,586</td>
<td>6,578,815</td>
<td>7,068,275</td>
<td>7,260,903</td>
<td>7,238,704</td>
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<tr>
<td>Total Floating debt</td>
<td>203,217</td>
<td>303,541</td>
<td>273,937</td>
<td>202,034</td>
<td>161,367</td>
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<tr>
<td>Interest paid</td>
<td>236,619</td>
<td>289,376</td>
<td>301,462</td>
<td>295,934</td>
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<tr>
<td>Interest paid as percent of mortgage debt</td>
<td>3.6</td>
<td>4.09</td>
<td>4.15</td>
<td>4.09</td>
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<table>
<thead>
<tr>
<th></th>
<th>1820</th>
<th>1829</th>
<th>1834</th>
<th>1838</th>
<th>1842</th>
</tr>
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<tbody>
<tr>
<td><strong>Panel B: Unpaid interest</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accumulated unpaid interest</td>
<td>558,613</td>
<td>821,386</td>
<td>1,002,255</td>
<td>1,123,623</td>
<td>1,333,486</td>
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<tr>
<td>Unpaid interest as share of mortgage debt</td>
<td>12.49</td>
<td>14.18</td>
<td>15.47</td>
<td>18.42</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>1820</th>
<th>1829</th>
<th>1834</th>
<th>1838</th>
<th>1842</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Borrowing and repayment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net borrowing or borrowing minus repayment of debt in current year</td>
<td>45,334</td>
<td>-35,412</td>
<td>-33,292</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net change in mortgage and floating debt over previous year</td>
<td></td>
<td></td>
<td></td>
<td>-16,225</td>
<td>-29,711</td>
</tr>
</tbody>
</table>

Sources: Data for 1820 are from Second Report from the Select Committee of the House of Lords Appointed to Examine the Turnpike Returns (1833, p. 173). Data for 1829, 1834, and 1838 are from BPP 1840 (XXVII, p. 647.). Data for 1842 are from BPP (1844 XLII).
Table 3: A comparison of investment portfolios in the early nineteenth century

<table>
<thead>
<tr>
<th>Portfolio, return type, years</th>
<th>Mean (unweighted)</th>
<th>Standard Dev.</th>
<th>Sharpe ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>turnpike bonds, interest payments as percent of debt, 1823-1850</td>
<td>4.2</td>
<td>1.69</td>
<td>0.45</td>
</tr>
<tr>
<td>farmland held by charities, rate of return, 1823-50</td>
<td>3.69</td>
<td>1.49</td>
<td>0.168</td>
</tr>
<tr>
<td>five canal companies, return on equity, 1825-1850</td>
<td>10</td>
<td>8.12</td>
<td>0.808</td>
</tr>
<tr>
<td>top five railway companies, Return on capital employed, 1838-1850</td>
<td>5.77</td>
<td>2.1</td>
<td>1.11</td>
</tr>
<tr>
<td>canal securities, dividend yield, 1825-1850</td>
<td>4.94</td>
<td>1.41</td>
<td>1.064</td>
</tr>
<tr>
<td>railway securities, dividend yield, 1825-1850</td>
<td>3.11</td>
<td>4.03</td>
<td>-0.082</td>
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<tr>
<td>canal securities, total return, 1825-1850</td>
<td>3.21</td>
<td>5.21</td>
<td>-0.044</td>
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<tr>
<td>railway securities, total return, 1825-1850</td>
<td>4.01</td>
<td>16.08</td>
<td>0.035</td>
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</tbody>
</table>

Notes and sources: For turnpike portfolio see generic investor portfolio discussed in text. The farmland portfolio is taken from charity records described by Clark (1988), The return on equity for canals is taken from Arnold and McCartney (2005), the return on capital for railways is taken from Arnold and McCartney (2005), canal and railway securities returns are based on data described in Acheson, Hickson, Turner, and Ye (2009).