Policy uncertainty and investment: Evidence from the English East India Company*

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Abstract

The English East India Company received valuable trading privileges from governments in England and India, but at times it operated in an uncertain policy environment due to wars, conflicts with governments, and public pressures. This paper examines whether policy uncertainty lowered the Company's investments in shipping capacity. It creates several new measures of policy uncertainty based on regime changes, wars, deficits, and mentions of the Company and its trade in contemporary publications. The results show that regime instability from elections to the House of Commons and greater publications mentioning trade lowered investment. The effects are comparable to changes in stock price volatility which serves as a proxy for general uncertainty. The results contribute to the broader literature on policy uncertainty, the performance of East Indian companies, and institutions in Britain and India.

Keywords: Policy Uncertainty, Investment, English East India Company.

JEL Codes: N4, P1, L9

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1 Introduction

The English East India Company was among the most important firms in the world during the 1600s, 1700s, and 1800s. The Company or EIC was engaged in trade between England and Asia, then known as the East Indies. Its business required large investments in physical capital, like ships and forts, and an organizational structure that spanned locations halfway across the globe. The EIC made huge fortunes for its directors, employees, and many of its investors. It also laid the foundation for British colonial rule in the subcontinent.

This paper examines the effects of policy uncertainty on the EIC's investment. It is motivated by two separate strands of literature. One deals with the history of the EIC and its conflicted relations with governments in England and India. It is well known that the EIC held a monopoly over Asian trade with England, and that the monopoly was granted by the English monarch and later supported by Parliament. However, historians have documented that the EIC was forced to lend to the Monarchy and pay bribes to retain their trading privileges. There were also public pressures to open the EIC's markets and directorship in order to distribute the profits more broadly. Historians have also noted a connection between attacks on the EIC and political instability, especially the turbulent struggles to control the government. As Philip Lawson (1993, p. 74) states, "When the Company experienced its worst troubles...there was matching instability in national politics." The Company itself often expressed frustration with government, as exemplified by the EIC's legal counsel who warned in 1628 'there can be no partnership with the King (quoted in Scott 1912, p. 108)."

The EIC faced similar problems in its relations with the Mughal Empire in India. The risks of extraction by government officials was high. The EIC was also involved in military conflicts with Indian powers and other European companies which disrupted its trade. Extraction and warfare were linked with succession problems among Mughal leaders, foreign invasions, and regional conflicts. Watson (1980, p. 41) explains the implications of Emperor Aurangzeb's death in 1707, "the most important consequences of this highly unstable

situation were the extortionate practices under which commerce suffered."

The second strand of literature is from economics and argues for a connection between policy uncertainty and investment. Policy uncertainty occurs when firms have difficulty forecasting who will be making policy decisions, what policy decisions will be made by those who end up in charge, and how those policies will affect their profits (Mordfin 2014). One of the main arguments is that firms adopt a "wait-and-see" attitude when facing significant policy uncertainty. The basis for this claim is a negative relationship between firm level investment or entry and the onset of elections, deficits, and greater mentions of policy-related words in news media.[1]

This paper tests whether policy uncertainty negatively affected the EIC's investment in shipping capacity. It creates a new time series on shipping capacity from the early 1600s to the early 1800s. It also develops new measures of policy uncertainty drawing on the historical and economics literature. They include indices for regime changes and war instability in England and India, as well as a new index of public pressure based on mentions of the EIC and East Indian trade in the titles of publications between 1600 and 1800. Moreover, to capture general uncertainty I create a series on the volatility of the EIC's stock price.

In the empirical analysis, the uncertainty indices are added to a standard error correction investment model. The main results show that greater regime instability associated with elections to the House of Commons and greater public pressure in England associated with trade issues significantly lowered EIC investment. Their effects are comparable to changes in stock price volatility which also lowered investment. In an extension, I examine the effects on Dutch East India Company investment which serves as a quasi placebo test. The results show no significant effect from the main variables. In another extension, which includes additional time-lags, I show there is a rebound effect leading to volatility, in which investment first declines and then rises one to two years after policy uncertainty increases.

[1]See Julio and Yook (2012), Handley and Limao, (2012), Gulen and Ion (forthcoming), Fernandez-Villaverde (2015), Baker et. al. (2015).

Lastly, I conduct parameter stability tests, and find that uncertainty from European wars, government deficits, new English Monarchs, and new Mughal Emperors mattered more in the 17th and early 18th century than later.

