# Party connections, interest groups, and the slow diffusion of infrastructure:

# Evidence from Britain's first transport revolution

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Abstract

Economic and political interests often try to block or delay infrastructure improvements. This paper examines the effects of interest group influence and party connections by studying Britain's river navigation improvements in the early 1700s. These projects were controversial and were the subject of intense lobbying in parliament. Using a new dataset, I find that stronger party connections and influence in neighboring areas likely to oppose or support projects influenced whether a town adopted a river navigation act. Their effects are comparable to geography and town economic characteristics in magnitude, and help explain whether some towns were blocked from getting navigation improvements. The findings speak to the nature of Britain's institutions in the much debated period following the Glorious Revolution. They also address broader issues concerning infrastructure, technology diffusion, and political connections.

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Good Roads, canals, and navigable rivers, by diminishing the expense of carriage, put the remote parts of the country more nearly upon a level with those in the neighborhood of the town. They are upon that account the greatest of all improvements….It is not more than fifty years ago that some of the counties in the neighborhood of London, petitioned the parliament against the extension of the turnpike roads into the remoter counties. Those remoter counties, they pretended, from the cheapness of labour, would be able to sell their grass and corn cheaper in the London market than themselves, and would thereby reduce their rents, and ruin their cultivation.

Adam Smith, *the Wealth of Nations*, Chapter XI, Of the Rent of Land (1976 p. 164).

## I. Introduction

In the face of opposition, infrastructure improvements are often slow to diffuse. One commonly held view is that infrastructure projects are more likely to be blocked if opposing interest groups have more influence and connections with politicians and the government.[2] The case of Britain in the early 1700s is instructive because powerful interest groups often lobbied to reject infrastructure bills when they came up in parliament. In the passage above, Adam Smith notes that landowners close to London petitioned against the extension of turnpike roads during the early 1700s because it threatened their rents. Bills for river navigation improvements were especially prone to opposition from neighboring landowners. The gentlemen and freeholders of Somerset contended the river Avon navigation project would be a great prejudice to all parts of the county by bringing corn and other commodities from Wales, where the value of lands are low. Opposition also came from neighboring property owners and some towns. Henry Parsons lobbied against the Avon bill arguing that his six mills would be rendered useless to the great loss of the poor and to himself. Town officials in Bristol, the navigation head of the Avon, argued that the bill contained clauses that may be construed to interrupt their ancient rights.[3]

[2] As one example, see the article in the Economist on why extensions to runways at Heathrow airport are taking so long. http://www.economist.com/blogs/economist-explains/2015/07/economist-explains-1.

[3] The preceding petitions can be found in the Journals of the House of Commons, vol. 17, p. 112 (26 Feb., 1712), p. 132 (12, Mar., 1712), and p. 134 (13, Mar. 1712).

The role of interest groups and connections also speaks to broader debates about Britain's institutions in the decades after the Glorious Revolution of 1688-89. Some works in the literature see Britain's institutions as being conducive to economic growth, either because they protected property rights and eased the financing of wars, or because they allowed for an active parliament.[4] But many scholars have noted that corruption was common in the early eighteenth century making it less obvious that Britain's institutions supported investment and innovation.[5] Moreover, some have argued that the Whig and Tory parties maintained majorities in the House of Commons by appeasing local interests, including those opposed to policies that might have aided economic development.[6] Other scholars see the Whigs and Tories as having different connections, resulting in different policies depending on which party had power. [7]

This paper quantifies the effect of interest groups, political parties, and party connections at a micro-level and gauges their significance. The empirical analysis focuses on the diffusion of acts of parliament authorizing river navigation improvements across towns in England and Wales. I estimate a discrete time hazard model specifying the probability a candidate town adopted a river act in each of the 14 parliaments from 1690 to 1741. Candidate towns have rivers but they were not navigable by 1690, or they did not have river acts in earlier parliaments. The second model I estimate specifies the probability a town's river bill succeeded in parliament given it was introduced. The aim in both models is to test whether the influence and party connections of interest groups have large effects in comparison to the geographic and economic characteristics of candidate towns.

[4] See North and Weingast (1989), Acemoglu et.al. (2005), Bogart and Richardson (2011), Cox (2012), Bosker et. al. (2012).
[5] See O'Brien et. al. (1991); Mokyr and Nye (2007), Harris (2010), Zahedieh (2010), Temin and Voth (2013), and Pettigrew (2013).
[6] See Black (1990), Speck (1970), Holmes (1987), Colley (1982), O'Gorman (1989).
[7] See Plumb (1967), Stasavage (2003, 2007), Pincus (2009), Pincus and Robinson (2013), and Dudley (2013).

The dataset contains new spatial measures on infrastructure and the economic characteristics of all market towns in England and Wales. I also add new spatial data on Members of Parliament (MPs) and their party affiliation. The variables include population and economic specialization indicators for candidate towns, the same for their neighboring towns, and measures of whether the candidate town's neighboring MPs were connected to the majority party, either the Whigs or Tories. Crucially, since location is important for infrastructure projects, I separate neighboring majority party MPs and neighboring towns into upstream and downstream areas based on the location between a candidate town and its navigation head. The data show that opposition to river bills often came from downstream areas, while support often came from upstream. Building on these patterns I use upstream and downstream majority party MPs to measure the party connections of likely supporters and opponents of navigation.

There are several notable findings. First, more favorable geography and economic characteristics, like manufacturing specialization and high market potential, were among the most important factors determining whether towns adopted river acts. Second, the identity of the majority party in the House of Commons mattered. The adoption of river acts was much more likely in parliaments with Whig majorities compared to Tory majorities. Third, the characteristics of neighboring towns and neighboring majority party MPs had the largest impact in determining whether river bills succeeded in parliament. For example, having more towns on the road network upstream, more towns with water navigation downstream, and more majority party MPs representing the county all made a town's river bill significantly more likely to succeed. Having more majority party MPs downstream and more harbour towns downstream had the opposite effect. These findings have a broader implication because they suggest that greater

influence and connections among opposing and supporting interests played a significant role in parliament's decision to approve or reject river bills.

I also show that differences in influence and connections can explain why some towns were 'blocked' from getting a river act. A blocked town is one that had a bill in parliament but did not get an act by 1741 (the end of my analysis). The coefficient estimates combined with the observed differences between blocked and 'successful' towns show that variables for neighboring town characteristics had large effects. The effect of majority party MPs downstream was not as large, but it still played a significant role in blocking.

The main results are further examined in a series of robustness checks. One concern is the potential endogeneity of majority party MPs in the county and downstream. This issue is addressed using panel models including town and parliament fixed effects, and distinctions between incumbent and newly elected majority party MPs to get at plausibly exogenous sources of variation in party connections. The results confirm that having more majority party MPs downstream slowed adoption, but they are less supportive that more majority party MPs in the county increased adoption. Another issue concerns selection effects in analyzing the success or failure of bills in parliament. Here I use a bivariate probit model to jointly estimate decisions to introduce bills and decisions to approve bills in parliament allowing for a correlation in unobservable factors across the two equations. The results confirm the findings for downstream majority party MPs and reject selection bias. Other extensions explore weighting, heterogeneity, and modelling assumptions about the locations of supporters and opponents upstream and downstream. None of the main findings are materially changed.

The results contribute to several literatures. For economic history the most important finding is that Britain's institutional environment c.1700 was not favorable to the *rapid* adoption of infrastructure because of interest group pressures and party politics. This contribution is explained further in the following section. Other related literature points to the distributional effects of infrastructure projects, specifically dams in India (Duflo and Pande 2007) and highways in China (Faber forthcoming). This paper shows how potentially disaffected groups can manipulate the political process to prevent the realization of negative effects.

Another related literature studies the effects of political connections on firm-level outcomes, or on regions through party or ethnic representation. These studies generally find that political connections provide value to firms.[8] Many also show that government spending patterns differ when a district or region is strongly represented by the majority party or ethnic group in power.[9] This paper adds to this literature by demonstrating the effects of party connections in a setting with frequent turnover in the majority party. In most modern contexts the majority party changes infrequently, making identification of party connections challenging. Also, by using differences between incumbent and newly elected majority party MPs, this paper employs a new method for addressing the endogeneity of majority party representation.

A final related literature concerns the link between vested interests, institutions, and the diffusion of technologies. Evidence suggests vested interests are more effective in slowing the diffusion of new technologies in countries with weak institutions. [10] By studying an important

[8] See Faccio et. al. (2006), Faccio (2006), Blanes i Vidal et. al. (2012), Cingano and Pinotti 2013), Jayachandran (2006) and Ferguson and Voth (2008).
[9] See Levitt and Synder (1995), Lee (2003), Curto Grao et. al. (2012), Albouy (2013), and Burgess et. al. (2013).
[10] For contemporary studies see Comin and Hobijn (2009), Bellettini, Berti Ceroni, and Prarol (2014). For historical studies see Mokyr (1990), Rosenthal (1990), Mokyr and Nye (2007), North, Wallis, and Weingast (2009)

case in careful detail, this paper contributes to a general understanding of how efforts to block technologies are conditioned by institutions, and the interests of ruling groups.

The remainder of the paper is organized as follows. Sections II and III provide background on politics and river acts in Britain. Section IV describes the main empirical strategies. Sections V and VI introduce the data. Sections VII and VIII present the main estimation results. Sections IX and X summarize the robustness checks and extensions. Section XI concludes.

## II. Background on corporations, interest groups, and politics in Britain

Over the eighteenth century Britain emerged as the leading economy of Europe. Scholars have long debated the explanations for Britain's divergence. With respect to institutions, much of the debate focuses on the greater role of parliament after 1688-9, and whether it helped to foster development. One important aspect concerns acts of parliament creating corporations. The largest corporations were the Bank of England, the East India Company, and the South Sea Company. Aside from the three 'monied' companies, there were many other smaller trusts and joint stock companies that resembled public utilities in the twentieth century. They focused on infrastructure projects like building roads, rivers, canals, bridges, courts, and marketplaces. The broad diffusion of utilities was one of the driving forces in Britain's economic growth. They helped to catalyze the development of Britain's transportation and trading infrastructure.[11]

Acts for utilities and corporations were more common in the decades following the Glorious Revolution than in the decades before (Bogart 2011). But, like many new technologies, it proved quite difficult to form corporations in Britain. Bills proposing corporations had notoriously high failure rates in parliament, sometimes resulting in long delays or blocking of entry and projects.

[11] For an overview and related literature on transport's contribution to growth see the summary by Bogart (2014).

Opposition from interest groups was the most direct reason corporate bills failed. Sometimes the opposition came from existing corporations. For example, the Bank of England opposed the founding of the South Sea Company. Opposition also came from towns or industries arguing they would lose from the entry of a firm or the implementation of a project. According to some scholars, the influence of interest groups was so fundamental that political factors played a comparatively minor role. Ron Harris summarizes this perspective: "barriers on entry into the corporate world was not created by Parliament intentionally, nor was it to any considerable degree manipulated by Parliament….Parliament served only as the arena and set the procedural rules. The arena was left open to the active players in this game, the vested interests. And it was the vested interests which created the barriers on entry (2000 p. 135)."

Running counter to the interest-group only view is a more general argument that politics and parliament mattered. The two main political parties from the late 1670s through the middle of the eighteenth century were the Whigs and Tories. They had an intense competition in the eleven parliaments between 1690 and 1721, with the majority party in the elected House of Commons switching 7 times. The Whigs and Tories differed in their policy positions with the Tories favoring privileges for the Church of England, lower taxes, and a small government debt. The Whigs generally favored religious toleration and an aggressive foreign policy based on a well-funded army. The two parties also differed in their supporters. The Tories were generally supported by small to medium landowners known as country gentleman. The Whigs drew more support from merchants, financiers, and large landowners.

The Whig party came to dominate the Commons after 1721. The Whigs held a large majority in the four parliaments from 1722 to 1741 and for some decades after. One reason was the demise of the Tories as an effective opposition party after they were associated with a failed

Rebellion against the monarchy in 1715. Another was the emergence of Robert Walpole as the leader of the Whigs. Serving as the first Prime Minister from 1721 to 1742, Walpole was especially effective in using government favors to secure a working majority in the Commons.

There is a large historical literature on Britain's political parties.[12] One of the main debates concerns their capabilities in coordinating the actions of their fellow MPs. Geoffrey Holmes, a leading political historian, argues party organization was achieved by 1701 despite the fact that the Whigs and Tories did not possess a modern party machine and a system of official whips with recognized authority (1987, p. 287). There are mixed views about the role of parties in organizing local policies. Holmes argues that MPs would vote across party lines when it came to bills for duties and taxes affecting their constituency (1987, p. 45). But other historians have detected examples where party politics clearly influenced local affairs. According to Colley (1982, p. 22), as soon as the Whigs secured control of Norwich corporation in 1715 they made sure its plumbing and street lighting contracts went only to Whigs. Any publican who persisted in voting Tory was liable to have his license revoked. This paper is the first to empirically test whether Britain's early parties had the capability of targeting local policies to their supporters, much like modern parties.[13]

Another strand of the literature emphasizes differences between the Whigs and Tories in terms of strategies and connections. Stasavage (2003, 2007) provides evidence that British government bond yields were lower when the Whigs had a larger majority. Stasavage argues that bondholders were a key part of the Whig coalition. Likewise, Dudley (2013) argues that the Whigs were more favorable to the manufacturing sector and worked to assist this sector when

[12] See Namier (1957), Walcott (1956), Plumb (1967), Black (1990), Speck (1970), Hill (1976), Horwitz (1977), Harris (1993).
[13] See Cox and McCubbins (1986), Lindbeck and Weibull (1987), and Dixit and Londregan (1996) for targeting.

they had a majority. Pincus (2009) and Pincus and Robinson (2013) see the Whigs as being more favorable to development projects including infrastructure. The differences between the two parties will be explored below. Like previous works, I use switches in the majority party to identify party effects. Unlike previous work, my analysis uses town-level data and investigates differences in the way party connections worked.

### *II.2 Background on River Navigation Acts*

Preceding canals and railways, river navigation was a key part of Britain's early transport system. A river navigation act established a company or authority with rights to levy tolls and purchase land necessary for improvements in navigation. The tolls were subject to a price cap and there were provisions on how the project was to be carried out, including how landowners would be compensated for damages. Notably, there were no public subsidies, so all financing came from investors in the companies (Willan 1964).

Through their statutory powers, navigation companies played a key role in the extension of inland waterways. Nearly all the companies that got acts successfully built locks and dredged rivers. In the process, they increased the length of navigable waterways in England and Wales. Figure 1 draws on Willan (1964) to illustrate the changes. The black lines show rivers that were navigable in 1690 and the grey lines depict rivers with acts improving their navigation by 1740. Generally, acts extended navigation near the coast or on existing navigable rivers. They gave established and emerging towns better access to waterway transport.

The extension of river navigation to a town generally increased its economic prospects. Improved navigation lowered transport costs since freight rates by inland waterway were approximately one-third the freight rates by road. Many contemporaries, including Daniel Defore

(1724), argued that trade increased for a city when it was connected to the waterway network. In light of the economic importance of waterway transport it is significant that the diffusion of river navigation acts was fairly slow. It took nearly 50 years from 1690 to 1740 to extend navigation on the rivers in figure 1. One immediate reason is that projects were proposed several times in parliament before being approved and some were never approved at all.

The House of Commons was the key decision-making body for river bills in parliament. Projects started as an order for a bill by the House of Commons or as a petition by the public, with petitions becoming the dominant form after 1700. Petitions were assigned to a special committee of MPs who would draft a bill to be reviewed by the entire Commons. The committees had around 25 MPs, but there was a norm that any MP from neighboring counties and boroughs could attend. Another norm was that any interested individual or group could petition the committee in favor or against the bill. The next section documents that petitioning campaigns were a prominent feature of river navigation bills.

## III. River bills, acts, and towns: background and data

The *Journals of the House of Commons* provide rich information on all river navigation bills.[14] The details of every river bill from 1690 to 1741 were entered in a spreadsheet, including petitions, orders of the House, committee reports, votes, amendments, and whether the bill became an act.[15] Several key features of river bills are summarized in table 1. First, less than half of all river bills succeeded confirming that success was far from guaranteed. Second, over 80% of river bills started with a petition from groups outside the Commons. The rest started as an

[14] There were generally two types of river bills. One was to make rivers navigable and the other to amend the rights of a river navigation authority created by a previous act. The analysis here focuses on bills to make rivers navigable.
[15] See Hoppit (1997) and Bogart (2011) for more details on the *Journals* as a source. Note that votes are only occasionally reported, and include only the names of the 'tellers' for yes and no and the totals for each side.

order for a bill from within the Commons but the origin is never stated. Third, officials or inhabitants of a town were the most common group to start a bill through a petition. Less than 20% of the original petitions came from landowners or individuals with unstated locations. Fourth, most bills had supporting petitions from towns (82.6%), but just over one-third (37.6%) had opposing petitions from towns. When at least one town opposed, there were often several more (3.38 on average). Fifth, just under one third of bills had opposing petitions from landowners who self-identified as being near or adjacent to the river. They rarely supported bills. Sixth, county officials, like Justices of the Peace, both opposed and supported bills, although support was more common.

The frequency of petitions suggests that a variety of interests influenced rivers bills. Towns were clearly important because they originated over 80% of bills through petitions. Towns also opposed more than a third of bills. In the analysis below, I focus on the diffusion of river bills and acts across towns and study how the characteristics of a town and its neighboring towns influenced adoption. The town database is drawn from Richard Blome's *Britannia* (1673). Blome's lengthy book is a guide to 782 market towns in England Wales. The list includes large cities like London, Bristol, and Norwich. It also includes small and medium-sized towns that would later become industrial and shipping centers, like Manchester and Liverpool. Blome also describes the economic and political characteristics of towns, like whether it has manufacturing and municipal government. Finally, Blome provides county-level maps showing town locations, waterways, and coastal features.

All the towns in the Blome list are coded with a latitude and longitude. I then identify which towns were on navigable rivers or the coast, which were located on rivers or streams that could be made navigable, and which had neither. The classification is based on modern maps and

Blome's county maps. Table 2 shows counts of towns in the three categories. There are 435 'candidate' towns that did not have access to river navigation by 1690 but did have water sources. For each candidate town the route of its river or stream is traced to the coast or the navigation head using Google maps.[16] The total route distance in miles is recorded along with the starting elevation at the town and then again at the coast or navigation head.

The next step is to match river bills and acts with candidate towns based on descriptions of the project in the *Commons Journals*.[17] Panel B in table 2 summarizes towns matched to river bills and acts. In total 17% of the candidate towns had river bills across all parliaments between 1690 and 1741, but only 11.7% of towns had a river act. The implication is that river acts were limited to a relatively small number of towns by 1741. Also note that some towns had river bills across multiple parliaments due to failures. There are 107 town-bill-parliament matches compared to 74 towns matched to a bill in at least one parliament.

Further details on the failure of river bills among candidate towns are given in panel C of table 2. Among the candidate towns with a river bill, nearly two thirds had their first bill fail. Among these, just over half eventually got a river act by 1741. The time delay between first failure and first act averaged 11.1 years. The 23 candidate towns with river bills that did not get acts by 1741 were not necessarily blocked forever from inland water navigation. Among the towns whose first river bill failed, 91.5% eventually got a canal or river navigation act by 1830. Their eventual adoption took time however. Figure 2 shows the diffusion curve for all towns with at least one river bill before 1741. Many did not get river acts until long after 1741, when

[16] A particularly useful program was http://bikehike.co.uk/index.php which provides a 'course creator' tool.
[17] The average number of matched towns per bill was 1.55, and the median number of towns per bill was 1. Two river bills, dealing with the Wivenhoe and Beverley Beck, could not be matched to any towns in Blome.

this study ends. Overall, the average time between first bill (anytime between 1690 and 1741) and the first navigation act (anytime between 1690 and 1830) was 18.8 years.[18]

More insights can be gained by examining towns ever petitioning in support or against river bills. I identified 94 towns in the Blome list with at least one supporting petition and 62 towns with at least one opposing petition. Supporting and opposing towns were similar in that both are close to the candidate town. To illustrate, distances are calculated between the candidate town for each river bill and all towns supporting or opposing its bill in a parliament.[19] In cases where bills had multiple candidate towns, the candidate town that is most 'downstream' is used. The example of the river Nene bill is shown in figure 3. Northampton is the most upstream candidate town relative to the navigation head in Peterborough. Wellingborough, Higham Ferrers, and Thrapston are successfully more downstream candidate towns. Panel A of table 3 reports that the average supporting town was 22.8 miles from the most downstream candidate town and the average opposing town was 20 miles. Although similar in their means, supporting towns tended to be more widely distributed. Figure 4 shows kernel density estimates for opposing and supporting towns' distance. Opposing towns were more concentrated around 20 miles.

A key difference between opposing and supporting towns was their location in upstream or downstream areas. To illustrate, I create an indicator for whether any town is downstream or upstream from the candidate town. The methodology is again illustrated by figure 3. Towns strictly in the northeast plane of Northampton are downstream (i.e. towards the navigation head

[18] It is also revealing that the average time between first failed bill (anytime between 1690 and 1741) and the first navigation act (anytime between 1690 and 1830) is 30.6 years.
[19] There were 160 towns matched to supporting petitions for the 69 bills and 88 towns matched to opposing petitions for the 69 bills. 10 towns were matched to a supporting and an opposing petition.

Peterborough) and towns in the southwest plane are upstream.[20] Panel B of table 3 shows that the mean of the downstream indicator is significantly lower for supporting towns compared to opposing towns.[21] The pattern holds if the candidate town is dropped rather than being upstream.

The analysis below builds on these patterns by using variables for the characteristics of towns in upstream areas within 25 miles and in downstream areas within 25 miles. The variables capture the structure of interest groups in areas most likely to support or oppose a town's river bill. Similar variables are created for upstream and downstream majority party MPs to capture political connections. The following section describes models for analyzing river acts and bills.

## IV. Modeling the diffusion of river acts and the success of river bills in parliament

The diffusion of river acts across candidate towns and parliaments is analyzed using a discrete time hazard model. The discrete time model comes from a more general literature analyzing an individual's transition to an absorbing state.[22] A classic example is the outcome of death for a patient, perhaps following treatment for disease. In the technology diffusion literature the discrete time hazard model builds on a threshold utility model where an individual or firm's profits must exceed a threshold level for them to adopt an irreversible technology.[23]

The threshold utility model is applied to this setting assuming towns have a utility from getting river acts. Let $y_{it}^{*} = \beta X_{it} + \varepsilon_{it}$ be the utility to candidate town *i* if it gets a river act in parliament *t*, $X_{it}$ is a vector of variables, $\beta$ is a vector of coefficients, and $\varepsilon_{it}$ is an error term.

[20] A straight line is drawn from the candidate town (Northampton) to the navigation head (Peterborough). A perpendicular line is created to divide the upstream plane away from the navigation head (southwest of Northampton) and a downstream plane towards the head (northeast of Northampton). An upstream and downstream region is then created with a circle of potentially varying size centered on the candidate town. In the case of figure 3, a circle with a radius of 25 miles identifies all towns in the upstream and downstream region for Northampton.
[21] Ten towns recorded as having a petition in support and against are dropped for this test leaving 238 towns in total.
[22] Singer and Willett (2003) and Allison and Christakis (2006) summarize models of event occurrence including the discrete time hazard models.
[23] For an overview of technology diffusion models and the threshold utility approach see Geroski (2000).

Assuming the alternative of no act yields zero utility, the town will seek an act if $y_{it}^{*} > 0$ or $\beta X_{it} > -\varepsilon_{it}$. Defining the variable $y_{it}$ equal to 1 if $y_{it}^{*} > 0$, and 0 otherwise, and assuming the error term $\varepsilon_{it}$ is distributed standard normal yields the equation:

$$Prob(y_{it} = 1) = \Phi(\beta X_{it}). \qquad (1)$$

In terms of estimation $y_{it}$ equals 1 if town *i* adopts a river act in parliament *t* and 0 otherwise. Note that town *i* is dropped in parliament *t* if it had a river act in any previous parliament. No town had more than one river navigation act, and river acts were irreversible. Also note that the normality assumption is not crucial. Logit and linear models can also be considered.

The variables in $X_{it}$ come under several sub-labels including $town_i$, $neighbor_i$, $geography_{it}$, $political_{it}$, $otheracts_{it}$, $whig_t$, $region_i$, $year_t$, $region_i \times year_t$. $town_i$ is a vector of characteristics that pre-exist the era of navigation improvements and are meant to capture the town's economic returns from getting river acts. It includes the town's market potential and other economic indicators described in the next section. $neighbor_i$ has similar characteristics for upstream and downstream towns within 25 miles. $geography_{it}$ includes elevation change and distance to the navigation head. Note that geography has a time subscript because as other towns closer to the navigation head got river acts the distance declined and the elevation changed. $political_{it}$ has characteristics for upstream and downstream political constituencies within 25 miles in parliament *t*. A key characteristic is the number of majority party MPs downstream as it will capture the political connections of likely opponents. Other key variables are the number of majority party MPs in town *i's* county and in its closest constituency. $otheracts_{it}$ is the number of towns within 25 miles with river or turnpike acts at the start of parliament *t*. Turnpike acts were similar to river navigation acts except they improved roads by

introducing tolls. I include neighboring river and turnpike acts to capture network effects. $whig_t$ is an indicator for parliaments with Whig majorities, and captures the effect of which party was in power. $year_t$ is the year the current parliament ended, and is a time control. $region_i$ is a vector of indicators for whether the town is in the Southwest, East Midlands, West Midlands, North, or Wales region (the Southeast is omitted). They control for fixed unobservable factors across regions. Finally, $region_i \times year_t$ is a vector of region-specific time trends. They allow some regions to become more attractive for river navigation with time.

In terms of identification, many of the variables in equation (1) are exogenous. For example, the variables in $town_i$ and $neighbor_i$ are determined long before river acts became an issue. However, numbers of majority party MPs were political outcomes and thus they might be correlated with omitted variables. For example, one could argue that more educated or better funded towns could foresee which party would win a majority in the next election and could seek to elect a majority party MP; if so, majority party MPs' estimated effects reflect other factors than just party connections. In the robustness section IX, I follow two approaches to address the issue of omitted variable bias. First, I incorporate fixed effects, which control for time invariant unobservable factors across towns and time varying factors across parliaments. Second, I use variation in majority party representation coming from incumbents versus newly elected MPs. As I argue below the number of incumbent majority party MPs is more likely to be unrelated to omitted variables influencing river acts.

In a second model, I analyze parliament's decision to approve or reject bills. The model is of special interest because it speaks to the role of interest group pressures and party connections in parliament. I model bill 'success' by assuming that candidate town *i* has introduced a bill in parliament *t* and letting $s_{it}^* = \beta_S X_{Sit} + \varepsilon_{Sit}$ be the utility to parliament if town

*i's* bill is successful in parliament *t*. Assuming the alternative yields zero utility, parliament will pass a bill if $s_{it}^{*} > 0$ or $\beta_s X_{Sit} > -\varepsilon_{Sit}$. Defining the variable $s_{it}$ equal to 1 if town *i* has a successful river bill in parliament *t* and 0 otherwise and assuming the error term $\varepsilon_{it}$ is distributed standard normal gives the equation, $Prob(s_{it} = 1) = \Phi(\beta_s X_{Sit})$.

There are several issues in analyzing the bill success equation. First, it is an open question what factors influenced parliament's decision making, and thus what variables should be included in $X_{Sit}$. One theory is that parliament was mainly influenced by political considerations, which motivates the inclusion of variables in $political_{it}$ and $whig_t$. A broader theory sees parliament's decision making as being influenced by interest group pressures and project feasibility. The variables in $neighbor_i$, like the number of neighboring towns with manufacturing, should capture the influence of local interest groups. The market potential variable measures the candidate town's influence and surrounding towns. There is a possibility of opposition from competing transport projects, which motivates the inclusion of turnpike acts in nearby towns. Project feasibility is best captured by the geographic variables, like elevation change and distance to the navigation head.

A second issue in the success function concerns selection bias, where bills that arrive before parliament have unobservable characteristics correlated with some of the key variables determining success. I address this issue in robustness section IX by estimating a bivariate probit model with sample selection.[24] There are two outcomes corresponding to the decision by towns to introduce bills and the success or failure of bills once in parliament. Importantly, the bivariate probit model allows for a correlation in unobservable factors across the two equations. A

[24] The bivariate probit is often used in health economics where there are multiple binary outcomes, like switching insurance companies and purchasing supplementary insurance, see Dormont et. al. (2009) and French and McLean (2006). Greene (2008) provides an overview of discrete choice modeling including reviewing the bivariate probit.

significant correlation would suggest a selection bias in the baseline bill success equation. The downside to this methodology is that some variables in the bill selection equation should be omitted from the success equation. I exclude the regional indictors and indicators for town characteristics, like whether the town had manufacturing. The argument is that interest group pressures are already captured by the characteristics of neighboring towns and local market potential. Regional considerations are unlikely to be relevant as there are no suggestions of regional favoritism in parliament. I maintain these same restrictions in the baseline bill success equation to aid the comparison with the bivariate model.

## V. Summary data on the characteristics of towns

Candidate town characteristics are created using several sources. From Blome's description, I create indicators for whether the town had manufacturing, had mining, had a harbour, was on the main road network c.1670, and had a free school. There is also an indicator for whether the candidate town had municipal government, which, for simplicity, is one if the town had at least one type of official like mayors or council members.[25]

Population is an important town characteristic omitted from Blome's summary. Fortunately there is an alternative source. I linked the towns in Blome with 1670 parish population estimates provided by the Cambridge Population History group.[26] The details of the linking are described in the online data appendix. The town population data is used to construct a 'local' market potential variable for each town, measuring the size of the town and its nearby neighbors that could use the waterway network. The local market potential for town $i$ is $\sum_{j=1}^{782} Pop_j/d_{ij}$, where

[25] For roads I supplemented Blome with Robert Morden's, *The New Description of the State of England*, written in the 1690s. Morden provides maps of roads in each county in the 17th century before turnpikes.

[26] I thank Leigh Shaw Taylor for kindly sharing the CAMPOP's data.

$Pop_j$ is the population of town $j$ (in tens of thousands) and $d_{ij}$ is the Euclidean distance between town $i$ and town $j$.[27]

As a preview, the first columns of table 4 show summary characteristics for candidate towns adopting or not adopting river acts by 1741.[28] Several significant differences are revealed. Towns with river acts by 1741 have smaller elevation changes to their navigation head, lower distance to the navigation head, and higher local market potential than towns that did not get acts by 1741. Also towns with river acts were significantly more likely to have municipal government, manufacturing, a harbour, or to be on the main road network. All of these patterns are sensible.

The second group of columns in table 3 reports the mean characteristics of candidate towns ever getting or ever not getting river acts by 1741 given they had at least one bill by 1741. Here there are fewer significant differences. Towns that did not get river acts had greater elevation changes to the navigation head and were less likely to have municipal government, but these mean differences are significant only at the 10% level. Thus, on the whole, the geographic and economic characteristics of towns cannot obviously explain why some towns with bills were blocked from river acts before 1741. The last columns in table 4 report summary statistics for towns with river bills that did or did not succeed on the first try given the town eventually got an act by 1741. Again the geographic and economic characteristics of towns cannot obviously explain delays in getting river acts.

## VI. Summary data on neighboring town and constituency characteristics

[27] The sum is over all 782 towns in the Blome list. The distance between town i and itself is taken to be $0.333*\sqrt{(1/\pi)}$ following the convention adopted by Keeble et al. (1982) to measure the market potential of regions

[28] Summary statistics on town characteristics for all candidate towns without river acts in a previous parliament are provided in online appendix table 1.

Most of the neighboring characteristics are defined in upstream and downstream areas within 25 miles. Specifically, there are variables for the number of towns with mining, manufacturing, water navigation c. 1670, municipal government, and free schools in both upstream and downstream areas within 25 miles. In the appendix, I show that most of these characteristics are associated with a higher likelihood of a town ever supporting or ever opposing through a petition. I also show that when petitioning towns are matched with river bills and assigned to upstream or downstream areas, there are some characteristics more associated with supporting petitions than opposing petitions.[29] For example, a petitioning town is more likely to support if it is upstream and on the main road network, and also if it is downstream and has water navigation c.1670. Thus, by summing over the number of upstream towns on the road network and the number of downstream towns with water navigation c.1670, I am capturing the influence or strength of interest groups most likely to support. In other variables, I capture the influence of towns most likely to oppose. One is the population of the town at the navigation head.

Related variables are created for the characteristics of political constituencies and their MPs upstream and downstream within 25 miles. In England and Wales from 1690 to 1741, there were 53 county constituencies and 220 municipal boroughs. Most county and borough constituencies were represented by two MPs but there were some with one or four. To locate these constituencies in space, the latitude and longitude of boroughs is taken from the towns in Blome identified as boroughs. The latitude and longitude of counties are given by the latitude and longitude of their most central point. In figure 3 towns near the river Nene with dark-filled circles are boroughs represented in the Commons and dashed lines mark county boundaries.

[29] See appendix table 2 for difference in means tests for towns ever supporting or opposing bills. Appendix table 3 analyzes whether petitioning towns support or oppose as a function of locational and economic characteristics.

The party affiliation of MPs in each constituency is taken from new data created by this author. Until recently the majority party in each parliament could be taken from *The History of Parliament* (Cruickshanks, Handley, and Hayton 2002, Sedgwick 1970), but there was no available data for the party affiliation of every MP in each parliament. Elsewhere, I detail how to identify whether each MP was affiliated with the Whigs or Tories when they had a majority in the Commons for all parliaments from 1690 to 1747 (Bogart, forthcoming). The political classification draws on division lists which identify party affiliation directly or voting on major pieces of legislation associated with the leaders of the two parties. The party-MP data are used to measure the number of majority party MPs across constituencies for every parliament.[30] Party affiliation is then projected in space using the coordinates of constituencies. Figures 3 and 4 in the online appendix illustrate the variation in party representation for the 1708 and 1710 parliaments when the Whigs and then Tories were in the majority.

The variation in party representation across time and space is crucial to this paper. For each candidate town I create a list of party connection variables including the number of majority party MPs in their county, in their closest constituency, and the number of majority party MPs in their downstream or upstream areas within 25 miles. As neighboring MP and constituency characteristics could also matter, similar variables are created for the number of MPs, incumbent MPs, and constituencies with electoral contests within 25 miles, both upstream and downstream.[31] The number of MPs serves as a control variable as some areas had more representation and hence more majority party MPs and incumbents.[32]

[30] Note that some constituencies have more than one MP in a parliament due to deaths or exits. Here the number of majority party MPs is the monthly average across MPs who sat in a parliament.

[31] A contest involved two or more candidates for the same seat in the Commons and provides an indicator of local political competition. Contests are documented in the History of Parliament (Cruickshanks, Handley, and Hayton 2002, Sedgwick 1970). The History also documents the political tenure of each MP in a constituency. An

Finally, to capture network effects, I count the number of towns within 25 miles that had river acts and turnpike acts by the end of the previous parliament. Blome towns are matched to turnpike acts using similar sources. Figure 3 shows a turnpike road connecting to Northampton.

The top panel in table 5 previews the most important differences in means for neighboring town variables.[33] The results show that if more upstream towns within 25 miles were on the main road network c.1670 then candidate towns were more likely to get acts by 1741. Having more downstream towns with harbours or with municipal government made a town significantly less likely. Most of the same neighboring town characteristics are correlated with towns having bills succeed in parliament given they had at least one bill. One difference is that a town's bill was more likely to succeed if more of its downstream towns within 25 miles had water navigation c.1670, or if the navigation head had lower population. Several of these results match the findings mentioned earlier that upstream towns on the road network and downstream towns with water navigation were more likely to petition in support of bills rather than against.

The bottom panel of table 5 previews the correlations for variables that vary across the 14 parliaments from 1690 to 1741. Towns getting river acts in a particular parliament had significantly fewer downstream majority party MPs within 25 miles. The same is true of candidate towns with successful river bills in a parliament. Note that the mean value for majority party MPs downstream is 3.85 and the standard deviation is 3.2. Thus, towns with river acts in a parliament had one-third of a standard deviation lower value for downstream majority party MPs than towns that did not have river acts. Other findings are that towns with river acts in a

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incumbent is defined as an MP that served two consecutive parliaments in the same constituency. I also require that the MP serve the full term of both parliaments and not take over because the death of another MP.

[32] The maps of constituencies in the appendix show the variation in representation across space.

[33] Summary statistics for neighboring town characteristics are shown in appendix table 1 for all candidate towns that did not have river acts in a previous parliament.

parliament had more turnpike acts in neighboring towns. Also towns were significantly more likely to get river acts in parliaments with a Whig majority but there is a weaker relationship between Whig majorities and the likelihood that river bills succeed in parliament. These same patterns are now examined using the econometric models described in section IV.

## VII. Baseline results I: the adoption of river acts

The coefficient estimates for the baseline discrete-time hazard model are reported in table 6 along with robust standard errors clustered on candidate towns. Several geographic and town variables are found to be statistically significant. The same applies to several neighboring town and majority party variables.[34] Table 7 summarizes the magnitudes for the most precisely estimated coefficients by reporting the adjusted predicted probability of an act at representative 'low' and 'high' values. For continuous variables the representative values are one standard deviation below and above the mean. For indicator variables, a 0 or 1 is used as the representative value. All other variables are kept at their original values. Thus the adjusted predicted probability of an act is made assuming all candidate towns have the low representative value and again assuming they all have the high representative value. Readers should note that the probability of a town getting an act in any given parliament was quite low (prob.=0.009), and even if a variable has a large effect it will not make the overall probability large. Thus the magnitudes are better represented by the percentage change in the adjusted predicted probabilities at the representative low and high values (shown in the last column of table 7). A 95% confidence interval is also reported to show the precision of the predicted probabilities.

[34] There might be a concern that the standard errors are understated for geography, town characteristic, and neighboring town variables because they don't vary across parliaments. As it turns out, this is not a problem. The signs and significance of these variables are generally similar after estimating a probit model but restricting the sample to a single year and analyzing which candidate towns ever adopted river acts. After dropping Wales the sample size is 435 rather than 5393.

One key finding is that the Whig majority indicator has a large quantitative effect. Towns had a 160% higher probability of getting a river act under a Whig majority in the Commons compared to a Tory majority. This finding supports the view that Whig majorities were more conducive to development. Readers should note that the Whig effect is robust to the inclusion of time varying controls like interest rates.[35] It is not simply the case that Whig majorities occurred in years more favorable to development.

Majority party connections also have large effects. Having two majority party MPs in the town's county constituency raised the probability of an act by 165% compared to having zero majority party MPs in the county. Moving from a low to a high value for the number of majority party MPs downstream within 25 miles lowered the probability of act by 88%. Together these two results suggest that party connections of river act supporters and opponents mattered. County MPs represented the economic interests of the region surrounding a river project and would have been more likely to support than not. Downstream majority MPs represented river act opponents.

The majority party variables have significant effects but they were not as large as geography or town characteristics. If a town's elevation increased from a low to a high value its probability of adoption decreased by nearly 100%. Clearly the feasibility of projects, especially the problems with elevation changes, mattered a lot. Distance to the navigation head was also quite important, but the sign is different from the simple means analysis shown earlier. Increasing the distance from low to high raised the probability of an act by just over 900%. Project scale is the most likely explanation for this result. A river with a greater distance meant that the fixed costs of

[35] Potentially correlated time varying controls include the inflation rate, rates of return on land, indicators for harvest failures, indicators for years of war, the growth rate of coastal trade, and the length of parliamentary sessions (see Bogart 2011). I average these variables across a parliament and include them in the probit model for river act adoption. The main finding is that the Whig majority indicator remains large, positive, and significant. Results are shown in online appendix table 4.

bringing a bill into parliament, getting it passed, and implementing the project could be spread across more users. Towns with manufacturing and with municipal governments were 107% and 156% more likely to get an act compared to towns without these characteristics. Increasing local market potential from a low to a high value increased the probability of an act by 136%. Greater demand for transport improvements is the most likely explanation for the local market potential and manufacturing results. The municipal government result is interesting from a collective action perspective. Towns with municipal government could more easily form coalitions, giving them an organizational advantage.

The effects of neighboring town characteristics were generally smaller in magnitude, but there are several significant results. A higher population for the town at the navigation head lowered the probability of an act. The same applies to having more downstream towns with municipal government, more upstream mining towns, and more upstream towns with water navigation c.1670. Several of these factors, like the higher population of towns at the navigation head and downstream towns with municipal government, are indicative of the strength of opposing groups and their role in slowing diffusion of acts.

Turnpike road improvements in nearby towns also significantly increased the probability of adopting river acts. The most likely explanation is network effects. New roads were often complementary to improvements in inland water navigation, as has been shown for turnpike and canals acts in the late 1700s (Bogart 2009). I now turn to the second model analyzing the success of river bills in parliament. Some of the results above will carry over to success, but not all.

## VIII. Baseline results II: river bill success

Table 8 shows the coefficient estimates and robust standard errors for the probit model examining bill success. The first column shows a parsimonious model with MP, constituency, and party variables. The number of majority party MPs representing the county and the number of majority party MPs downstream are significant. The signs are consistent with the model for adopting river acts. In the second specification, several added variables relating to geography, population, and neighboring town characteristics are also significant. These include elevation, distance to the navigation head, local market potential, the population of the navigation head, and upstream or downstream towns with harbours, water navigation, and main roads.

Note that some factors affecting the adoption of river acts are not relevant for the success of river bills. For example, Whig majorities do not have a consistently significant effect on bill success. This finding suggests that parliaments with Whig majorities contributed to acts for reasons other than the Whigs being more favorable to the approval of river bills. Other variables have the opposite sign in the success equation. For example, turnpike acts have a negative sign, suggesting there may have been opposition by competing road authorities, even as they complemented a town's river improvements.

The magnitudes of the most precisely estimated variables affecting bill success are illustrated in table 9. Like table 7 it reports the adjusted predicted probability at representative low and high values. The probabilities are averaged across the 107 candidate towns matched to a bill. The sizeable effects of majority party MPs point to the significance of party connections. Having two instead of zero majority party MPs in the county raised the likelihood of bill success by 75%. More majority party MPs downstream reduced the likelihood of success by 73%.

Neighboring town characteristics also had relatively large effects on the success of bills. More downstream towns with water navigation c.1670 raised the likelihood that the bill would succeed by 124%. The same applies to more upstream towns with harbours and upstream towns on the road network c.1670. Such neighboring towns were likely to be supportive of extending river navigation, suggesting that the influence of neighboring towns most favorable to river bills encouraged their success in parliament. One interesting finding is that more harbours downstream lowered the probability of a bill succeeding. The *Commons Journal* has several petitions from harbour towns arguing that navigation improvement upstream will negatively affect them.[36] The results suggest that harbours had great influence in parliament, and in some cases their influence could work against extending river navigation.

There are other findings of note. Moving from low to high values of local market potential increased the probability of success by nearly 70%. The most natural interpretation is that lobbying by populous candidate towns increased the chances of their bill's success. Also, moving from lower to higher elevation changes decreased the probability by 47% and moving from lower to higher distances to the navigation head increased the probability by 149%. It would appear that parliament considered the feasibility and scale of projects. A last notable finding relates to the greater likelihood of success over time. The last entry in table 9 compares the probability of a bill succeeding in the parliament that ended in 1695 and in the parliament that ended in 1722. For 1722 the probability of a bill succeeding went up by 117% compared to 1695. It appears that parliament got better in passing river bills, and perhaps better in resolving conflicts among various interest groups.

[36] An example is Newcastle upon Tyne opposing the river Wear bill (see the Journals of the House of Commons, vol. 18, p. 516 (28, Mar., 1717).