The paper contributes to several literatures. First, it builds on a number of studies that analyze the performance of East India Companies in England and Europe.[2] While some works emphasize a link between instability and performance (e.g. Chaudhuri 1978, Watson 1980, and Lawson 1993), none have analyzed the connection theoretically and empirically. Towards that end, this paper develops a new shipping capacity series for the EIC and the Dutch Company or VOC. It also models the effects of uncertainty on investment. The results shed new light on why the EIC's trade was volatile and why it fell behind the Dutch Company before the mid 1700s.

This paper also contributes to the literature dealing with the determinants of investment, especially as they relate to political instability and uncertainty.[3] This paper is novel because it offers evidence on a historically important firm, and it analyzes the effects of different uncertainty shocks on the same investment activity over a 100-year time span. To my knowledge, it is one of the first papers to compare the effects of policy uncertainty with general uncertainty measured by stock price volatility. The paper also focuses on a firm which served as a public utility in part. Policy uncertainty is of particular relevance to this sector because it's profitability is often reliant on government subsidies and limits on

[2]See Scott (1912), Chaudhuri (1965, 1978, 1993), Sutherland (1962), Horwitz (1978), Watson (1980), Desai (1984), Carlos and Nicholas (1991), Lawson (1993), Bowen (2005), Hejeebu (2005), Robins (2006), Stern (2011), Philips (2013), Solar (2013), Erikson (2014), and Bogart (2015) for works on the EIC. See De Vries (2003, 2010), Rei (2011), Gelderblom et. al. (2013), and Dari-Mattiacci et. al. (2014) for comparative works, especially relating to the VOC.

[3]There are a number of papers that focus on the aggregate effects of political instability including Rodrick (1991), Alesina and Perotti (1996), Svensson (1998), Feng (2001), and Henisz (2002) among others. See McDonald and Siegel (1986), Caballero (1991), Rodrick (1991), Dixit and Pindyck (1994) Abel and Eberly (1994), and Bloom et. al. (2007) for theoretical models on investment and uncertainty. See Leahy and Whited (1996), Bond and Lombardi (2006), Bloom et. al. (2007), Bloom (2009), Stein and Stone (2013) for empirical analyses of uncertainty and investment. Lastly, see Julio and Yook (2012), Handley and Limao, (2012), Gulen and Ion (forthcoming), Fernandez-Villaverde et. al. (forthcoming), Baker et. al. (2015) for works specifically on policy uncertainty.

competition.[4]

There is another related literature on English institutions that is worth emphasizing. The English monarch entered into a charter and made a commitment to the EIC that it could earn monopoly profits. In return, the EIC agreed to pay special customs duties and check the influence of European rivals in Asia by investing in shipping and fortification. The narrative and econometric evidence here shows that the British government, including Parliament, could not always make credible commitments to the EIC. Political instability, emanating from contentious regime changes and fiscal crises, was a problem for British corporations during the 17th and early 18th century.[5] Also significant is the finding that public pressure played a role in determining policy uncertainty, suggesting there were broader factors influencing British institutions in this crucial period.

The results also speak to the state of Indian institutions. A number of historians argue that conflicts over Mughal succession and internecine warfare undermined property rights, and contributed to economic stagnation.[6] The paper shows there is some evidence for a connection between Indian political instability and the performance of the EIC, but the effects were mixed across different shocks.

The rest of the paper is organized as follows. Section 2 provides background on the EIC, its trade, and government relations. Section 3 provides the theoretical and empirical framework. Section 4 presents the data and section 5 discusses the results.

2 Background

The markets of the East Indies were extremely valuable to Europeans starting in the 1500s. Asian spice and textile imports could generate large profits. Europeans also had

[4]See Newberry (2002), Guasch (2004), Laffont (2005) for overviews of policies towards infrastructure.

[5]See North and Weingast (1989) and Acemoglu, Johnson, and Robinson (2005) for discussions of commitments to protect property rights. Protections of corporate rights in Britain are discussed by Carruthers (1999), Broz and Grossman (2004), Bogart (2011), Cox (2012), and Jha (2015).