Overall the estimates suggest that geographic factors along with neighboring town characteristics and MP party connections affected the success of bills in parliament. A natural follow up question is whether these characteristics delayed bills from succeeding or whether they contributed to river bills being blocked. To address this question, I estimated counter-factual probabilities of bill success for the 23 towns that had river bills before 1741 but zero acts before 1741. Recall that most of these towns eventually got navigation acts, but not for many decades. A counter-factual is conducted for each of the key variables in the bill success equation. It is assumed the 23 blocked towns have the average value of the 51 towns with successful river bills before 1741. A comparison is then made with the actual average value in the 23 blocked towns for each key variable. The sample size of blocked towns is smaller and thus the precision of the predicted probabilities is not as high as before, but the calculations still yield insights.

The results on blocking are shown in table 10. Neighboring town characteristics had the largest effect on blocking. Specifically, if blocked towns had fewer towns with water navigation upstream and fewer with harbours downstream, as did towns with successful bills, their chances of having a successful river bill in parliament would have gone up by 59 to 70%. Similarly if they had more towns with water navigation downstream and more on the main road network upstream their chances would have increased by 74%. Several of these results suggest that if blocked towns had stronger interests supporting their bill and weaker interests opposing their bill their outcome could have been different. Regarding party connections, the size of the effect for downstream majority party MPs is smaller than for neighboring towns but not trivial. If blocked towns had the same average downstream majority party MPs as successful towns then their chances of getting a successful bill would have increased by nearly 24%. This last result suggests that patterns of opposing party connections persisted for some towns and contributed to blocking.

By comparison, the effect of the number of majority party MPs in the county is small. Thus county party connections resulted in delays in getting river navigation acts, but not blocking.

## IX. Robustness I: Selection effects and endogeneity of political connections

This section addresses the two main identification concerns of selection bias in the success equation and the endogeneity of majority party MPs in neighboring constituencies. I start with the bivariate probit model, which estimates two equations, one for bill selection and another for bill success. Bill selection is modeled much like the adoption of river acts by towns. Let $y^*_{bit} = \beta_B X_{it} + \varepsilon_{Bit}$ be the utility to the candidate town if a bill is introduced, where $X_{it}$ is defined earlier, $\beta_B$ is a vector of coefficients, and $\varepsilon_{Bit}$ is an error term. Assuming the alternative of no bill yields zero utility, the town will introduce a bill if $y^*_{Bit} > 0$ or $\beta_B X_{it} > -\varepsilon_{Bit}$. As above, the bill success equation is modeled as a decision by parliament, where a bill succeeds if $\beta_S X_{Sit} > -\varepsilon_{Sit}$. The difference now is that I incorporate that parliament decides on a bill only if $\beta_B X_{it} > -\varepsilon_{Bit}$. Thus there are three potential outcomes. In the first, no bill is introduced by the town, in the second, a bill is introduced but it fails, and in the third, a bill is introduced and it succeeds. The probability of no bill is $Prob(\beta_B X_{it} < -\varepsilon_{Bit})$. The probability of a failed introduced bill is $Prob(\beta_B X_{it} > -\varepsilon_{Bit}, \beta_S X_{Sit} < -\varepsilon_{Sit})$. The probability of a successful introduced bill is $Prob(\beta_B X_{it} > -\varepsilon_{Bit}, \beta_S X_{Sit} > -\varepsilon_{Sit})$.

The distributions of $\varepsilon_{Bit}$ and $\varepsilon_{Sit}$ are the key assumptions in the bivariate probit model. I assume that $\varepsilon_{Bit}, \varepsilon_{Sit} \sim N(0,0,1,1,\rho)$ , which yields the bivariate probit likelihood function with well-known properties and estimation routines.[37] The $\rho$ parameter allows the unobservable factors in the bill selection and bill success decisions to be correlated. The other key assumption

[37] I use the estimation package in stata called Heckprobit, see http://www.stata.com/manuals13/rheckprobit.pdf.

concerns the exclusion restrictions in $X_{Sit}$. The second specification for bill success analyzed in section VIII includes local market potential and variables from $geography_{it}$, $neighbor_i$, $political_{it}$, $year_t$, $otheracts_{it}$, and $whig_t$ in $X_{Sit}$. I follow this specification in the bivariate probit, except turnpike acts and neighboring towns with free schools had to be dropped to obtain convergence in the estimation.[38]

The coefficient estimates for the bill success equation in the bivariate probit model are shown in the second column of table 11. I also report estimates for the bill success equation from the probit model without selection effects in the first column. The results are generally similar. For example, more downstream majority party MPs significantly lowered the probability of bill success, and likewise for upstream towns with water navigation and downstream towns with harbours. One difference is that majority party MPs in the county is no longer significant in the bivariate model. The other notable result concerns the negative but insignificant selection coefficient ρ reported at the bottom of table 11. Its imprecision suggests selection effects are not of major importance. The coefficient estimates for the bill selection equation are shown in online appendix table 5. To conserve on space the results are not fully discussed. Many are consistent with the results for the river act adoption model, including Whig majorities.

The second identification issue is the potential endogeneity of the political constituency variables. I address this concern using linear fixed effects models and plausibly exogenous sources of variation in majority party representation. Town and parliament fixed effects (FEs) control for any time-invariant unobservable factors at the town level and any time-varying factors common among all towns in a parliament. If the political constituency variables are

[38] Several other exclusions restrictions were applied with similar results. For example, local market potential was dropped from the success equation and turnpike acts were included. The key coefficients for majority party MPs and neighboring towns were very similar in magnitude and statistical significance.

correlated with these unobservable factors then their magnitude should change with the addition of fixed effects. I switch to the linear model which can easily incorporate FEs.[39] The models take the following form:

$$y_{it} = \beta_1 political_{it} + \beta_2 geography_{it} + \beta_3 acts_{it} + \alpha_i + \delta_t + \varepsilon_{it} \quad (2)$$

where $y_{it}$ is an indicator for whether town *i* got a river act in parliament *t*, $\alpha_i$ is a town FE, and $\delta_t$ is a parliament FE, and $\varepsilon_{it}$ is an error term. Three linear FE models are estimated under different assumptions about the standard errors. The first clusters the standard errors on the town. The second computes Driscoll-Kraay standard errors which incorporate cross-sectional dependence between towns (see Driscoll-Kray 1998, Hoechle 2007). The third uses panel corrected standard errors with an AR(1) disturbance term.

The results are very similar across the three FE models. The detailed estimates are shown in online appendix table 6. Panel A.1 in table 12 examines the magnitudes for the main two political constituency variables using the model which clusters the standard errors on towns. As before the adjusted predicted probabilities are reported at representative low and high values among all candidate towns. The findings are generally consistent with the results of the baseline probit model. In the linear FE model, moving from low to high values for majority party MPs downstream decreases the probability by 75%. In the probit model, the same change reduced the probability of an act by 88%. The quantitative effect for majority party MPs in the county is larger in the linear FE model. Going from 0 to 2 county MPs with the majority party raised the probability of an act by 234%.

[39] The FEs cannot be included in the probit model discussed earlier. FEs can be included in the linear probability model but at the cost of dropping $town_i$ and $neighbor_i$ which are fixed for a town across all parliaments.

Panel A.2 of table 12 summarizes fixed effects estimates for the subsample of candidate towns that had at least one river bill before 1741 (appendix table 7 gives the full results). Here only the effect of downstream majority party MPs is precisely measured across all models. These results confirm our earlier conclusion that among the political constituency variables, only downstream majority party MPs is significantly linked with delays and blocking.

The results for downstream majority party MPs are further confirmed by a conditional fixed effects logit model. Here identification comes from variation only in the towns that got river acts.[40] The coefficient estimates for the two main variables are shown in panel B of table 12. Again the number of majority party MPs downstream has a significant negative effect.

A second approach to addressing the potential endogeneity of majority party connections uses different sources of variation coming from incumbents and newly elected MPs. To build intuition, consider there were two ways that an MP in a constituency could be affiliated with the majority party in a parliament. First, the MP is an incumbent and the national electorate selects the incumbent's party in the most recent election. Second, the MP enters by winning the most recent election and he is affiliated with the party chosen by the national electorate. In the first case local interests got an MP affiliated with the majority party by maintaining the status quo. Country-wide majority party changes gave them majority party affiliation. In the second case locals got affiliation with the majority party by choosing a new MP. Given their greater activity, it is possible that in the second case local interests were more able to choose a majority party MP to help secure or defeat bills in the Commons. Thus one could interpret the variation from newly elected majority party MPs as more likely to be endogenous, while the variation coming from

[40] Parliament fixed effects cannot be included in this specification. Instead, I include the indicator for Whig parliaments to capture some differences across parliaments that are common to all towns. Appendix table 7 gives the full estimates for the conditional fixed effects model, along with an identical logit model with no town fixed effects.

incumbent majority party MPs is more likely to be exogenous. If there are no such differences, then the coefficient estimates for incumbent majority party MPs should be similar to the baseline estimates of majority party MPs reported earlier.

I conduct tests by creating variables for majority party MPs that were incumbents and majority party MPs that were newly elected. Approximately 50% of MPs affiliated with the majority party were incumbents and the other 50% were newly elected. [41] While there is an even balance between the two types, it is possible that constituencies with incumbents are different from those who elect majority party MPs. [42] I address this issue by estimating models with and without controls and by trying different specifications. The first specification uses the discrete time hazard model to analyze the adoption of river acts in a town, but the only variables are incumbent majority party MPs and controls for the number of upstream and downstream MPs and the year parliament ended. The results are shown in column 1 of table 13. Only downstream majority party MPs are found to be significant. The second specification adds all the other controls and is very similar to the baseline river act adoption model.[43] The results are consistent with the first specification, suggesting it is unlikely some other characteristic explains the effects of incumbent majority party MPs. In terms of the estimates, the downstream coefficient is nearly identical to the baseline estimates reported earlier in table 6. The same is not true of the other variables. For example, majority party MPs in the county is half as large as in table 6 and is no longer significant. The same general pattern holds in the conditional fixed effects logit model

[41] From 1690 to 1741 there were 6669 MP-constituency-parliament observations in the data. Of these 3424 were incumbents and 3310 were affiliated with the majority party in that parliament, and across these sets 1688 MPs were incumbents and were affiliated with the majority party.
[42] Incumbent control was possibly related to aristocratic control over constituencies or to a strong connection between the voters and incumbents on religious or non-economic issues. See O'Gorman (1989) and Speck (1970) for a discussion of how MPs were selected to represent constituencies.
[43] Note that all observations from the 1695 parliament are dropped in this regression because incumbency must first be established in the previous parliament to generate the variables.

reported in column 3. Column 4 combines both types of majority party MPs in a single regression. The specification is otherwise similar to column 2 and the baseline model. The results show no significant differences in the effects of downstream majority party MPs in either scenario, whether they were incumbents or newly elected MPs. Majority party MPs in the county have larger effects if the MPs are newly elected, than if they were incumbents.

The bottom line is that the estimated effects of county majority party MPs is less robust. In part, it likely captures unobservable characteristics of interest groups near the town. By contrast, there is no evidence that the estimated effects of downstream majority party MPs are masking other factors. The results consistently show that stronger party connections in areas that generally opposed river acts slowed their diffusion.

## X. Robustness II: Weighting, model specification, and heterogeneity

There are several other potential concerns relating to weighting, measurement, and model specification. This section addresses these issues. The baseline discrete time hazard model compares towns with river acts and all towns without river acts in some previous parliament. One could argue that a better comparison is between towns with river acts and towns that were most similar on other observable characteristics. To explore this further I select a set of "similar" candidate towns that did not get acts in the same parliament. The matching is based on the nearest neighbor matching algorithm where all variables in $town_i$, $neighbor_i$, $geography_{it}$, and $region_i$ are used to form the match.[44] The number of matches varies from one to two towns. In the next step, the means for the political constituency characteristics of the candidate towns

[44] The matching was done using the nnmatch command in Stata. The weighting matrix is the k x k diagonal matrix of the inverse sample standard errors of the k variables in the vectors $town_i$, $neighbor_i$, $geography_{it}$, and $region_i$.

with acts are compared with the means of their matched counter-parts which are most similar in observable characteristics.

Table 14 focuses on the number of upstream and downstream majority party MPs within 25 miles and reports the results for two separate matching exercises. The first identifies a single matched candidate town in a parliament for each town that got a river act. The second identifies two matched towns. The bottom of the table 14 reports the average 'distance' between towns and their matched counter-parts in both samples.[45] The results show that the mean number of downstream majority party MPs was significantly lower for towns that had river acts. Figure 5 shows a kernel density estimate for the distribution of downstream majority party MPs for towns with acts compared to their matched town. There is a clear tendency to have higher values in the matched towns. By comparison there is no difference in upstream majority party MPs between towns with acts and their matched counterpart. The baseline hazard model showed a somewhat imprecise effect for this variable. Comparisons with matched towns are also made for other constituency variables. The results are in online appendix table 9. None show a significant difference with earlier results.

A different set of issues relates to model specification. There is an assumption in the previous models that all the relevant towns and constituencies are within 25 miles of the candidate town. Of course, the 25 mile spatial scale may miss some aspects because it is too large or too small. As such, I estimate two additional models, one where all the variables are specified as upstream and downstream within 20 miles and the other using 30 miles. The

[45] As expected, the sample with 2 matches has a greater distance than the sample with 1 match, but the difference is not large and is not statistically different from zero. An analysis with 3 matches reveals similar results for majority party MPs downstream within 25 miles, but here the distance between towns with acts and matched towns in observables becomes larger and the mean distance in the 3 town matched sample is statistically different from the sample that matches to only 1 town.

coefficient estimates are shown in online appendix table 10. Briefly, they show that spatial scale matters for some variables, but the main conclusion that party connections and interest group structures had an effect is not overturned.[46]

Throughout it has been assumed that neighboring towns and constituencies differed if they were upstream or downstream. However, there is a concern that such distinctions are spurious. To examine this issue, I use a placebo test. As before I draw a line between the candidate town and its navigation head, but now I divide the plane into towns that were to the left and right of the candidate town rather than above or below the town. Left and right distinctions should not matter, or at the very least they should have smaller and less precise effects than upstream and downstream distinctions. Table 15 shows the main results of the placebo test for the probit model explaining bill success and the probit model explaining river act adoption (all the coefficients are in online appendix table 11). Few of the left/right variables significantly influenced bill success. The same is true in the model for the adoption of river acts, except majority party MPs to the left has a negative effect at the 10% significance level. The size and significance of this coefficient is much less than downstream majority party MPs reported earlier, suggesting that downstream is a more meaningful distinction.

Another estimation issue concerns heterogeneity in the effects. One possibility is that the marginal effects of majority party MPs differed under the Whig and Tories. I examine this possibility by including interactions between the Whig majority indicator and the variables for majority party MPs in the town's county, the closest constituency to the town, and in upstream and downstream constituencies within 25 miles. The results for the interaction variables are

[46] The main differences are that at 20 miles neighboring towns with river navigation, upstream towns on the road network, and downstream towns with municipal government are now insignificant. For 30 miles, upstream contests are now positive and significant, and neighboring towns with mining and downstream towns with municipal government are insignificant.

represented with plots of the average predicted probabilities under Whig and Tory majorities and different values for each majority party variable (the coefficient estimates are reported in online appendix table 12). Figure 6 shows that some of the marginal effects differ between the two parties. The negative effect of downstream majority party MPs is larger under the Whigs, and the negative effect of MPs in the closest constituency is larger under the Tories. The negative local constituency effect possibly points to the Tories stronger connection with local landowners and other interests who often opposed river acts.

A related set of specifications explores the variation in majority party representation coming from party strongholds. Each party had stronghold constituencies that would yield party wins in the vast majority of elections. Other constituencies generally swung between the parties. I use information which identifies party strongholds from 1701 to 1715, a period of intense political competition (see Bogart, forthcoming). Numbers of strongholds are counted in neighboring constituencies depending on which party was in the majority of that parliament. The baseline adoption model is then estimated including upstream, downstream, and county strongholds along with upstream, downstream, and county majority party MPs. A summary of the key results are shown in the first column of table 16. Controlling for downstream strongholds does not affect the coefficient for downstream majority party MPs. It appears that party connections among opponents worked the same in stronghold and swing constituencies. The results also show that strongholds in the county have their own positive effect on river acts above the effect of majority party MPs in the county. This suggests that majority parties treated their county strongholds differently. The stronghold effect is negative for upstream MPs, whereas the effect for upstream majority party MPs is positive. One interpretation is that majority parties favored connected supporters of river acts more if they were swing constituencies.

In the last specification, I test for interaction effects between electoral contests and majority party MPs. Variables are created to measure the numbers of upstream, downstream, and county constituencies that were from the majority party and who came from constituencies that had a contest in the election for the current parliament. The variables are then added to the baseline adoption model. The main results are shown in the second column of table 16. There is no interaction effect for contests and majority party MPs downstream or in the county, but there is a positive interaction effect of contests and majority party MPs upstream. This result is consistent with a positive effect for upstream majority party MPs, and a negative effect for strongholds upstream in column 1. It also suggests that majority parties favored connected supporters of river acts more if they had swung to the majority party following a competitive election.

## XI. Conclusion

This paper studies how the influence and party connections of interest groups affected the diffusion of river navigation acts across towns in England and Wales from 1690 to 1741. The results show that the economic and political characteristics of navigation supporters and opponents in neighboring areas had a large effect. For example, more towns with roads in upstream areas (generally supporters) increased the likelihood of a town's river bill succeeding in parliament and more towns with harbours downstream (generally opponents) reduced the likelihood of the bill succeeding. Such factors were as important as project feasibility, measured by elevation changes, in determining whether a town was blocked from getting an act.

Another important factor was the strength of majority party representation in neighboring political constituencies. Having more downstream connections to the majority party reduced the likelihood of a town's bill succeeding in parliament and it contributed to towns getting blocked

from navigation acts. The identity of the majority party was also relevant. Whig majorities increased the probability of river acts being adopted, but the reasons are not related to the Whigs being more favorable to the passage of bills in parliament.

The findings speak to the nature of institutions after the Glorious Revolution of 1689. First, it is worth pointing out that Britain's institutions after 1689 were more favorable to infrastructure investments than previously. Many projects were approved and implemented in the first half of the eighteenth century. The same is not true of the seventeenth century (Bogart 2011). However, the institutional environment was not favorable to rapid adoption of infrastructure or to adoption based on economic demands alone. Interest groups were powerful and could block projects which went against their interest. The Tory party, which controlled the House of Commons for several parliaments in the 1690s, 1700s, and 1710s, contributed to the blocking power or bias from interest group pressures. The Whigs appear to be more pro-development than the Tories but they too could succumb to interest group pressures. Thus the efficacy of British institutions in the early 1700s looks more mixed than some accounts would suggest (i.e. North and Weingast 1989, Acemoglu, Johnson, and Robinson 2005). A conjecture is that the greater political influence of groups outside the traditional elite led to an intensification of lobbying which had both pro-growth and anti-growth effects.

More generally the case of navigation improvements in Britain offers insights to the study of infrastructure, politics, and development. First, it focuses attention on the distributional effects of infrastructure, and how they influence efforts to block projects. Second, political connections clearly matter, and as this case shows, the distribution of connections can have important economic consequences. Finally, this paper provides a good example of how interest groups can block or delay technologies when political institutions are weak or in transition.

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Figure 1: Navigable Rivers and River Navigation Acts, 1690-1741

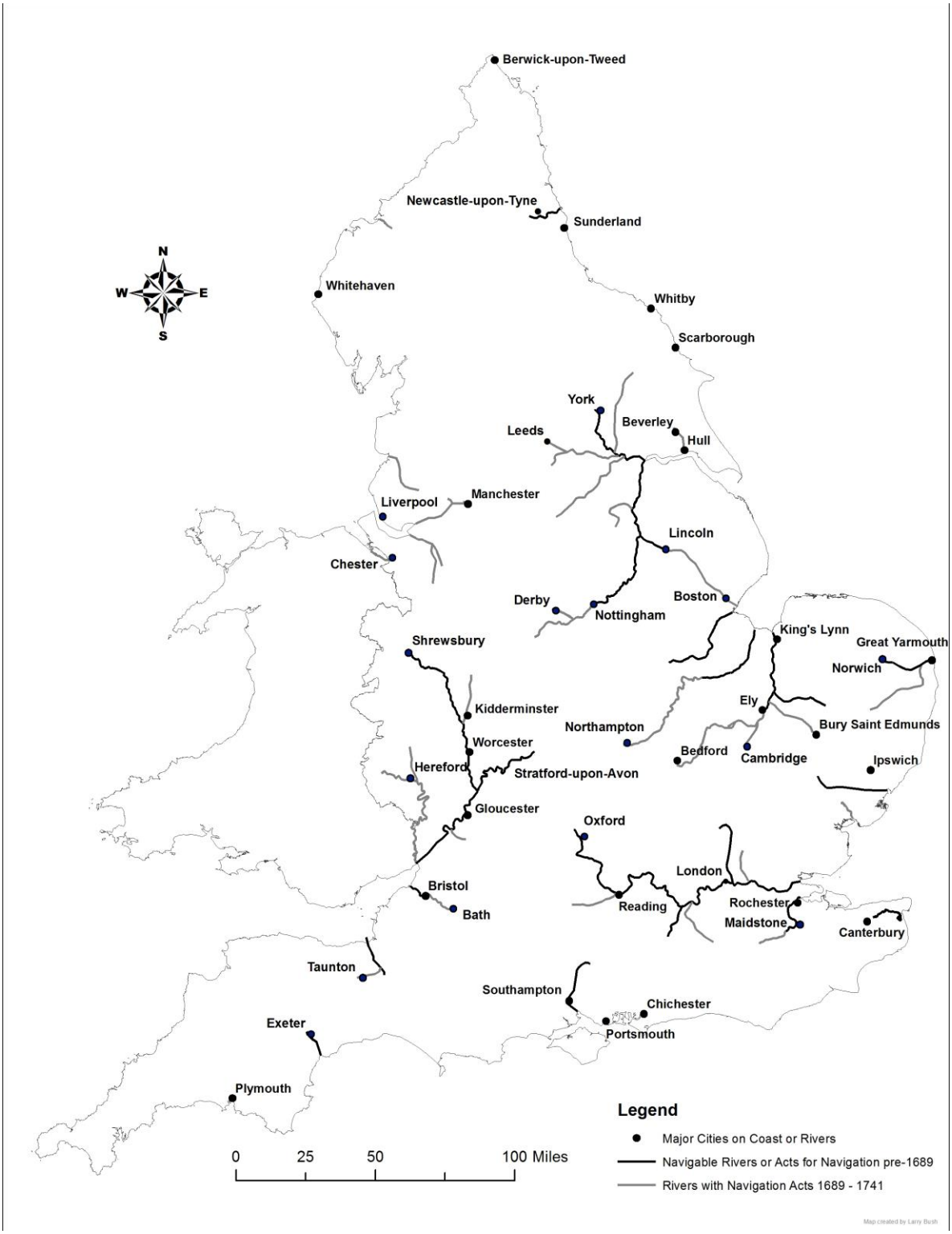


Table 1: Summary of river bills, acts, and petitions drawn from Journals of House of Commons

| | |
|---|---|
| **Panel A: Number of bills and acts** | |
| Number of River bills in all parliaments between 1690 and 1741 | 69 |
| Number of River acts in all parliaments between 1690 and 1741 | 32 |
| Percentage of river bills succeeding between 1690 and 1741 | 46.3 |
| Average Number of bills per parliament between 1690 and 1741 | 4.93 |
| Average Number of acts per parliament between 1690 and 1741 | 2.29 |
| **Panel B: Origins of bills** | |
| Number of river bills starting with petition from group outside Commons (%) | 56 (81.2) |
| If bill starts with petition, number where officials or inhabitants from a town are named in original petition (%) | 45 (80.3) |
| **Panel C: Supporting and opposing petitions for bills** | |
| Number of bills with at least one town supporting (%) | 57 (82.6) |
| If at least one town supports, average number of supporting towns per bill | 2.76 |
| Number of bills with at least one town opposing (%) | 26 (37.6) |
| If at least one town opposes, average number of opposing towns per bill | 3.38 |
| Number of bills where landowners adjacent to river opposed (%) | 22 (31.8) |
| Number of bills where county officials opposed (%) | 10 (14.9) |
| Number of bills where county officials supported (%) | 18 (26.1) |

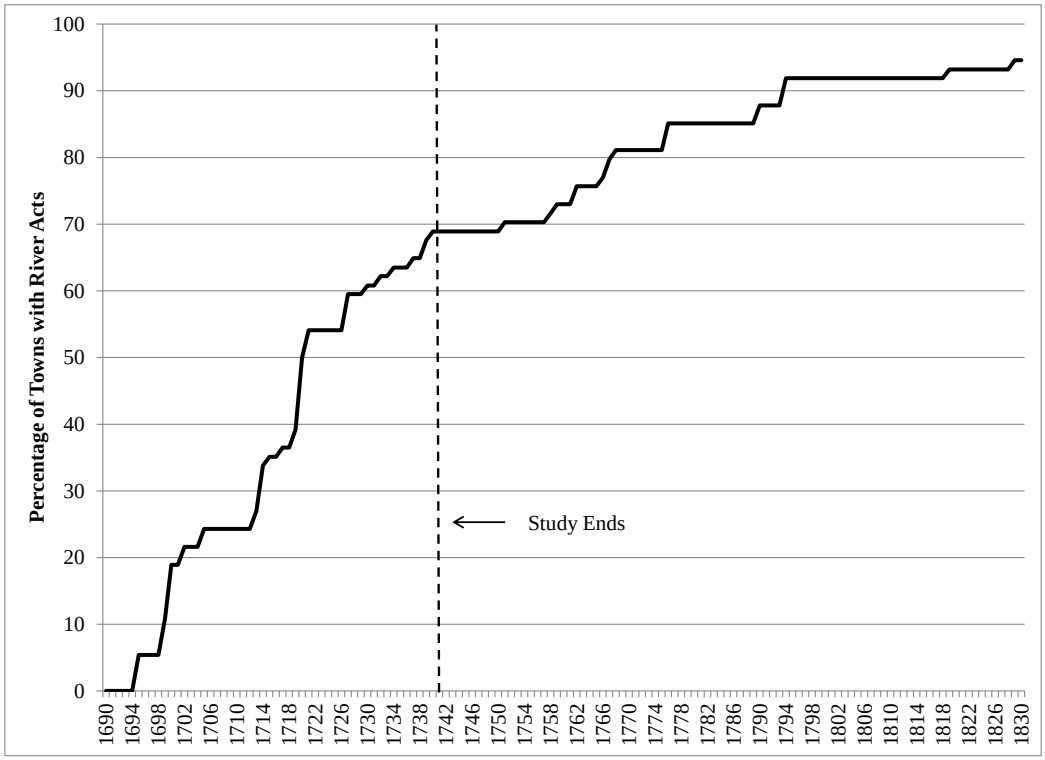
Sources: see text.

Table 2: Summary of towns and river acts and bills matched to towns

| | |
|---|---|
| **Panel A: Blome market towns** | |
| Number of towns in England and Wales c.1670 | 782 |
| Number of Towns on navigable rivers or coast c.1670 | 110 |
| Number of towns *not* on navigable rivers or coast c.1670 and *no* water | 237 |
| Number of towns *not* on navigable rivers or coast c.1670 but *have* water (candidate towns) | 435 |
| **Panel B: Candidate towns matched with river bills and acts** | |
| Number of candidate towns matched with river bill between 1690 and 1741 (%) | 74 (17.0) |
| Number of candidate towns matched with river act between 1690 and 1741 (%) | 51 (11.7) |
| Number of candidate town-parliament matches with river bill | 107 |
| **Panel C: Towns with delayed and failed river bills** | |
| Percentage of candidate towns with river bill that failed on first try | 63.5 |
| If first bill failed, percentage of candidate towns that got river act before 1741 | 52.1 |
| If first bill failed and got act by 1741, average years between first bill and act | 11.1 |
| If first bill failed, percentage of candidate towns that got river act before 1830 | 91.5 |
| If first bill failed and got act by 1830, average years between first bill and act | 30.6 |
| Average years between first bill and act (if act by 1830) | 18.77 |

Sources: see text.

Figure 2: Diffusion curve for towns with at least one river bill between 1690 and 1741




Sources: see text.

Table 3: Summary of towns opposing and supporting bills

Panel A: Petitioning towns location relative to bill's most downstream candidate town

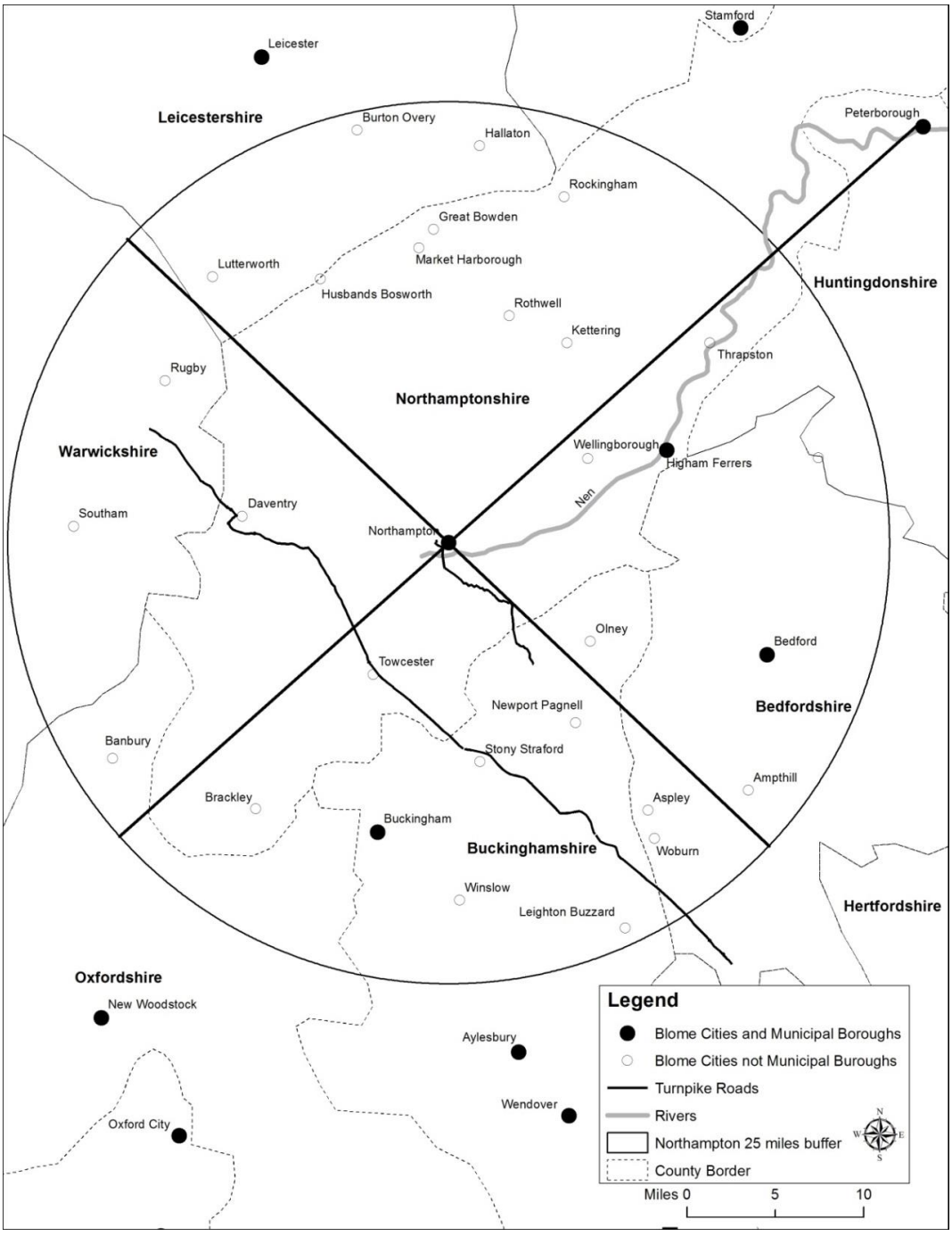
| | |
|---|---|
| Average distance to candidate town if supporting (Stand. Dev.) | 22.8 mi. (25.1) |
| Average distance to candidate town if opposing (Stand. Dev.) | 20.0 mi. (14.7) |

Panel B: Petitioning towns location relative to bill's candidate town

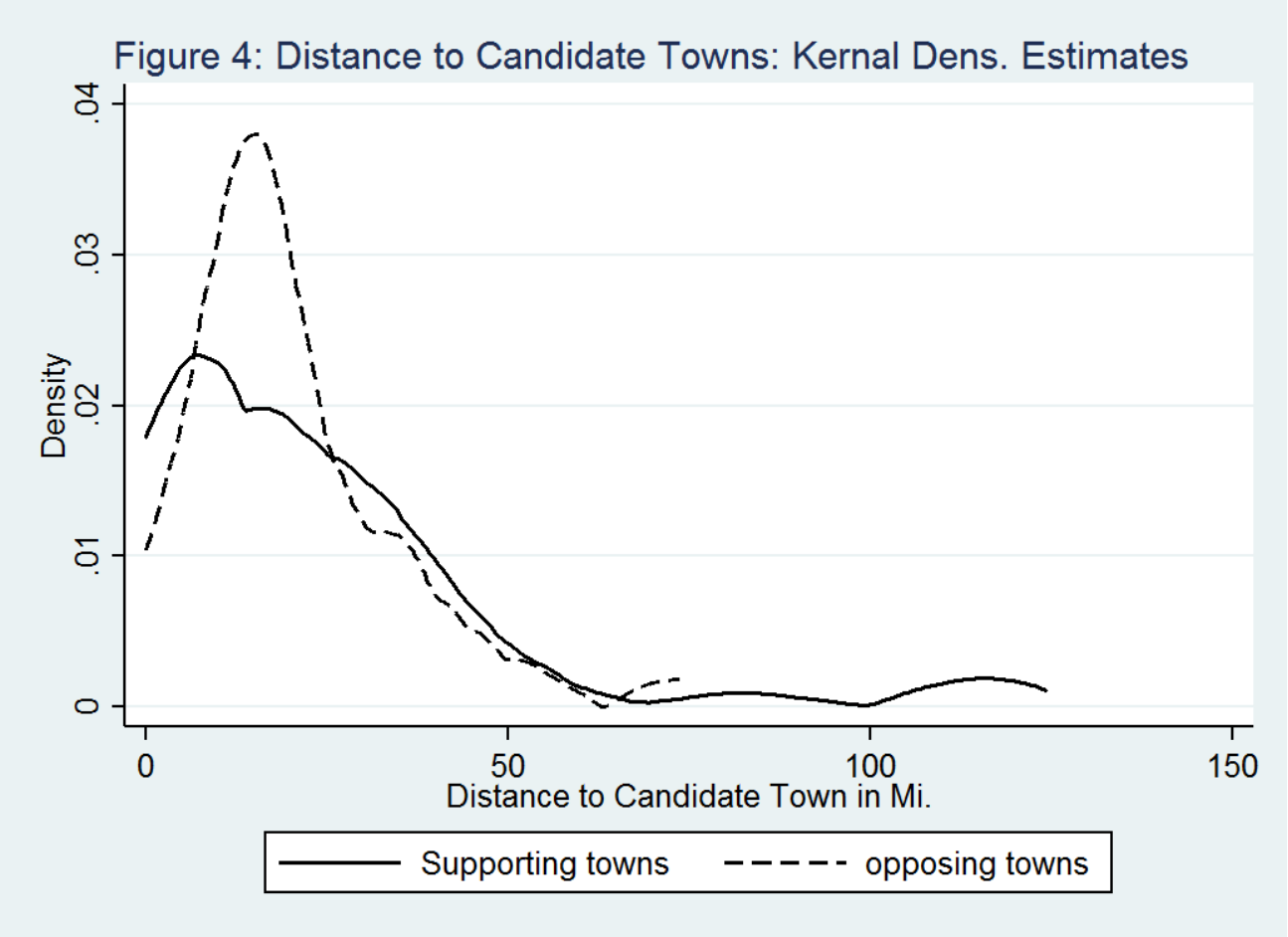
| | Candidate town upstream | | | Candidate town is dropped | | |
|---|---|---|---|---|---|---|
| | Petitioning town means if | | | Petitioning town means if | | |
| Variables | Supporting | Opposing | p-value | Supporting | Opposing | p-value |
| Indicator for Downstream from Candidate Town | 0.21 | 0.64 | 0.00 | 0.26 | 0.67 | 0.00 |
| N | 160 | 78 | | 126 | 75 | 201 |

Notes: P-value is for null hypothesis of equal means assuming equal variances. For sources see text.

Figure 3: Towns and features near the river Nene




Sources: see text.




Sources: see text.

Table 4: Characteristics for candidate towns with river acts and successful bills by 1741

| | All Candidate Towns | | | Candidate towns with river bill | | | Candidate towns who got act by 1741 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Candidate town means if | | | Candidate town means if | | | Candidate town means if | | |
| Variables | river act by 1741 | no river act by 1741 | p-value | river act by 1741 | no river act by 1741 | p-value | bill succeeds first try | Bill fail first try | p-value |
| Elevation Change to Nav. Head in 10 ft. | 5.97 | 16.14 | 0.00 | 5.97 | 8.74 | 0.08 | 5.91 | 6.05 | 0.91 |
| Distance to Nav. Head in 10 mi. | 2.73 | 3.25 | 0.14 | 2.74 | 2.71 | 0.95 | 2.81 | 2.66 | 0.80 |
| Local Market Potential (10,000s) | 2.31 | 1.64 | 0.00 | 2.31 | 2.37 | 0.91 | 2.47 | 2.14 | 0.41 |
| Has Municipal Govt. | 0.47 | 0.19 | 0.00 | 0.47 | 0.26 | 0.09 | 0.37 | 0.58 | 0.13 |
| Has Manufacturing | 0.37 | 0.2 | 0.01 | 0.37 | 0.30 | 0.57 | 0.30 | 0.46 | 0.24 |
| Has Mining | 0.04 | 0.04 | 0.92 | 0.04 | 0.00 | 0.34 | 0.04 | 0.04 | 0.93 |
| Has Harbour | 0.04 | 0.01 | 0.05 | 0.04 | 0.00 | 0.34 | 0.04 | 0.04 | 0.93 |
| On Main Road Network | 0.80 | 0.61 | 0.01 | 0.80 | 0.70 | 0.31 | 0.78 | 0.83 | 0.63 |
| Has a Free School | 0.12 | 0.08 | 0.3 | 0.12 | 0.05 | 0.32 | 0.19 | 0.04 | 0.12 |
| N | | | 435 | | | 74 | | | 51 |

Notes: P-value is for null hypothesis of equal means assuming equal variances. For sources see text.

Table 5: Preview of significant neighboring town and constituency characteristics

Panel A: Characteristics in neighboring towns and indicators for getting river acts

| | All Candidate Towns | | | Candidate towns with river bill | | |
|---|---|---|---|---|---|---|
| | Town means if | | | Town means if | | |
| Variables | river act by 1741 | no river act by 1741 | p-value | river act by 1741 | no river act by 1741 | p-value |
| Towns on road network upstream, 25 miles | 10.27 | 8.03 | 0.01 | 10.27 | 6.82 | 0.01 |
| Towns with Municipal Govt. downstream, 25 miles | 2.15 | 2.71 | 0.02 | 2.16 | 2.65 | 0.14 |
| Towns with harbours downstream, 25 miles | 0.33 | 0.61 | 0.05 | 0.33 | 0.91 | 0.00 |
| Towns with water navigation c.1670 downstream, 25 miles | 2.80 | 2.27 | 0.31 | 2.80 | 1.35 | 0.03 |
| Population of Navigation Head in 1000s | 1.95 | 2.11 | 0.68 | 1.95 | 4.26 | 0.00 |
| N | | | 435 | | | 74 |

Panel B: Turnpike acts, Whigs, downstream majority MPs, and indicators for river acts and bills by parliament

| | All candidate towns | | | Candidate towns with river bill | | |
|---|---|---|---|---|---|---|
| | Town means if | | | Town means if | | |
| Variables | river act in parl. | no river act in parl. | p-value | river act in parl. | no river act in parl. | p-value |
| Towns with turnpike acts, 25 mi. | 4.35 | 1.53 | 0.00 | 4.35 | 1.66 | 0.05 |
| Majority party MPs downstream, 25 miles | 2.66 | 3.86 | 0.01 | 2.66 | 3.73 | 0.01 |
| Parliaments With Whig majority | 0.8 | 0.56 | 0.00 | 0.80 | 0.66 | 0.10 |
| N | | | 5813 | | | 107 |

Notes and Sources: see text.

Table 6: Coefficient estimates: Baseline probit model for adoption of river acts in a town

| VARIABLES | Coeff. (std. err.) | VARIABLES | Coeff. (std. err.) |
|---|---|---|---|
| **Geographic Variables** | | | |
| Elevation Change to Nav. Head | -0.140*** | Distance to Nav. Head | 0.362*** |
| | (0.0216) | | (0.0748) |
| **Town Characteristics** | | | |
| Has harbor | 0.487 | Has Manufacturing | 0.382** |
| | (0.384) | | (0.183) |
| Has mining | 0.629 | On Main Road Network 17c. | -0.108 |
| | (0.439) | | (0.179) |
| Has free school | 0.0116 | Local Market Potential (10,000s) | 0.231*** |
| | (0.230) | | (0.0548) |
| Has Municipal Govt. | 0.492*** | | |
| | (0.161) | | |
| **Neighboring Town Characteristics** | | | |
| Towns w/ harbors up, 25 mi. | -0.00982 | Towns w/ mining up, 25 mi. | -0.309** |
| | (0.147) | | (0.128) |
| Towns w/ harbors down, 25 mi. | -0.163 | Towns w/ mining down, 25 mi. | 0.185* |
| | (0.112) | | (0.102) |
| Towns w/ manufact. up, 25 mi. | -0.0141 | Towns w/ water nav. 1670 up, 25 mi. | -0.167** |
| | (0.0358) | | (0.0708) |
| Towns w/ manufact. down, 25 mi. | 0.0861* | Towns w/ water nav. 1670 down, 25 mi. | 0.105* |
| | (0.0506) | | (0.0566) |
| Towns on road network up, 25 mi. | 0.0488* | Towns w/ free schools up, 25 mi. | 0.00104 |
| | (0.0255) | | (0.0753) |
| Towns on road network down, 25 mi. | -0.0454* | Towns w/ free schools down, 25 mi. | 0.0131 |
| | (0.0275) | | (0.0822) |
| Towns w/ munic. govt. up, 25 mi. | 0.0182 | Pop. of Navigation Head in 1000s | -0.0763** |
| | (0.0753) | | (0.0371) |
| Towns w/ munic. govt. down, 25 mi. | -0.162** | | |
| | (0.0763) | | |
| **Neighboring Political Constituencies** | | | |
| MPs up, 25 mi. | -0.0921** | Majority party MPs county | 0.259** |
| | (0.0379) | | (0.103) |
| MPs down, 25 mi. | 0.0759** | Majority party MPs closest constituency | -0.143 |
| | (0.0369) | | (0.0916) |
| Majority party MPs up, 25 mi. | 0.0738* | Constituencies w/ contests up, 25 mi. | 0.0764 |
| | (0.0425) | | (0.0644) |
| Majority party MPs down, 25 mi. | -0.177*** | Constituencies w/ contests down, 25 mi. | -0.0795 |
| | (0.0429) | | (0.0652) |

| | | | |
|---|---|---|---|
| Incumbent MPs up, 25 mi. | 0.0313 | Incumbent MPs down, 25 mi. | -0.0009 |
| | (0.0327) | | (0.0325) |
| Majority Party | | | |
| Whig majority indicator | 0.471*** | | |
| | (0.151) | | |
| Other Acts by start of current parliament | | | |
| Towns with turnpike acts, 25 mi. | 0.0311* | Towns with river acts, 25 mi. | -0.00699 |
| | (0.0187) | | (0.0478) |
| Region Indicators | | | |
| North | 16.21 | West Midlands | 63.08** |
| | (30.86) | | (26.58) |
| East Midlands | 43.85 | Southwest | 76.94** |
| | (26.76) | | (34.44) |
| Time and Region Trends | | | |
| Year | 0.0392** | Year x East Midlands | -0.0253 |
| | (0.0154) | | (0.0156) |
| Year x North | -0.00922 | Year x West Midlands | -0.0363** |
| | (0.0179) | | (0.0154) |
| Year x Southwest | -0.0446** | Constant | -70.43*** |
| | (0.0201) | | (26.54) |
| Observations | 5,393 | Pseudo R-square | 0.337 |

Notes: Robust standard errors are reported clustered on towns. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Adjusted predicted probability of river act for selected variables at representative low and high Values: Baseline probit model

| Variables | Variable Low Average Prob. | [95% Conf. Interval] | | Variable High Average Prob. | [95% Conf. Interval] | | % change Prob. Low to High |
|---|---|---|---|---|---|---|---|
| Elevation Change to Nav. Head | 0.0898 | [0.0481 | 0.1316] | 0.0001 | [0.000 | 0.0004] | -99.9 |
| Distance to Nav. Head | 0.0048 | [0.0031 | 0.0066] | 0.0481 | [0.0210 | 0.0752] | 902.1 |
| Town, Manufacturing | 0.0076 | [0.0051 | 0.0100] | 0.0157 | [0.0075 | 0.0238] | 106.6 |
| Town, Municipal Govt. | 0.0068 | [0.0042 | 0.0095] | 0.0174 | [0.0102 | 0.0246] | 155.9 |
| Local Market Potential | 0.0055 | [0.0033 | 0.0077] | 0.0130 | [0.0092 | 0.0167] | 136.4 |
| Pop. of Navigation Head in 1000s | 0.0134 | [0.0081 | 0.0186] | 0.0068 | [0.0037 | 0.0098] | -49.3 |
| Towns with Mining up, 25 mi. | 0.0129 | [0.0088 | 0.0169] | 0.0066 | [0.0036 | 0.0094] | -99.9 |
| Towns with water nav. up, 25 mi. | 0.0144 | [0.0082 | 0.0205] | 0.0058 | [0.0028 | 0.0087] | -59.7 |
| Towns Municipal Govt. down, 25 mi. | 0.0143 | [0.0075 | 0.0212] | 0.0052 | [0.0021 | 0.0083] | -63.6 |
| Towns with turnpike acts, 25 mi. | 0.0080 | [0.0056 | 0.0104] | 0.0116 | [0.0070 | 0.0161] | 45.0 |
| Whig majority indicator | 0.0048 | [0.0022 | 0.0075] | 0.0125 | [0.0088 | 0.0163] | 160.4 |
| Maj. party MPs county | 0.0066 | [0.0040 | 0.0093] | 0.0175 | [0.0089 | 0.0260] | 165.2 |
| Maj. party MPs down, 25 mi. | 0.0220 | [0.0119 | 0.0321] | 0.0026 | [0.0009 | 0.0044] | -88.2 |
| N | | | | | | | 5393 |

Notes: Average probability is the average predicted probability across all candidate towns when a variable is changed but all other variables are kept same. Low is one standard deviation below mean & high is one standard deviation above mean. All calculations are done using the Margins command in Stata.

Table 8: Coefficients for river bill success function: probit model

| VARIABLES | (1) Coeff. (std. err.) | (2) Coeff. (std. err.) |
|---|---|---|
| MPs up, 25 mi. | -0.128* | -0.0358 |
| | (0.0715) | (0.124) |
| MPs down, 25 mi. | 0.121 | 0.161 |
| | (0.0832) | (0.175) |
| Majority party MPs county | 0.387* | 1.075*** |
| | (0.203) | (0.401) |
| Majority party MPs closest constituency | 0.0298 | -0.450 |
| | (0.184) | (0.347) |
| Majority party MPs up, 25 mi. | 0.0650 | 0.0837 |
| | (0.110) | (0.162) |
| Majority party MPs down, 25 mi. | -0.439*** | -1.032*** |
| | (0.114) | (0.281) |
| Constituencies w/ contests up, 25 mi. | 0.148 | -0.193 |
| | (0.136) | (0.203) |
| Constituencies w/ contests down, 25 mi. | 0.0502 | 0.141 |
| | (0.156) | (0.227) |
| Incumbent MPs up, 25 mi. | 0.119 | 0.254* |
| | (0.0841) | (0.131) |
| Incumbent MPs down, 25 mi. | 0.0897 | 0.152 |
| | (0.0937) | (0.165) |
| Whig majority indicator | 0.550* | 0.941 |
| | (0.324) | (0.682) |
| Elevation Change to Nav. Head | | -0.186** |
| | | (0.0792) |
| Distance to Nav. Head | | 0.811*** |
| | | (0.235) |
| Local Market Potential (10,000s) | | 0.510** |
| | | (0.213) |
| Pop. of Navigation Head in 1000s | | -0.157* |
| | | (0.0875) |
| Towns w/ harbors up, 25 mi. | | 2.249*** |
| | | (0.612) |
| Towns w/ harbors down, 25 mi. | | -1.121*** |
| | | (0.343) |
| Towns w/ mining up, 25 mi. | | -0.293 |
| | | (0.387) |
| Towns w/ mining down, 25 mi. | | 0.500* |
| | | (0.300) |
| Towns w/ manufact. up, 25 mi. | | 0.139 |
| | | (0.165) |
| Towns w/ manufact. down, 25 mi. | | 0.330* |
| | | (0.170) |
| Towns w/ water nav. 1670 up, 25 mi. | | -0.654*** |
| | | (0.251) |

| | | |
|---|---|---|
| Towns w/ water nav. 1670 down, 25 mi. | | 0.575*** |
| | | (0.182) |
| Towns on road network up, 25 mi. | | 0.227** |
| | | (0.111) |
| Towns on road network down, 25 mi. | | 0.238* |
| | | (0.123) |
| Towns w/ free schools up, 25 mi. | | 0.542* |
| | | (0.318) |
| Towns w/ free schools down, 25 mi. | | -0.164 |
| | | (0.287) |
| Towns w/ munic. govt. up, 25 mi. | | 0.325 |
| | | (0.236) |
| Towns w/ munic. govt. down, 25 mi. | | -0.527 |
| | | (0.397) |
| Towns with turnpike acts, 25 mi. | | -0.180** |
| | | (0.0880) |
| Year | | 0.0891*** |
| | | (0.0236) |
| Constant | -0.542 | -160.1*** |
| | (0.462) | (41.81) |
| Pseudo R-square | 0.197 | 0.575 |
| Observations | 107 | 107 |

Notes: Robust standard errors are reported. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Adjusted predicted probability of successful river bill for selected variables at representative low and high values

| | Variable Low | | | Variable High | | | % change Prob. |
|---|---|---|---|---|---|---|---|
| Variables | Average Prob. | [95% Conf. Interval] | | Average Prob. | [95% Conf. Interval] | | Low to High |
| Elevation Change to Nav. Head | 0.6265 | [0.5235 | 0.7295] | 0.3306 | [0.2306 | 0.4305] | -47.2 |
| Distance to Nav. Head | 0.3003 | [0.2292 | 0.3714] | 0.7054 | [0.6089 | 0.8018] | 134.9 |
| Local Market Potential | 0.3594 | [0.2715 | 0.4473] | 0.6097 | [0.4951 | 0.7244] | 69.6 |
| Towns with water nav. up, within 25 mi. | 0.5462 | [0.4824 | 0.6100] | 0.3339 | [0.2511 | 0.4168] | -38.9 |
| Towns with water nav. down, within 25 mi. | 0.3046 | [0.2150 | 0.3942] | 0.6838 | [0.5837 | 0.7838] | 124.5 |
| Towns with harbours up, within 25 mi. | 0.4185 | [0.3612 | 0.4758] | 0.7190 | [0.6452 | 0.7928] | 71.8 |
| Towns with harbours down, within 25 mi. | 0.5687 | [0.4970 | 0.6405] | 0.3489 | [0.2864 | 0.4113] | -38.6 |
| Towns on road network up, 25 mi. | 0.3396 | [0.2411 | 0.4382] | 0.6707 | [0.5131 | 0.8282] | 97.5 |
| Maj. party MPs county | 0.3801 | [0.2924 | 0.4237] | 0.6666 | [0.5436 | 0.7896] | 75.4 |
| Maj. party MPs down, within 25 mi. | 0.7826 | [0.6991 | 0.8663] | 0.2084 | [0.1538 | 0.2630] | -73.4 |
| Year Parliament ended | 0.2832 | [0.2059 | 0.3604] | 0.6152 | [0.5425 | 0.6879] | 117.2 |
| N | | | | | | | 107 |

Notes: Average probability is the average predicted probability across all candidate towns that had river bills when a variable is changed but all other variables are kept same. Low is one standard deviation below mean & high is one standard deviation above mean. A low 'year parliament ended' is 1695 and a high year is 1722. All calculations are done using the Margins command in Stata.

Table 10: Adjusted predicted probability of successful river bill for selected variables at representative values for blocked towns and towns with successful bills

| | Variable equal to mean for blocked town | | | Variable equal to mean for towns with successful bills | | | % change Prob. |
|---|---|---|---|---|---|---|---|
| Variables | Average Prob. | [95% Conf. Interval] | | Average Prob. | [95% Conf. Interval] | | Low to High |
| Elevation Change to Nav. Head | 0.1518 | [0.0666 | 0.2370] | 0.2093 | [0.1223 | 0.2962] | 37.9 |
| Distance to Nav. Head | 0.2651 | [0.1608 | 0.3693] | 0.2679 | [0.1628 | 0.3731] | 1.1 |
| Local Market Potential | 0.4895 | [0.4298 | 0.5492] | 0.4851 | [0.4262 | 0.5439] | -1.0 |
| Towns with water access up, within 25 mi. | 0.1035 | [0.0406 | 0.1664] | 0.1757 | [0.1063 | 0.2451] | 69.8 |
| Towns with water access down, within 25 mi. | 0.1674 | [0.0832 | 0.2515] | 0.2917 | [0.1787 | 0.4047] | 74.3 |
| Towns with harbours up, within 25 mi. | 0.2069 | [0.1162 | 0.2976] | 0.2319 | [0.1396 | 0.3243] | 12.1 |
| Towns with harbours down, within 25 mi. | 0.1428 | [0.0762 | 0.2094] | 0.2270 | [0.1421 | 0.3118] | 58.9 |
| Towns on road network up, 25 mi. | 0.1729 | [0.0791 | 0.2667] | 0.3013 | [0.1292 | 0.4743] | 74.3 |
| Maj. party MPs county | 0.2394 | [0.1405 | 0.3383] | 0.2226 | [0.1289 | 0.3162] | -7.0 |
| Maj. party MPs down, within 25 mi. | 0.1717 | [0.0973 | 0.2462] | 0.2122 | [0.1275 | 0.2968] | 23.6 |
| N | | | | | | | 23 |

Notes: Calculations are the same as table 9 except the first set of columns uses the average values from 1690 to 1741 for towns with river bills but no act by 1741. The second set of columns uses the average values for towns with river bills and acts by 1741.

Table 11: Estimates for bill success: baseline probit and bivariate probit with selection effects

| VARIABLES | (1) Baseline Probit Coeff. (std. err.) | (2) Bivariate Probit with selection Coeff. (std. err.) |
|---|---|---|
| MPs up, 25 mi. | -0.0358 | -0.0808 |
| | (0.124) | (0.121) |
| MPs down, 25 mi. | 0.161 | 0.0852 |
| | (0.175) | (0.207) |
| Majority party MPs county | 1.075*** | 0.685 |
| | (0.401) | (0.524) |
| Majority party MPs closest constituency | -0.450 | -0.0135 |
| | (0.347) | (0.486) |
| Majority party MPs up, 25 mi. | 0.0837 | 0.0181 |
| | (0.162) | (0.177) |
| Majority party MPs down, 25 mi. | -1.032*** | -0.752** |
| | (0.281) | (0.381) |
| Constituencies w/ contests up, 25 mi. | -0.193 | -0.134 |
| | (0.203) | (0.245) |
| Constituencies w/ contests down, 25 mi. | 0.141 | 0.00360 |
| | (0.227) | (0.236) |
| Incumbent MPs up, 25 mi. | 0.254* | 0.295** |
| | (0.131) | (0.126) |
| Incumbent MPs down, 25 mi. | 0.152 | 0.0212 |
| | (0.165) | (0.118) |
| Whig majority indicator | 0.941 | 0.304 |
| | (0.682) | (0.743) |
| Elevation Change to Nav. Head | -0.186** | -0.111 |
| | (0.0792) | (0.162) |
| Distance to Nav. Head | 0.811*** | 0.575 |
| | (0.235) | (0.563) |
| Local Market Potential (10,000s) | 0.510** | 0.200 |
| | (0.213) | (0.586) |
| Pop. of Navigation Head in 1000s | -0.157* | -0.132 |
| | (0.0875) | (0.0975) |
| Towns w/ harbors up, 25 mi. | 2.249*** | 1.812*** |
| | (0.612) | (0.541) |
| Towns w/ harbors down, 25 mi. | -1.121*** | -1.136*** |
| | (0.343) | (0.271) |
| Towns w/ mining up, 25 mi. | -0.293 | -0.0647 |
| | (0.387) | (0.225) |
| Towns w/ mining down, 25 mi. | 0.500* | 0.272 |
| | (0.300) | (0.430) |
| Towns w/ manufact. up, 25 mi. | 0.139 | 0.206 |
| | (0.165) | (0.129) |

| | | |
|---|---|---|
| Towns w/ manufact. down, 25 mi. | 0.330* | 0.126 |
| | (0.170) | (0.257) |
| Towns w/ water nav. 1670 up, 25 mi. | -0.654*** | -0.654*** |
| | (0.251) | (0.245) |
| Towns w/ water nav. 1670 down, 25 mi. | 0.575*** | 0.351 |
| | (0.182) | (0.289) |
| Towns on road network up, 25 mi. | 0.227** | 0.176 |
| | (0.111) | (0.138) |
| Towns on road network down, 25 mi. | 0.238* | 0.176 |
| | (0.123) | (0.134) |
| Towns w/ free schools up, 25 mi. | 0.542* | |
| | (0.318) | |
| Towns w/ free schools down, 25 mi. | -0.164 | |
| | (0.287) | |
| Towns w/ munic. govt. up, 25 mi. | 0.325 | 0.223 |
| | (0.236) | (0.170) |
| Towns w/ munic. govt. down, 25 mi. | -0.527 | -0.0244 |
| | (0.397) | (0.458) |
| Towns with turnpike acts, 25 mi. | -0.180** | |
| | (0.0880) | |
| Year | 0.0891*** | 0.0944** |
| | (0.0236) | (0.0392) |
| $\rho$ | | -0.238 |
| | | (2.282) |
| Observations | 107 | 107 |

Notes: Robust standard errors are reported clustered on towns. *** p<0.01, ** p<0.05, * p<0.1.

Table 12: Fixed effects models for adoption of river acts

Panel A: Predicted probability of river act for selected variables at representative low and high values

| | Variable Low | | | Variable High | | | % change Prob. |
|---|---|---|---|---|---|---|---|
| Variables | Average Prob. | [95% Conf. | Interval] | Average Prob. | [95% Conf. | Interval] | Low to High |
| Panel A.1: Sample includes all Candidate Towns | | | | | | | |
| Average Probability of Town getting act in a parliament given no prior act = 0.009 | | | | | | | |
| Maj. Party MP County | 0.0044 | [0.0008 | 0.0081] | 0.0147 | [0.0095 | 0.0198] | 234.1 |
| Maj. party MPs down, within 25 mi. | 0.0140 | [0.0099 | 0.0181] | 0.0035 | [-0.0006 | 0.0076] | -75.0 |
| N | | | | | | | 5813 |
| Panel A.2: Sample includes only Candidate Towns that ever had a river bill | | | | | | | |
| Average Probability of Town getting act in a parliament given no prior act = 0.067 | | | | | | | |
| Maj. Party MP County | 0.0503 | [0.0319 | 0.0687] | 0.0823 | [0.0658 | 0.0988] | 63.6 |
| Maj. party MPs down, within 25 mi. | 0.0973 | [0.0718 | 0.1228] | 0.0371 | [0.0116 | 0.0625] | -61.9 |
| N | | | | | | | 759 |

Panel B: Sample includes only Candidate Towns that ever had a river act

| | Coefficients Conditional fixed Effects Logit | | | |
|---|---|---|---|---|
| | Coefficient | (Std. Err.) | | |
| Maj. Party MP County | 0.446 | (0.429) | | |
| Maj. party MPs down, within 25 mi. | -0.428 | (0.218)** | N | 437 |

Notes: For panel A the average probability is the average predicted probability across all candidate towns when variable is changed but all other variables are kept same. Low is one standard deviation below mean & high is one standard deviation above mean. For panel B: *** p<0.01, ** p<0.05, * p<0.

Table 13: The effects of incumbent majority party MPs: probit and FE logit models

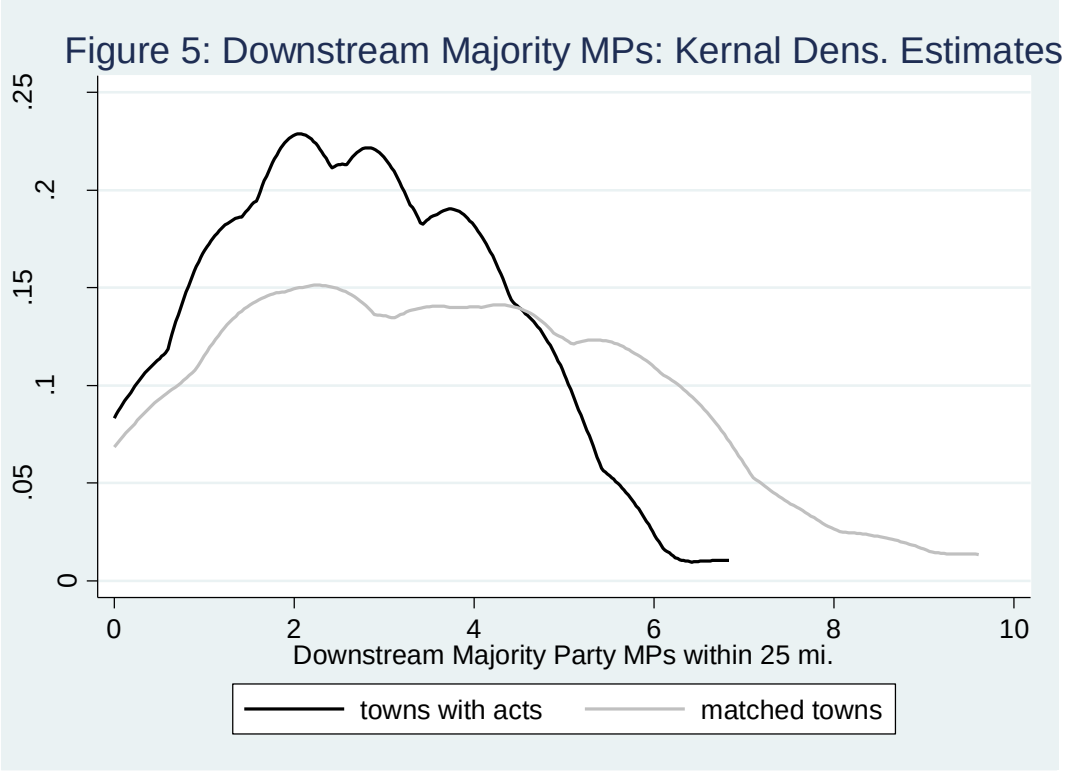
| VARIABLES | (1) Probit Coeff. (std. err.) | (2) Probit Coeff. (std. err.) | (3) FE Logit Coeff. (std. err.) | (4) Probit Coeff. (std. err.) |
|---|---|---|---|---|
| Majority Party MPs County, Incumbents | 0.114 | 0.126 | -0.452 | 0.169 |
| | (0.093) | (0.109) | (0.315) | (0.112) |
| Majority Party MPs Closest Cons., Incumbents | 0.0452 | -0.042 | -0.087 | -0.0833 |
| | (0.098) | (0.101) | (0.341) | (0.106) |
| Majority Party MPs Upstream, Incumbents | -0.044 | 0.013 | -0.236 | 0.00740 |
| | (0.033) | (0.056) | (0.177) | (0.0614) |
| Majority Party MPs Downstream, Incumbents | -0.086** | -0.161*** | -0.351* | -0.163** |
| | (0.039) | (0.061) | (0.200) | (0.0676) |
| Majority Party MPs County, Newly Elected | | | | 0.370** |
| | | | | (0.145) |
| Majority Party MPs Closest Cons., Newly Elected | | | | -0.187 |
| | | | | (0.127) |
| Majority Party MPs Upstream, Newly Elected | | | | 0.145** |
| | | | | (0.0691) |
| Majority Party MPs Downstream, Newly Elected | | | | -0.205*** |
| | | | | (0.0754) |
| Town Fixed effects? | No | No | Yes | No |
| Time Trend? | Yes | Yes | No | Yes |
| Control for MPs Up, Down, 25 mi. | Yes | Yes | No | Yes |
| Control for Incumbents, Contests Up, Down, 25 mi. | No | Yes | Yes | Yes |
| Other control variables? | No | Yes | No | Yes |
| Pseudo R-square | 0.02 | 0.31 | | 0.37 |
| Observations | 4,988 | 4,988 | 380 | 4,988 |

Notes: Robust standard errors clustering on towns reported for columns 1, 2, and 4. *** p<0.01, ** p<0.05, * p<0.1

Table 14: Differences in political constituency variables for towns with river acts and their matched towns

| | Matched to 1 town in parl. | | | Matched to 2 towns in parl. | | |
|---|---|---|---|---|---|---|
| | town means if | | | town means if | | |
| Variables | river act in parl. | no river act in parl. | p-value | river act in parl. | no river act in parl. | p-value |
| Majority party MPs upstream, within 25 miles | 4.16 | 4.12 | 0.95 | 4.16 | 4.22 | 0.92 |
| Majority party MPs downstream, within 25 miles | 2.66 | 3.65 | 0.01 | 2.66 | 3.49 | 0.02 |
| Average "Distance" between towns with acts and matched towns | | | 14.58 | | | 16.47 |
| N, towns with acts | | | 51 | | | 51 |
| N, matched towns | | | 51 | | | 100 |
| N, total | | | 102 | | | 151 |

Notes: The matches were based on the nearest neighbor matching algorithm. The distance refers the distance in observable town and neighbor characteristics along with regional indicators.



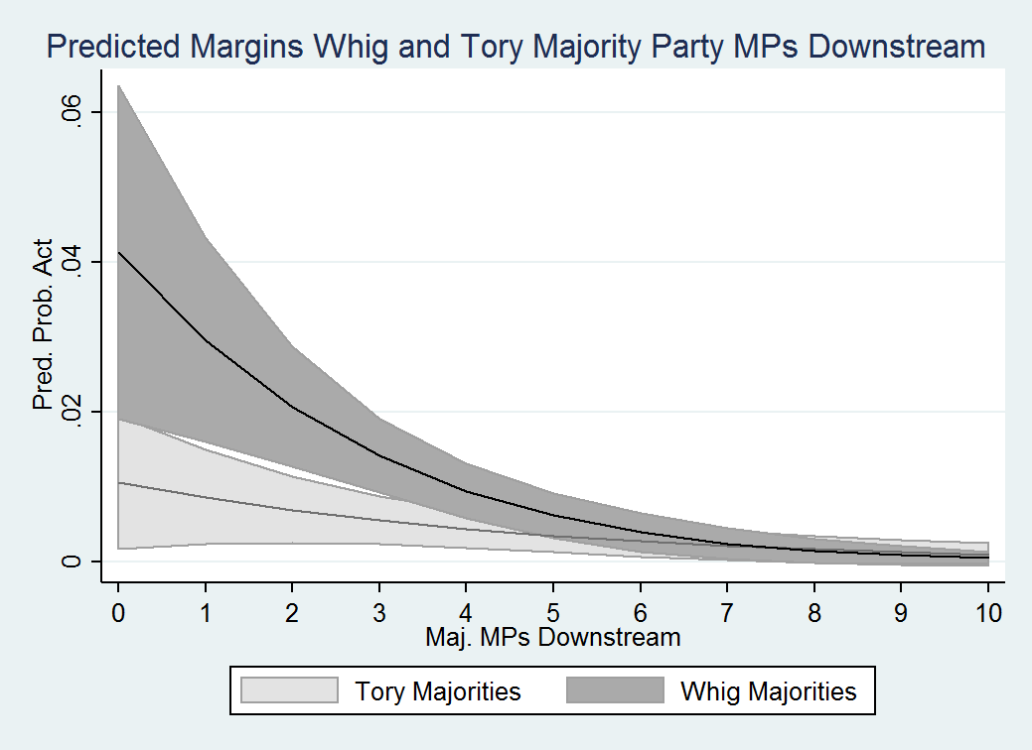

Sources: see text.

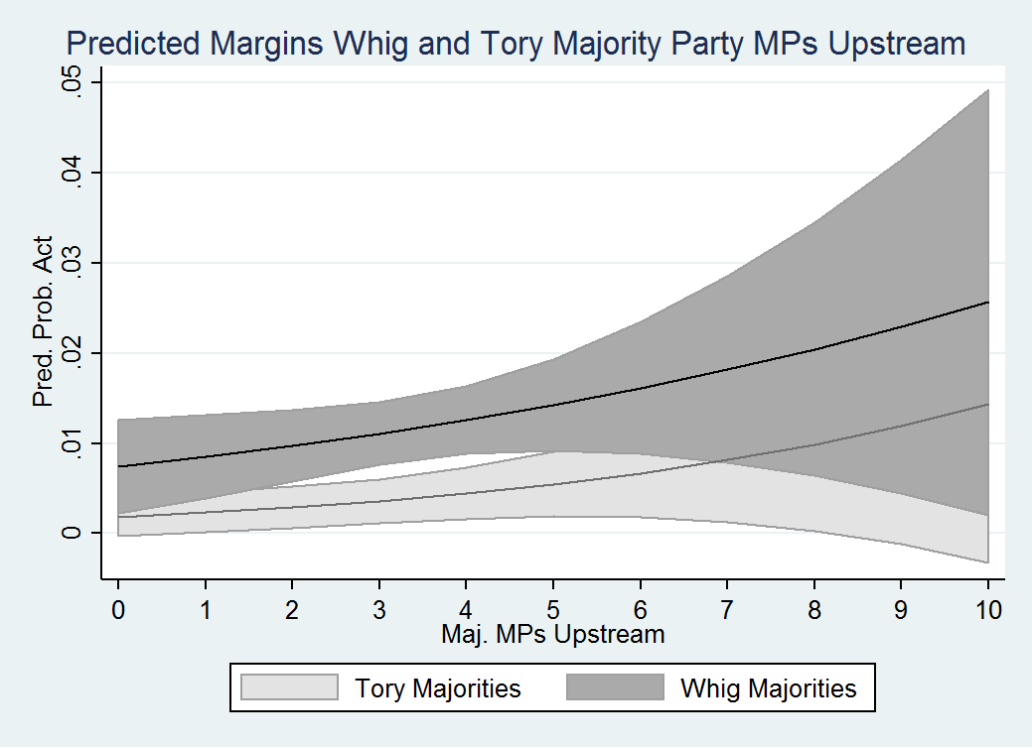
Table 15: Left/Right placebo test: Probit coefficients for river bill success and acts

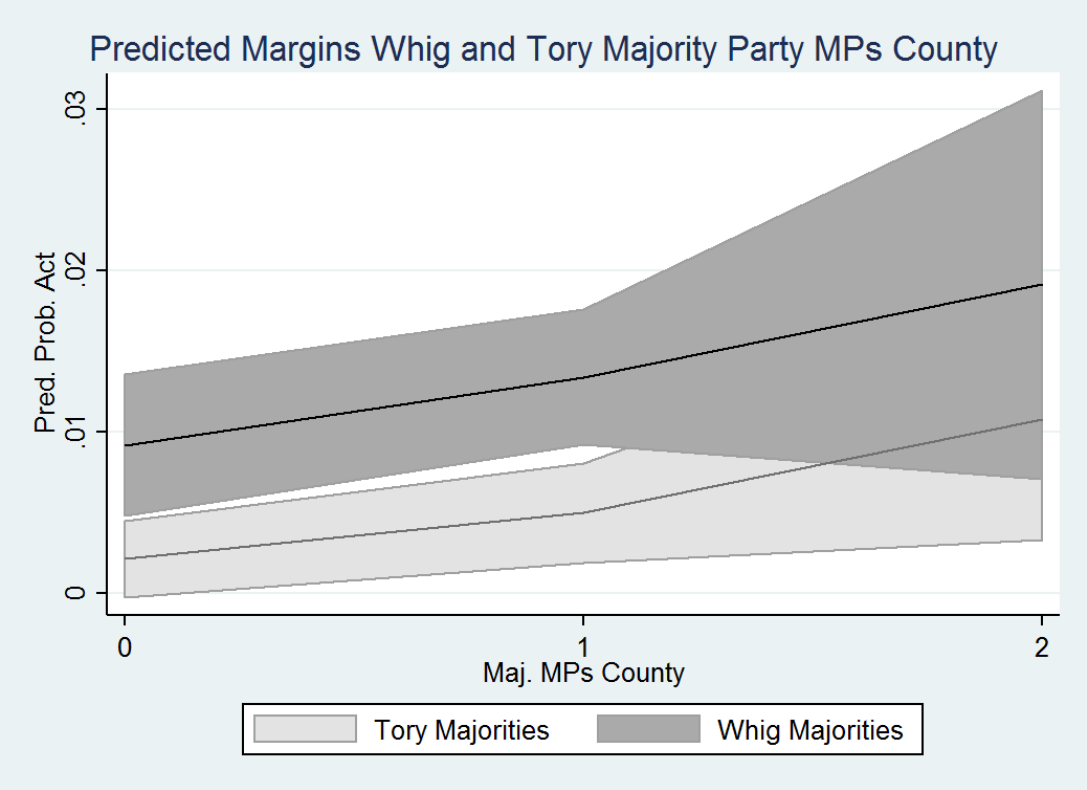
| VARIABLES | (1) Bill Success Coeff. (std. err.) | (2) River Act Coeff. (std. err.) |
|---|---|---|
| Majority party MPs left, 25 mi. | -0.0995 | 0.00679 |
| | (0.149) | (0.0296) |
| Majority party MPs right, 25 mi. | -0.147 | -0.0784* |
| | (0.120) | (0.0416) |
| Constituencies w/ contests left, 25 mi. | 0.198 | -0.0241 |
| | (0.154) | (0.0673) |
| Constituencies w/ contests right, 25 mi. | 0.278 | 0.0471 |
| | (0.172) | (0.0595) |
| Incumbent MPs left, 25 mi. | 0.238** | 0.0541 |
| | (0.111) | (0.0337) |
| Incumbent MPs right, 25 mi. | 0.0599 | -0.0309 |
| | (0.115) | (0.0331) |
| Towns w/ harbors left, 25 mi. | -0.186 | 0.0474 |
| | (0.273) | (0.110) |
| Towns w/ harbors right, 25 mi. | 0.433 | -0.0990 |
| | (0.422) | (0.140) |
| Towns w/ mining left, 25 mi. | 0.118 | -0.153 |
| | (0.322) | (0.101) |
| Towns w/ mining right, 25 mi. | 0.148 | 0.00366 |
| | (0.331) | (0.105) |
| Towns w/ manufact. left, 25 mi. | -0.113 | 0.0483 |
| | (0.0974) | (0.0440) |
| Towns w/ manufact. right, 25 mi. | 0.124 | 0.00440 |
| | (0.106) | (0.0436) |
| Towns w/ water nav. 1670 left, 25 mi. | 0.116 | -0.102* |
| | (0.135) | (0.0550) |
| Towns w/ water nav. 1670 right, 25 mi. | 0.0654 | 0.0894 |
| | (0.129) | (0.0563) |
| Towns on road network left, 25 mi. | 0.162** | 0.0406 |
| | (0.0662) | (0.0279) |
| Towns on road network right, 25 mi. | 0.0446 | -0.0510** |
| | (0.0981) | (0.0249) |
| Towns w/ free schools left, 25 mi. | -0.236 | -0.0754 |
| | (0.176) | (0.0741) |
| Towns w/ free schools right, 25 mi. | -0.180 | 0.0857 |
| | (0.238) | (0.0605) |
| Towns w/ munic. govt. left, 25 mi. | 0.106 | -0.0843 |
| | (0.159) | (0.0659) |
| Towns w/ munic. govt. right, 25 mi. | -0.0474 | 0.0326 |
| | (0.199) | (0.0761) |
| Town and Region variables included? | No | Yes |
| Whig, Year, Majority party county and closest constituency included? | Yes | Yes |
| Observations | 107 | 5,393 |

Notes: Robust standard errors are reported in column 1. Robust standard errors clustered on towns are reported in 2. *** p<0.01, ** p<0.05, * p<0.1.

Figure 6: Heterogeneous effects depending on whether Whigs or Tories are in majority




Predicted Margins Whig and Tory Majority Party MPs County
Pred. Prob. Act
0
.01
.02
.03
0
1
2
Maj. MPs County
Tory Majorities
Whig Majorities

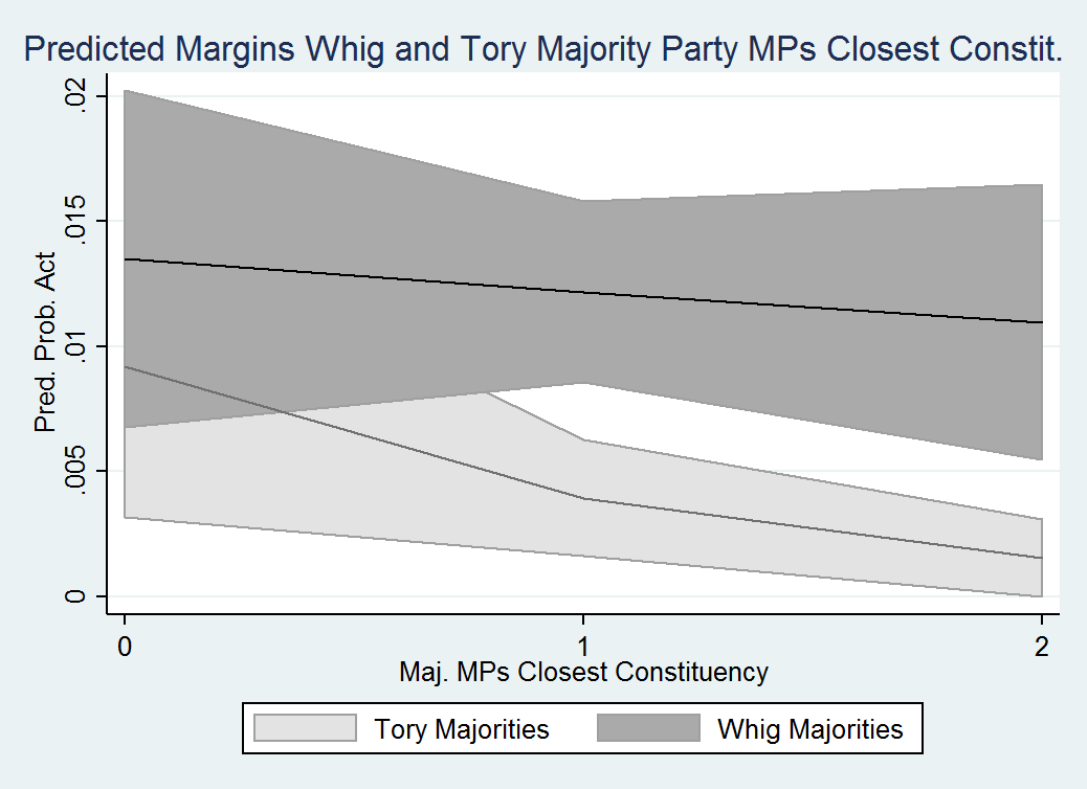

Predicted Margins Whig and Tory Majority Party MPs Closest Constit.
Pred. Prob. Act
0
.005
.01
.015
.02
0
1
2
Maj. MPs Closest Constituency
Tory Majorities
Whig Majorities

Table 16: Probit Estimates in specifications including party strongholds and interactions with contests

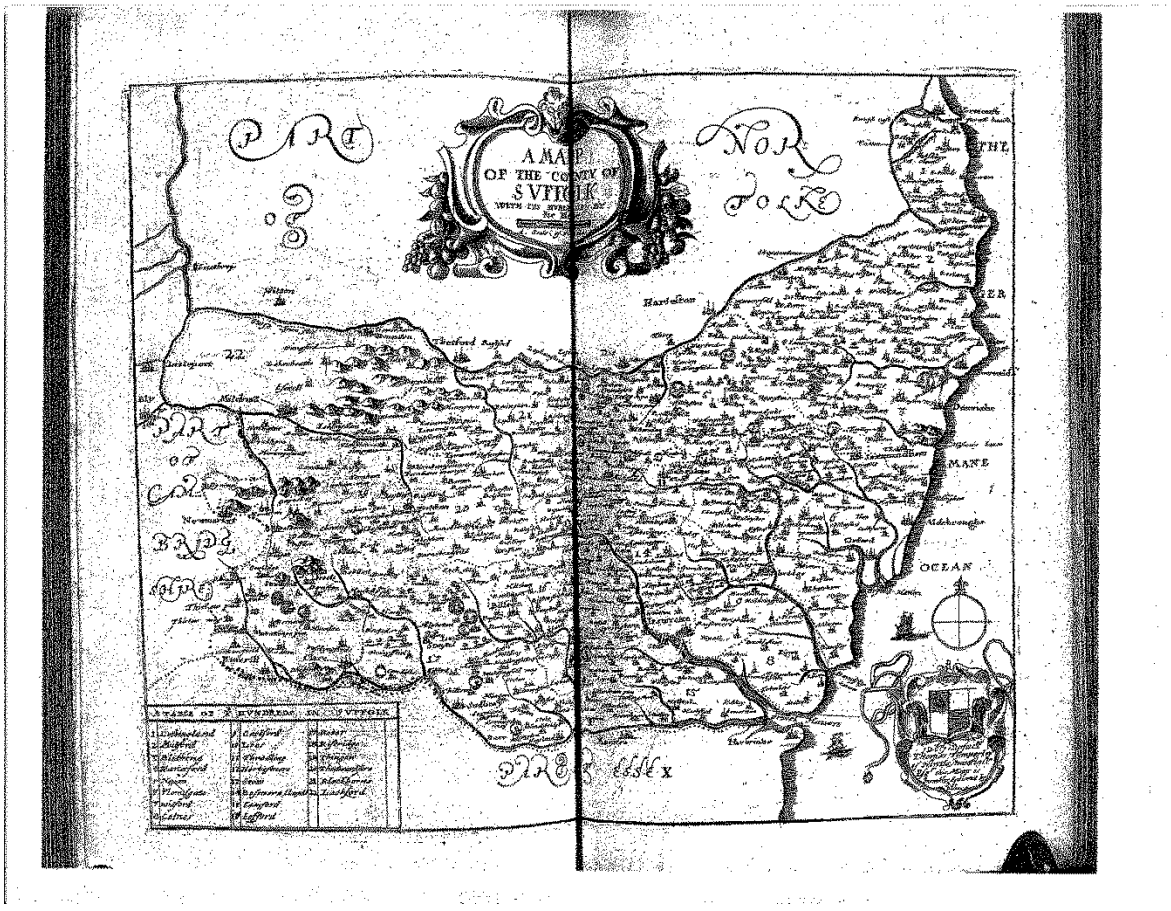
| VARIABLES | (1) Coeff. (std. err.) | (2) Coeff. (std. err.) |
|---|---|---|
| Majority party MPs county | 0.187* | 0.3337** |
| | (0.104) | (0.1164) |
| Majority party MPs closest constituency | -0.157* | -0.1967* |
| | (0.0950) | (0.1014) |
| Majority party MPs up, 25 mi. | 0.0980** | -0.0226 |
| | (0.047) | (0.0547) |
| Majority party MPs down, 25 mi. | -0.1882*** | -0.1296** |
| | (0.0482) | (0.0543) |
| Party strongholds up, 25 mi. | -0.197* | |
| | (0.111) | |
| Party strongholds down, 25 mi. | 0.0442 | |
| | (0.1091) | |
| Party strongholds county | 0.4060* | |
| | (0.2133) | |
| Whig majority indicator | 0.4665*** | 0.5059*** |
| | (0.1487) | (0.1532) |
| Majority party MPs county * indicator if county had contest | | -0.0325 |
| | | (0.2377) |
| Majority party MPs in constituencies with contests, up 25 mi. | | 0.1748* |
| | | (0.0904) |
| Majority party MPs in constituencies with contests, down 25 mi. | | -0.0028 |
| | | (0.1028) |
| Other Political Constituency characteristics | Yes | Yes |
| Town Characteristics | Yes | Yes |
| Neighboring Town Characteristics | Yes | Yes |
| Acts in Previous Parliament | Yes | Yes |
| Time and Region specific Trends | Yes | Yes |
| Geography variables | Yes | Yes |
| Observations | 5,393 | 5,393 |

Notes: Robust standard errors are reported clustered on towns. *** p<0.01, ** p<0.05, * p<0.1.

*Online Appendix I: Data and Sources*

To my knowledge, Richard Blome's *Britannia* provides the most comprehensive information on towns during the late seventeenth century. Blome also provides a map of each county that includes cities, waterways, and coastal features. An example of Blome's map for Suffolk County is provided in appendix Figure 1. Notice that the coastline as well as main rivers and streams are easily identified. Town names can be identified by a zoom on the map.

Appendix Figure 1: Richard Blome's Map of Suffok, 1673

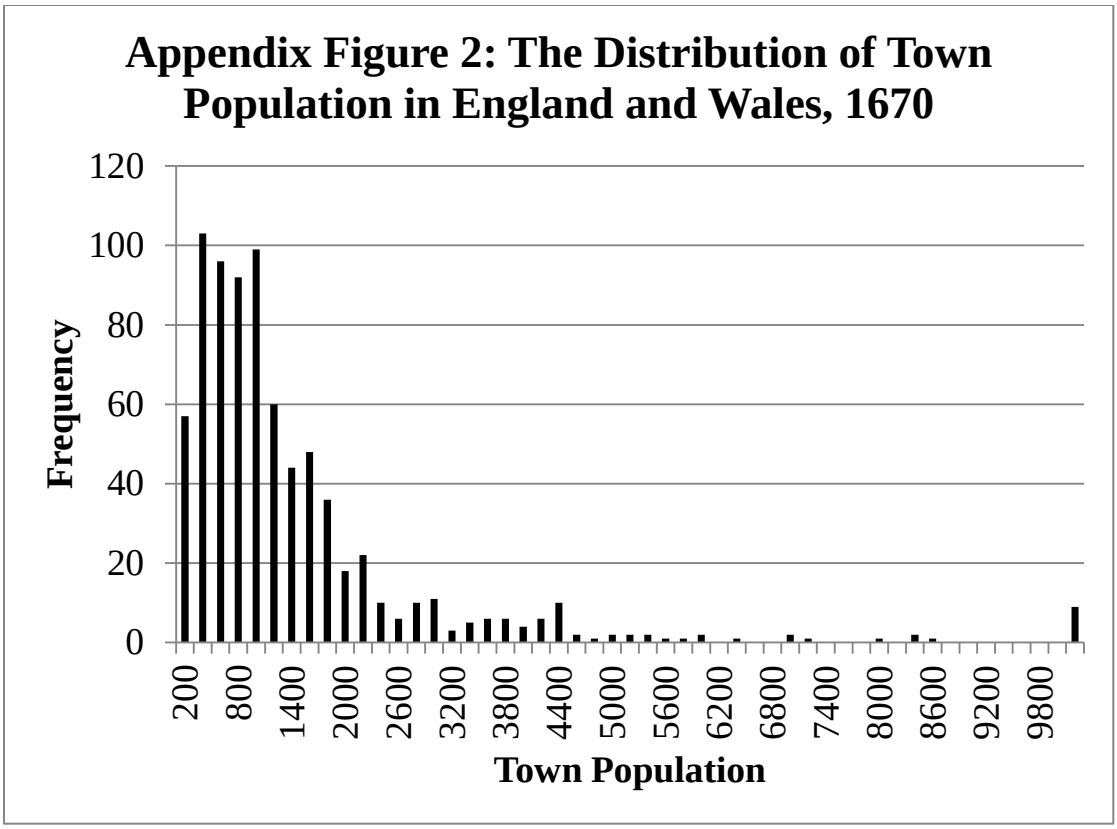



Source: Blome (1673).

Blome's *Britannia* serves as a starting point for the analysis but it is necessary to supplement with other data. Not surprisingly, Blome did not know the population of towns when he wrote in

1673. Official census-data on town populations was not available until 1801. The Cambridge Population History group has estimated the pre-1801 population of all parishes in England and Wales using census-like sources. The Cambridge Population History group has kindly provided their estimates of parish population in 1670 which I use to reconstruct the population of towns listed in Blome. Blome towns are matched with parishes in the Cambridge data, and if necessary, parishes are aggregated to form the boundaries of a town. Out of the 782 towns in the Blome list, 717 were successfully matched with the Cambridge data. The population of the remaining 65 towns was estimated using a model that predicts population from the amount of text Blome devotes to descriptions of each town.

The resulting town-level population data is to my knowledge the best that can be done with current information. The population distribution across towns suggests that the estimates are reasonable (see Appendix figure 2). The distribution is skewed to the right as is often the case with modern data. Over half of the towns had a population under 1,000 in 1670, while the mean population is 1584. A few large cities like London pull the average population higher.

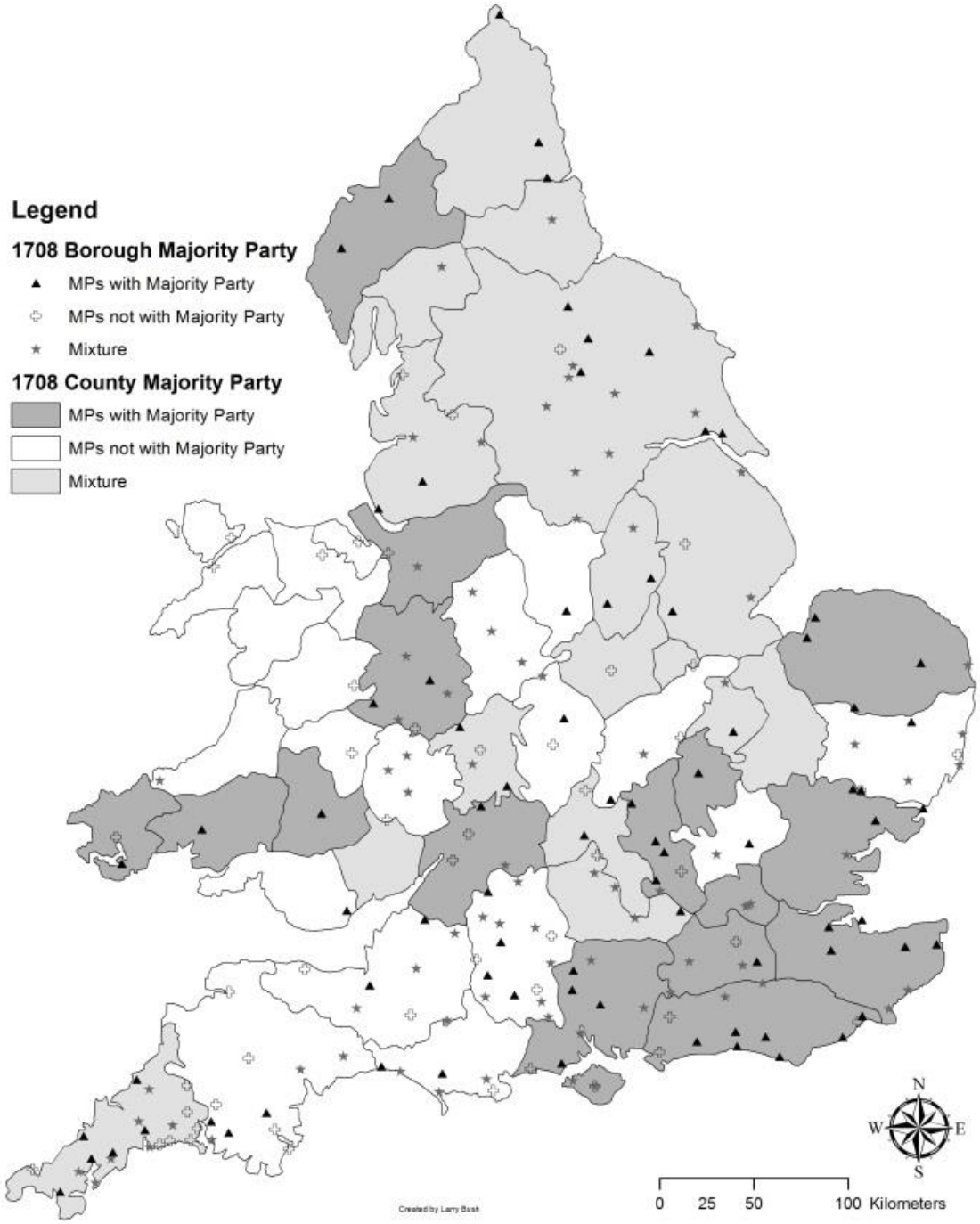



Sources: see text.

As discussed in the text, many of the key variables in this paper have a spatial component. The first step in building these spatial variables is to geo-code the towns in the Blome list. I was able to successfully match all cities to the Ordinance Survey based on name. From there, latitude and longitude coordinates are obtained. Locational data allows geographic features, like elevation changes and distance to the navigation head, to be incorporated to the analysis.

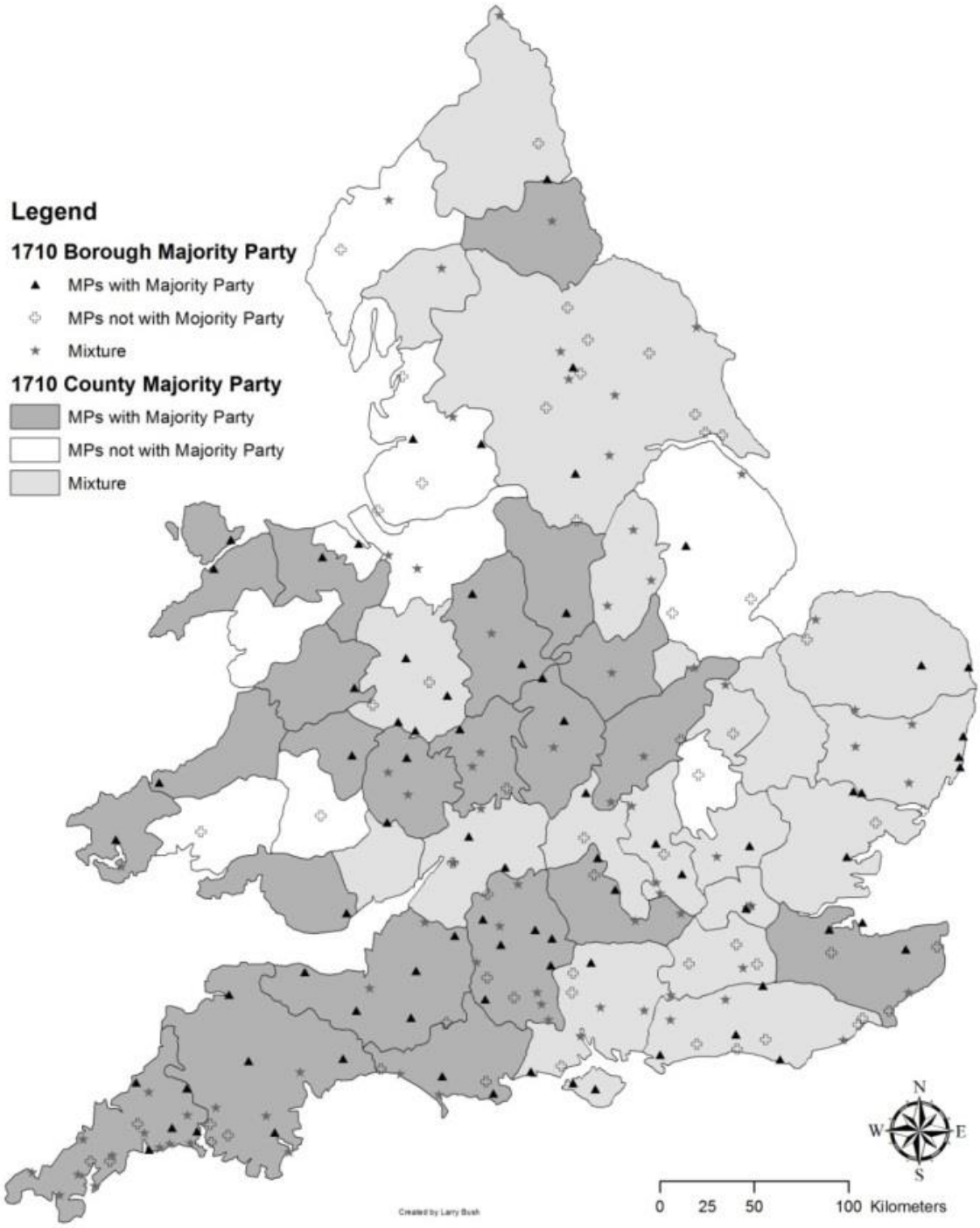
Another crucial source for this paper is the data on majority party representation across constituencies in England and Wales in all parliaments from 1690 to 1741. The methods are fully described in Bogart (forthcoming). The following two maps illustrate the patterns of representation in 1708 and 1710 when the Whigs and then the Tories had majorities.

Appendix Figure 3: Geography of Whig Majority Party Representation in 1708




Sources: Bogart (forthcoming).

Appendix Figure 4: Geography of Tory Majority Party Representation in 1710




Source: Bogart (forthcoming).

*Online Appendix II: Additional tables*

Appendix table 1 gives summary statistics for all variables uses in the river act adoption model. The sample includes all candidate towns that did not have river acts in a previous parliament.

Appendix table 2 identifies whether towns ever petitioning in support of river bills had different characteristics than towns that never petitioned. See the first set of columns for the differences in means. The second set of columns identifies whether towns ever petitioning in opposition to river bills had different characteristics than towns that never petitioned. I find very similar characteristics differentiate towns that ever petitioned against compared to towns that never petitioned.

Once the locations of towns are taken into account, towns with certain characteristics are more associated with supporting petitions than opposing petitions. To illustrate, town petitions are matched to river bills, producing 238 unique town-bill petitions. Towns petitioning in support, petitioning against, and petitioning in support or against are identified. There are 10 towns that petition in support and against. They are dropped leaving 228 towns that either petitioned in support or against. I create an indicator variable if the town petitioned in support and zero if they opposed. Each town is assigned its characteristics and its local market potential. I also create variables for whether a town was downstream from the candidate town matched to a bill and I interact the downstream indicator with all town characteristics. Appendix table 3 shows the marginal effects of each variable in a logit model which specifies the probability a town petitions in favor given then petitioned a bill.

Appendix table 4 shows the coefficient estimates for the bill success and bill selection equations in the bivariate probit model with selection. Most of the results in the bill success

equation are similar to the single bill success equation as noted in the text. Likewise many of the results for the bill selection equation are consistent with the estimates for the river act adoption model shown in table 6.

Appendix table 6 shows coefficient estimates for the linear three fixed effects models of river act adoption using variation across all candidate towns without previous river acts. Appendix table 7 does the same but it uses variation only across candidate towns that ever had a river bill. The first column of appendix table 8 shows the coefficients from a conditional fixed effects logit model. It uses variation only across towns that had river acts in some parliament. For comparison the second column reports coefficient estimates from a logit model without town fixed effects and using all candidate towns without a previous act.

Appendix table 9 shows the differences in means for neighboring political constituency variables between towns with river acts in a parliament and their matched counterpart. The matching procedure is discussed in the text.

Appendix table 10 reports estimates for the river act adoption model using different spatial scales for neighboring towns and political constituencies. Column (1) shows the baseline model with a radius of 25 miles for comparison. Columns (2) and (3) show 20 mile and 30 mile radius respectively.

Appendix table 11 reports estimates for the placebo test using planes to the left and right of candidate towns rather than upstream and downstream planes. Column (1) reports estimates for the bill success equation and column (2) reports estimates for the river act adoption model.

Appendix table 12 reports estimates for the river act adoption model after adding interactions between majority party variables and an indicator if the Whigs were the majority party. Only the main coefficients are shown.

Appendix table 1: Summary statistics for variables in towns without previous acts by parliament

| VARIABLES | Mean | St. Dev. | Min | Max |
|---|---|---|---|---|
| Indicator for River bill | 0.0184 | 0.134 | 0 | 1 |
| Indicator for River Act | 0.00877 | 0.0933 | 0 | 1 |
| MPs up, 25 mi. | 9.097 | 6.223 | 0 | 32 |
| MPs down, 25 mi. | 7.895 | 5.087 | 0 | 26 |
| Majority party MPs county | 0.838 | 0.790 | 0 | 2 |
| Majority party MPs closest constituency | 0.922 | 0.777 | 0 | 4 |
| Majority party MPs up, 25 mi. | 4.433 | 3.667 | 0 | 21.71 |
| Majority party MPs down, 25 mi. | 3.856 | 3.061 | 0 | 18.84 |
| Constituencies w/ contests up, 25 mi. | 2.131 | 1.937 | 0 | 13 |
| Constituencies w/ contests down, 25 mi. | 1.869 | 1.640 | 0 | 9 |
| Incumbent MPs up, 25 mi. | 4.278 | 3.523 | 0 | 23 |
| Incumbent MPs down, 25 mi. | 3.818 | 3.215 | 0 | 19 |
| Whig majority indicator | 0.565 | 0.496 | 0 | 1 |
| Elevation Change to Nav. Head (10 mi.) | 14.65 | 13.25 | 0 | 92.40 |
| Distance to Nav. Head (10 mi.) | 2.806 | 1.938 | 0.0790 | 13.40 |
| Has harbor | 0.00826 | 0.0905 | 0 | 1 |
| Has mining | 0.0375 | 0.190 | 0 | 1 |
| Has Manufacturing | 0.211 | 0.408 | 0 | 1 |
| On Main Road Network 17c | 0.632 | 0.482 | 0 | 1 |
| Has free school | 0.0793 | 0.270 | 0 | 1 |
| Has Municipal Govt. | 0.212 | 0.409 | 0 | 1 |
| Local Market Potential (10,000s) | 1.680 | 0.909 | 0.589 | 11.52 |
| Pop. of Navigation Head in (1000s) | 2.091 | 2.640 | 0.00475 | 19.63 |
| Towns w/ harbors up, 25 mi. | 0.457 | 0.837 | 0 | 5 |
| Towns w/ harbors down, 25 mi. | 0.594 | 0.952 | 0 | 5 |
| Towns w/ mining up, 25 mi. | 0.389 | 0.772 | 0 | 4 |
| Towns w/ mining down, 25 mi. | 0.389 | 0.715 | 0 | 4 |
| Towns w/ manufact. up, 25 mi. | 2.480 | 2.348 | 0 | 11 |
| Towns w/ manufact. down, 25 mi. | 2.239 | 2.122 | 0 | 10 |
| Towns w/ water nav. 1670 up, 25 mi. | 1.042 | 1.937 | 0 | 20 |
| Towns w/ water nav. 1670 down, 25 mi. | 2.350 | 3.610 | 0 | 19 |
| Towns on road network up, 25 mi. | 8.237 | 5.807 | 0 | 48 |
| Towns on road network down, 25 mi. | 8.220 | 6.453 | 0 | 34 |
| Towns w/ free schools up, 25 mi. | 1.020 | 1.232 | 0 | 6 |
| Towns w/ free schools down, 25 mi. | 0.882 | 1.180 | 0 | 6 |
| Towns w/ munic. govt. up, 25 mi. | 2.733 | 1.651 | 0 | 9 |
| Towns w/ munic. govt. down, 25 mi. | 2.682 | 1.614 | 0 | 8 |
| North | 0.192 | 0.394 | 0 | 1 |
| East Midlands | 0.150 | 0.357 | 0 | 1 |
| West Midlands | 0.157 | 0.364 | 0 | 1 |
| Southwest | 0.209 | 0.407 | 0 | 1 |
| Wales | 0.0723 | 0.259 | 0 | 1 |
| Towns with turnpike acts, 25 mi. | 1.557 | 4.576 | 0 | 47 |
| Towns with river acts, 25 mi. | 4.111 | 4.563 | 0 | 23 |
| Year Parliament ended | 1,712 | 13.40 | 1,695 | 1,741 |
| N | | | | 5813 |

Appendix table 2: Characteristics of towns ever petitioning in support or against bills

| Variables | Town means if At least one supporting | Never Petition | p-value | Town means if At least one opposing | Never Petition | p-value |
|---|---|---|---|---|---|---|
| Had water navigation c.1670 | 0.23 | 0.14 | 0.02 | 0.32 | 0.14 | 0.00 |
| Had Municipal Govt. | 0.40 | 0.21 | 0.00 | 0.47 | 0.21 | 0.00 |
| Had Manufacturing | 0.37 | 0.14 | 0.00 | 0.27 | 0.14 | 0.00 |
| Had Mining | 0.04 | 0.04 | 0.85 | 0.03 | 0.04 | 0.81 |
| Had Harbour | 0.04 | 0.07 | 0.29 | 0.10 | 0.07 | 0.48 |
| On Main Road Network 17c. | 0.77 | 0.61 | 0.00 | 0.76 | 0.61 | 0.02 |
| Had a Free School | 0.10 | 0.06 | 0.24 | 0.10 | 0.06 | 0.31 |
| N | 94 | 650 | | 62 | 650 | |

Notes: P-value is for null hypothesis of equal means assuming equal variances. For sources see text.

Appendix table 3: Logit estimates identifying characteristics associated with towns petitioning in support as opposed to petitioning against river bills

| VARIABLES | Marginal Effect (Stan. Err.) |
|---|---|
| Downstream indicator | -0.337** |
| | (0.160) |
| Distance to most downstream candidate town | 0.00312* |
| | (0.00188) |
| Has water navigation c.1670 | -0.133 |
| | (0.134) |
| Local market potential | 0.00246 |
| | (0.00570) |
| Has manufacturing | -0.00908 |
| | (0.0978) |
| Has mining | 0.0828 |
| | (0.204) |
| Has a harbour | -0.00213 |
| | (0.270) |
| On main road network | 0.203* |
| | (0.108) |
| Has free schools | 0.0534 |
| | (0.155) |
| Has municipal government | -0.0188 |
| | (0.0947) |
| Downtream * on main road network | -0.410** |
| | (0.185) |
| Downtream * has harbour | -0.0397 |
| | (0.350) |
| Downtream * has water navigation c.1670 | 0.326*** |
| | (0.0926) |
| Downtream * has manufacturing | 0.163 |
| | (0.121) |
| Downtream * has mining | -0.00391 |
| | (0.415) |
| Downtream * has schools | -0.242 |
| | (0.381) |
| Downtream * has municipal govt. | -0.0710 |
| | (0.184) |
| Observations | 228 |

Notes: The dependent variable is 1 if the town petitioned in support and 0 if it petitioned against. The sample is restricted to towns that petitioned for a river bill in a parliament. There were 10 towns that petitioned in support and in favor. They are dropped. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix table 4: Coefficients for river act adoption model adding time varying controls

| VARIABLES | (2)<br>Coeff.<br>(std. err.) |
|---|---|
| MPs up, 25 mi. | -0.132*** |
| | (0.0420) |
| MPs down, 25 mi. | 0.0416 |
| | (0.0375) |
| Majority party MPs county | 0.290*** |
| | (0.105) |
| Majority party MPs closest constituency | -0.0884 |
| | (0.0834) |
| Majority party MPs up, 25 mi. | 0.117*** |
| | (0.0432) |
| Majority party MPs down, 25 mi. | -0.163*** |
| | (0.0463) |
| Constituencies w/ contests up, 25 mi. | 0.0179 |
| | (0.0673) |
| Constituencies w/ contests down, 25 mi. | -0.127* |
| | (0.0655) |
| Incumbent MPs up, 25 mi. | 0.0989** |
| | (0.0414) |
| Incumbent MPs down, 25 mi. | 0.0879** |
| | (0.0420) |
| Whig majority indicator | 0.534** |
| | (0.214) |
| Indicator for foreign wars | 0.337 |
| | (0.480) |
| Indicator for bad harvests | -0.988** |
| | (0.461) |
| Rate of return on land | 1.636** |
| | (0.657) |
| Inflation rate | 0.108** |
| | (0.0498) |
| Average growth coastal trade | 0.198 |
| | (0.182) |
| Parliament length in years | 0.215*** |
| | (0.0759) |
| Town and geographic variables included? | Y |
| Neighboring town variables included? | Y |
| Region and Region time trends included? | Y |
| N | 5393 |
| Pseudo R-square | 0.41 |

Notes: Robust standard errors are reported. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 5: Bivariate Probit Estimates with Selection

| VARIABLES | (1) Bill Success Coeff. (std. err.) | (2) Bill Selection Coeff. (std. err.) |
|---|---|---|
| MPs up, 25 mi. | -0.0808 | 0.0272 |
| | (0.121) | (0.0231) |
| MPs down, 25 mi. | 0.0852 | 0.0149 |
| | (0.207) | (0.0282) |
| Majority party MPs county | 0.685 | 0.125* |
| | (0.524) | (0.0696) |
| Majority party MPs closest constituency | -0.0135 | -0.115* |
| | (0.486) | (0.0680) |
| Majority party MPs up, 25 mi. | 0.0181 | 0.00203 |
| | (0.177) | (0.0254) |
| Majority party MPs down, 25 mi. | -0.752** | -0.0228 |
| | (0.381) | (0.0292) |
| Constituencies w/ contests up, 25 mi. | -0.134 | -0.0257 |
| | (0.245) | (0.0392) |
| Constituencies w/ contests down, 25 mi. | 0.00360 | -0.0524 |
| | (0.236) | (0.0468) |
| Incumbent MPs up, 25 mi. | 0.295** | -0.0408** |
| | (0.126) | (0.0193) |
| Incumbent MPs down, 25 mi. | 0.0212 | -0.00118 |
| | (0.118) | (0.0220) |
| Whig majority indicator | 0.304 | 0.383*** |
| | (0.743) | (0.107) |
| Elevation Change to Nav. Head | -0.111 | -0.0989*** |
| | (0.162) | (0.0132) |
| Distance to Nav. Head | 0.575 | 0.206*** |
| | (0.563) | (0.0555) |
| Has harbor | | -0.145 |
| | | (0.516) |
| Has mining | | 0.174 |
| | | (0.480) |
| Has Manufacturing | | 0.450*** |
| | | (0.157) |
| On Main Road Network 17c. | | 0.0401 |
| | | (0.141) |
| Has free school | | -0.156 |
| | | (0.209) |
| Has Municipal Govt. | | 0.449*** |
| | | (0.145) |
| Local Market Potential (10,000s) | 0.200 | 0.237*** |
| | (0.586) | (0.0450) |
| Pop. of Navigation Head in 1000s | -0.132 | -0.00181 |
| | (0.0975) | (0.0278) |
| Towns w/ harbors up, 25 mi. | 1.812*** | -0.0927 |

| | | |
|---|---|---|
| | (0.541) | (0.115) |
| Towns w/ harbors down, 25 mi. | -1.136*** | -0.0497 |
| | (0.271) | (0.0836) |
| Towns w/ mining up, 25 mi. | -0.0647 | -0.172 |
| | (0.225) | (0.114) |
| Towns w/ mining down, 25 mi. | 0.272 | 0.0959 |
| | (0.430) | (0.0968) |
| Towns w/ manufact. up, 25 mi. | 0.206 | 0.00353 |
| | (0.129) | (0.0336) |
| Towns w/ manufact. down, 25 mi. | 0.126 | 0.0855** |
| | (0.257) | (0.0411) |
| Towns w/ water nav. 1670 up, 25 mi. | -0.654*** | -0.103** |
| | (0.245) | (0.0509) |
| Towns w/ water nav. 1670 down, 25 mi. | 0.351 | 0.0805 |
| | (0.289) | (0.0529) |
| Towns on road network up, 25 mi. | 0.176 | 0.0110 |
| | (0.138) | (0.0233) |
| Towns on road network down, 25 mi. | 0.176 | -0.0851*** |
| | (0.134) | (0.0236) |
| Towns w/ free schools up, 25 mi. | | -0.0821 |
| | | (0.0856) |
| Towns w/ free schools down, 25 mi. | | 0.0774 |
| | | (0.0723) |
| Towns w/ munic. govt. up, 25 mi. | 0.223 | -0.0252 |
| | (0.170) | (0.0636) |
| Towns w/ munic. govt. down, 25 mi. | -0.0244 | -0.0443 |
| | (0.458) | (0.0643) |
| Towns with turnpike acts, 25 mi. | | 0.0615*** |
| | | (0.0209) |
| Towns with river acts, 25 mi. | | -0.00307 |
| | | (0.0403) |
| Year | 0.0944** | 0.00514 |
| | (0.0392) | (0.0119) |
| $\rho$ | -0.238 | |
| | (2.282) | |
| Region indicators included? | N | Y |
| Region by year trends included? | N | Y |
| Observations | 107 | 5,813 |

Notes: Standard errors are clustered on towns. *** p<0.01, ** p<0.05, * p<0.1.

Appendix table 6: Linear Probability Fixed Effects Models: full sample of candidate towns

| VARIABLES | Clustered Stand. Err. (1) Model 1 | Driscoll Kraay Stand. Err. (2) Model 2 | PCSE with AR(1) (3) Model 3 |
|---|---|---|---|
| Majority party MPs county | 0.00510** | 0.00510* | 0.00398** |
| | (0.00224) | (0.00287) | (0.00175) |
| Majority party MPs closest constituency | -0.00151 | -0.00151 | -0.000929 |
| | (0.00184) | (0.00139) | (0.00118) |
| Majority party MPs up, 25 mi. | 0.00120* | 0.00120 | 0.000996*** |
| | (0.000652) | (0.000904) | (0.000379) |
| Majority party MPs down, 25 mi. | -0.00172** | -0.00172** | -0.00161*** |
| | (0.000679) | (0.000638) | (0.000450) |
| Constituencies w/ contests up, 25 mi. | -0.000292 | -0.000292 | -0.000700 |
| | (0.00111) | (0.00115) | (0.000535) |
| Constituencies w/ contests down, 25 mi. | -0.00248** | -0.00248* | -0.00207** |
| | (0.00118) | (0.00136) | (0.000856) |
| Incumbent MPs up, 25 mi. | -7.06e-05 | -7.06e-05 | 0.000222 |
| | (0.000594) | (0.000657) | (0.000659) |
| Incumbent MPs down, 25 mi. | 0.000607 | 0.000607 | 0.000578 |
| | (0.000494) | (0.000614) | (0.000480) |
| Elevation Change to Nav. Head | -0.00139** | -0.00139* | -0.00159*** |
| | (0.000680) | (0.000705) | (0.000262) |
| Distance to Nav. Head | 0.00691*** | 0.00691 | 0.00875*** |
| | (0.00214) | (0.00433) | (0.00136) |
| Towns with turnpike acts, 25 mi. | 0.00190** | 0.00190** | 0.00204*** |
| | (0.000837) | (0.000694) | (0.000231) |
| Towns with river acts, 25 mi. | 0.00407 | 0.00407 | 0.00716*** |
| | (0.00305) | (0.00527) | (0.00179) |
| Town FE | Y | Y | Y |
| Parliament FE | Y | Y | Y |
| Region Specific trends | Y | Y | Y |
| Observations | 5,813 | 5,813 | 5,813 |
| R-squared | 0.031 | 0.031 | 0.163 |
| Number of towns | 435 | 435 | 435 |

Notes: See column headings for discussion of standard errors. *** p<0.01, ** p<0.05, * p<0.1

Appendix table 7: Linear Probability Fixed Effects Models: Towns ever with a river bill.

| VARIABLES | Clustered Stand. Err. (1) Model 1 | Driscoll Kraay Stand. Err. (2) Model 2 | PCSE with AR(1) (3) Model 3 |
|---|---|---|---|
| Majority party MPs county | 0.0218* | 0.0218 | 0.0237** |
| | (0.0121) | (0.0167) | (0.0103) |
| Majority party MPs closest constituency | -0.0129 | -0.0129 | -0.0144* |
| | (0.0123) | (0.0104) | (0.00877) |
| Majority party MPs up, 25 mi. | 0.0102* | 0.0102 | 0.0109*** |
| | (0.00546) | (0.00622) | (0.00260) |
| Majority party MPs down, 25 mi. | -0.0128** | -0.0128** | -0.0126*** |
| | (0.00553) | (0.00518) | (0.00301) |
| Constituencies w/ contests up, 25 mi. | -0.00169 | -0.00169 | -0.00110 |
| | (0.00997) | (0.00714) | (0.00340) |
| Constituencies w/ contests down, 25 mi. | -0.00961 | -0.00961 | -0.00973 |
| | (0.0112) | (0.0112) | (0.00663) |
| Incumbent MPs up, 25 mi. | 3.16e-05 | 3.16e-05 | -0.000665 |
| | (0.00467) | (0.00543) | (0.00370) |
| Incumbent MPs down, 25 mi. | 0.00499 | 0.00499 | 0.00462 |
| | (0.00531) | (0.00708) | (0.00351) |
| Elevation Change to Nav. Head | -0.00498 | -0.00498 | -0.00559 |
| | (0.0133) | (0.0152) | (0.00499) |
| Distance to Nav. Head | 0.0708** | 0.0708 | 0.0664*** |
| | (0.0287) | (0.0444) | (0.0185) |
| Towns with turnpike acts, 25 mi. | 0.0130*** | 0.0130* | 0.0128*** |
| | (0.00414) | (0.00681) | (0.00201) |
| Towns with river acts, 25 mi. | 0.0432** | 0.0432 | 0.0386*** |
| | (0.0210) | (0.0354) | (0.0131) |
| Town FEs | Yes | Yes | Yes |
| Parliament FEs | Yes | Yes | Yes |
| Region by Year Trends | Yes | Yes | Yes |
| Observations | 759 | 759 | 759 |
| R-squared | 0.231 | 0.231 | 0.333 |
| Number of towns | 74 | 74 | 74 |

Notes: See column headings for discussion of standard errors. *** p<0.01, ** p<0.05, * p<0.1

Appendix table 8: Coefficient estimates for logit and conditional fixed effects logit model

| VARIABLES | (1)<br>Conditional FE Logit<br>Coeff.<br>(std. err.) | (2)<br>Logit<br>Coff.<br>(std. err.) |
|---|---|---|
| Majority Party MPs, county | 0.446 | 0.498** |
| | (0.429) | (0.211) |
| Majority Party MPs, closest constituency | -0.596 | -0.149 |
| | (0.513) | (0.201) |
| Majority party MPs up, 25 mi. | -0.122 | 0.00533 |
| | (0.223) | (0.0755) |
| Majority party MPs down, 25 mi. | -0.428** | -0.271*** |
| | (0.218) | (0.0932) |
| Constituencies w/ contests up, 25 mi. | -0.103 | -0.0206 |
| | (0.257) | (0.107) |
| Constituencies w/ contests down, 25 mi. | -0.335 | -0.00437 |
| | (0.316) | (0.128) |
| Incumbent MPs up, 25 mi. | 0.0876 | -0.0424 |
| | (0.148) | (0.0662) |
| Incumbent MPs down, 25 mi. | -0.350 | 0.130** |
| | (0.258) | (0.0661) |
| Elevation Change to Nav. Head | 8.393 | -0.216*** |
| | (147,449) | (0.0384) |
| Distance to Nav. Head | -17.66 | 0.477*** |
| | (296,198) | (0.105) |
| Towns with turnpike acts, 25 mi. | 19.28 | 0.0816*** |
| | (2,854) | (0.0244) |
| Towns with river acts, 25 mi. | 20.95 | 0.00764 |
| | (8,810) | (0.0443) |
| Whig majority indicator | 1.888*** | 1.171*** |
| | (0.726) | (0.373) |
| Town Fixed effects | Yes | Yes |
| Observations | 437 | 5,813 |

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 9: Political Constituency variables for Towns with acts and their matched towns

| | Matched to 1 town in parl. town means if | | | Matched to 2 towns in parl. town means if | | |
|---|---|---|---|---|---|---|
| Variables | river act | no river act | p-value | river act | no river act | p-value |
| Majority party MPs county | 0.84 | 0.73 | 0.49 | 0.84 | 0.70 | 0.31 |
| Majority party MPs in closest constituency | 0.85 | 0.75 | 0.49 | 0.85 | 0.83 | 0.86 |
| Majority party MPs downstream, within 25 miles | 2.66 | 3.65 | 0.01 | 2.66 | 3.49 | 0.02 |
| Majority party MPs upstream, within 25 miles | 4.16 | 4.12 | 0.95 | 4.16 | 4.22 | 0.92 |
| Incumbent MPs downstream, within 25 miles | 3.53 | 3.96 | 0.36 | 3.53 | 3.7 | 0.68 |
| Incumbent MPs upstream, within 25 miles | 4.04 | 4.00 | 0.95 | 4.04 | 3.87 | 0.73 |
| Contests downstream, within 25 miles | 1.59 | 1.94 | 0.22 | 1.59 | 1.98 | 0.12 |
| Contests upstream, within 25 miles | 2.14 | 2.14 | 0.99 | 2.14 | 2.09 | 0.87 |
| Average "Distance" between towns with acts and matched towns | | | 14.58 | | | 16.47 |
| N, towns with acts | | | 51 | | | 51 |
| N, matched towns | | | 51 | | | 100 |
| N, total | | | 102 | | | 151 |

Notes: The matches were based on the nearest neighbor matching algorithm. The distance refers the distance in observable town and neighbor characteristics along with regional indicators.

Appendix table 10: Robustness on different spatial scales

| VARIABLES | (1) 25 miles Coeff. (std. err.) | (2) 20 miles Coeff. (std. err.) | (3) 30 miles Coeff. (std. err.) |
|---|---|---|---|
| MPs up | -0.0921** | -0.119*** | -0.0476 |
| | (0.0379) | (0.0455) | (0.0305) |
| MPs down | 0.0759** | 0.0793* | 0.0738** |
| | (0.0369) | (0.0439) | (0.0316) |
| Majority party MPs up | 0.0738* | 0.107** | 0.0706** |
| | (0.0425) | (0.0517) | (0.0358) |
| Majority party MPs down | -0.177*** | -0.139** | -0.145*** |
| | (0.0429) | (0.0552) | (0.0370) |
| Constituencies w/ contests up | 0.0764 | 0.121* | 0.104** |
| | (0.0644) | (0.0717) | (0.0516) |
| Constituencies w/ contests down | -0.0795 | 0.0528 | -0.0381 |
| | (0.0652) | (0.0702) | (0.0542) |
| Incumbent MPs up | 0.0313 | 0.0475 | 0.0366 |
| | (0.0327) | (0.0446) | (0.0266) |
| Incumbent MPs down | -0.000894 | -0.0237 | 0.00732 |
| | (0.0325) | (0.0355) | (0.0271) |
| Towns w/ harbors up | -0.00982 | -0.0194 | 0.0992 |
| | (0.147) | (0.185) | (0.0901) |
| Towns w/ harbors down | -0.163 | -0.311** | 0.0497 |
| | (0.112) | (0.123) | (0.108) |
| Towns w/ mining up | -0.309** | -0.450*** | -0.170 |
| | (0.128) | (0.170) | (0.125) |
| Towns w/ mining down | 0.185* | 0.299** | -0.144 |
| | (0.102) | (0.148) | (0.113) |
| Towns w/ manufact. up | -0.0141 | 0.0611 | 0.0448 |
| | (0.0358) | (0.0437) | (0.0355) |
| Towns w/ manufact. down | 0.0861* | -0.000220 | 0.0269 |
| | (0.0506) | (0.0480) | (0.0343) |
| Towns w/ water nav. 1670 up | -0.167** | -0.117 | -0.0882** |
| | (0.0708) | (0.0776) | (0.0382) |
| Towns w/ water nav. 1670 down | 0.105* | 0.0536 | 0.114*** |
| | (0.0566) | (0.0732) | (0.0429) |
| Towns on road network up | 0.0488* | 0.0382 | 0.0416** |
| | (0.0255) | (0.0321) | (0.0209) |
| Towns on road network down | -0.0454* | -0.0242 | -0.0390* |
| | (0.0275) | (0.0396) | (0.0221) |
| Towns w/ free schools up | 0.00104 | -0.111 | -0.00554 |
| | (0.0753) | (0.105) | (0.0640) |
| Towns w/ free schools down | 0.0131 | 0.0747 | 0.0746 |
| | (0.0822) | (0.0883) | (0.0610) |
| Towns w/ munic. govt. up | 0.0182 | 0.102 | -0.104* |
| | (0.0753) | (0.0793) | (0.0580) |
| Towns w/ munic. govt. down | -0.162** | 0.0306 | -0.0358 |

| | | | |
|---|---|---|---|
| | (0.0763) | (0.0845) | (0.0665) |
| Town and Region variables included? | Yes | Yes | Yes |
| Whig, Year, Maj. party county and closest included? | Yes | Yes | Yes |
| Observations | 5,393 | 5,393 | 5,393 |

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix table 11: Coefficients, Left/Right Placebo Test

| VARIABLES | (1) Bill Success Coeff. (std. err.) | (2) River Act Coeff. (std. err.) |
|---|---|---|
| MPs left, 25 mi. | -0.172 | -0.0376 |
| | (0.108) | (0.0327) |
| MPs right, 25 mi. | 0.0538 | 0.00894 |
| | (0.0937) | (0.0345) |
| Majority party MPs county | 0.376 | 0.190** |
| | (0.275) | (0.0957) |
| Majority party MPs closest constituency | 0.0747 | -0.132 |
| | (0.242) | (0.0826) |
| Majority party MPs left, 25 mi. | -0.0995 | 0.00679 |
| | (0.149) | (0.0296) |
| Majority party MPs right, 25 mi. | -0.147 | -0.0784* |
| | (0.120) | (0.0416) |
| Constituencies w/ contests left, 25 mi. | 0.198 | -0.0241 |
| | (0.154) | (0.0673) |
| Constituencies w/ contests right, 25 mi. | 0.278 | 0.0471 |
| | (0.172) | (0.0595) |
| Incumbent MPs left, 25 mi. | 0.238** | 0.0541 |
| | (0.111) | (0.0337) |
| Incumbent MPs right, 25 mi. | 0.0599 | -0.0309 |
| | (0.115) | (0.0331) |
| Whig majority indicator | 0.685* | 0.458*** |
| | (0.408) | (0.134) |
| Elevation Change to Nav. Head | -0.110** | -0.130*** |
| | (0.0488) | (0.0220) |
| Distance to Nav. Head | 0.339** | 0.304*** |
| | (0.162) | (0.0660) |
| Has harbor | | 0.383 |
| | | (0.349) |
| Has mining | | 0.495 |
| | | (0.349) |
| Has Manufacturing | | 0.441** |
| | | (0.180) |
| On Main Road Network 17c. | | -0.0238 |
| | | (0.169) |
| Has free school | | 0.0770 |
| | | (0.220) |

| | | |
|---|---|---|
| Has Municipal Govt. | | 0.495*** |
| | | (0.157) |
| Local Market Potential (10,000s) | 0.154 | 0.143*** |
| | (0.116) | (0.0523) |
| Pop. of Navigation Head in 1000s | -0.0451 | -0.0404 |
| | (0.0744) | (0.0326) |
| Towns w/ harbors left, 25 mi. | -0.186 | 0.0474 |
| | (0.273) | (0.110) |
| Towns w/ harbors right, 25 mi. | 0.433 | -0.0990 |
| | (0.422) | (0.140) |
| Towns w/ mining left, 25 mi. | 0.118 | -0.153 |
| | (0.322) | (0.101) |
| Towns w/ mining right, 25 mi. | 0.148 | 0.00366 |
| | (0.331) | (0.105) |
| Towns w/ manufact. left, 25 mi. | -0.113 | 0.0483 |
| | (0.0974) | (0.0440) |
| Towns w/ manufact. right, 25 mi. | 0.124 | 0.00440 |
| | (0.106) | (0.0436) |
| Towns w/ water nav. 1670 left, 25 mi. | 0.116 | -0.102* |
| | (0.135) | (0.0550) |
| Towns w/ water nav. 1670 right, 25 mi. | 0.0654 | 0.0894 |
| | (0.129) | (0.0563) |
| Towns on road network left, 25 mi. | 0.162** | 0.0406 |
| | (0.0662) | (0.0279) |
| Towns on road network right, 25 mi. | 0.0446 | -0.0510** |
| | (0.0981) | (0.0249) |
| Towns w/ free schools left, 25 mi. | -0.236 | -0.0754 |
| | (0.176) | (0.0741) |
| Towns w/ free schools right, 25 mi. | -0.180 | 0.0857 |
| | (0.238) | (0.0605) |
| Towns w/ munic. govt. left, 25 mi. | 0.106 | -0.0843 |
| | (0.159) | (0.0659) |
| Towns w/ munic. govt. right, 25 mi. | -0.0474 | 0.0326 |
| | (0.199) | (0.0761) |
| North | | 18.13 |
| | | (25.37) |
| East Midlands | | 41.31** |
| | | (20.71) |
| West Midlands | | 62.41*** |
| | | (22.56) |
| Southwest | | 59.99* |
| | | (31.10) |
| Towns with turnpike acts, 25 mi. | -0.0702 | 0.0363* |
| | (0.0736) | (0.0196) |
| Towns with river acts, 25 mi. | | 0.00376 |
| | | (0.0480) |
| year | 0.0473** | 0.0301** |
| | (0.0189) | (0.0128) |
| Year x North | | -0.0103 |

| | | |
|---|---|---|
| | | (0.0148) |
| Year x East Midlands | | -0.0238** |
| | | (0.0121) |
| Year x West Midlands | | -0.0360*** |
| | | (0.0131) |
| Year x Southwest | | -0.0346* |
| | | (0.0181) |
| Constant | -84.09** | -54.85** |
| | (32.93) | (21.95) |
| N | 107 | 5,393 |

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix table 12: Probit model for Adoption of River Act with Party-Constituency Interactions

| Political Constituency Variables | Coeff. (std. err.) |
|---|---|
| MPs up, 25 mi. | -0.0912** |
| | (0.0371) |
| MPs down, 25 mi. | 0.0798** |
| | (0.0374) |
| Majority party MPs county | 0.390** |
| | (0.163) |
| Majority party MPs closest constituency | -0.415*** |
| | (0.141) |
| Majority party MPs up, 25 mi. | 0.102* |
| | (0.0524) |
| Majority party MPs down, 25 mi. | -0.113** |
| | (0.0482) |
| Constituencies w/ contests up, 25 mi. | 0.0744 |
| | (0.0634) |
| Constituencies w/ contests down, 25 mi. | -0.0823 |
| | (0.0655) |
| Incumbent MPs up, 25 mi. | 0.0281 |
| | (0.0320) |
| Incumbent MPs down, 25 mi. | -0.00152 |
| | (0.0331) |
| Whig majority indicator | 0.860** |
| | (0.350) |
| Whig majority indicator x Majority party MPs down, 25 mi. | -0.103** |
| | (0.0504) |
| Whig majority indicator x Majority party MPs up, 25 mi. | -0.0334 |
| | (0.0526) |
| Whig majority indicator x Majority party MPs closest constituency | 0.360** |
| | (0.177) |
| Whig majority indicator x Majority party MPs county | -0.189 |
| | (0.217) |
| Other Variables | |
| Town Characteristics | Y |
| Neighboring Town Characteristics | Y |

| | |
|---|---|
| Acts in Previous Parliaments | Y |
| Region Indicators | Y |
| Time and Region specific Trends | Y |
| Observations | 5,393 |

Notes: Standard errors are clustered on towns. *** p<0.01, ** p<0.05, * p<0.1.