[6]Dunbar (1949), Watson (1980), Clingingsmith and Williamson (2008), and Robb (2011) make this argument most forcefully. See Roy (2013) on the evolution of states and economic development in 18th century India more generally.

greater access to American silver, which was equally prized in the East Indies. To enter these markets, Europeans had to organize and have commercial and military capabilities. It was customary in the East Indies for foreigners to obtain a ruler's permission to trade. Without the backing of a company or government, traders were often denied an official audience (Dunbar 1949). Moreover, the Portuguese, who first arrived in the East Indies, relied on their naval power to drive out competitors. Thus later European traders found it advantageous to enter with well armed ships and under the banner of a company (Chaudhuri 1978).

European monarchs were also keen to have an organized trade with the East Indies. Most monarchs granted a monopoly and diplomatic support to a private company in exchange for additional tax revenues and promises of political support. The monopolies were most effective in European markets, where company ships entered the monarch's ports. It proved difficult to enforce distant entry barriers, particularly against company employees who took advantage of their position (Hejeebu 2005, Erikson 2014).

Table 1 reports the total shipping tonnages bound for Asia across European companies to show the relative positions. The Dutch and English leapfrog the Portuguese as the leaders in the early seventeenth century. But subsequently, English shipping tonnage falls behind the Dutch and remains below through the mid eighteenth century. The French, Danish, and Swedish also gain ground on the English. The turning point for English trade is after the mid eighteenth century. One contributing factor was the conquest of Bengal in the early 1760s, which brought new revenues and fostered shipping over the ensuing decades.

Table 1: East Asian bound Shipping Tonnage Among European Companies

Period	English	Dutch	Portuguese	French	Danish	Swedish	England % of Total
1581-90	0	0	55,419	0	0	0	0
1631-40	31,179	63,970	20,020	3000	4000	0	25.5
1681-90	47,879	130,849	11,650	17,500	4000	0	22.6
1731-40	67,880	280,035	13,200	53,891	12,267	7,368	15.6
1781-90	228,315	243,424	8,250	130,490	63,461	0	33.9
1820-29	859,090	178,000		168,180	22,770	6730	60.0

Source: De Vries (2003, pp. 46-49), Solar (2013, p. 649).

2.1 Government and Public Relations in England

The English East India Company or EIC had conflicted relations with governments throughout its history. The original charter in 1600 by Queen Elizabeth designated the EIC a corporate body with a governor, committees, and an assembly of shareholders; it granted a monopoly over all trade to England between the Cape of Good Hope and the Straights of Magellan, it gave the Company rights to export silver, and the use of six navy ships. The charter also specified the Monarch's rights to collect duties on imports, to recall naval ships, and to forbid trade impinging on the Monarch's foreign policy. The charter had a term of 15 years, but it contained a clause that the Monarchy could void the charter with two years notice if it was "not profitable to itself, its heirs and successors, or to the realm" (see Hill 1887).

As it turned out the EIC's charter was renegotiated several times in the seventeenth century. Notable renegotiation occurred in 1609, 1657, 1661, 1669, 1674, 1677, 1683, 1686, 1693, and 1694 (Scott 1912). Some expanded the EIC's powers. For example, the new charter of 1657 helped to reformulate the EIC as a joint stock company. But, many were accompanied by side payments or loans to the Monarch. For example, the EIC gave Charles II a silver plate worth £3,000 and his brother James, Duke of York, received £1,000 coincidental to getting a new charter in 1661. The new charter of 1677 was accompanied by loans to Charles II of £150,000 over a three year period from 1676 to 1678. Tables 1 and 2 list

all known forced loans, bribes, and fiscal impositions before 1750. The long list shows that extractions were common.

Table 2: Forced loans and repayments to the EIC before 1750

Year	Amount	Description
1641	£63,283	Charles I forces Company to give its pepper stock. £31,500 unpaid
1643	£6,000	Loan to Committee of Navy in Long Parliament. Repayment unknown
1655	£50,000	Loan to Council of State. £46,000 unpaid
1659	£15,000	Loan to Council of State. Canceled at Restoration
1662	£10,000	Loan to Charles II. Repayment unknown
1666	£50,000	Loan to Charles II. Repaid in 1667
1667	£70,000	Loan to Charles II. Repayment unknown
1676	£40,000	Loan to Charles II. Repaid in 1678
1678	£110,000	Loan to Charles II. Repaid in 1679
1698	£2,000,000	Loan to William by New East India Company. Redeemed in 1793
1708	£1,200,000	Loan to Anne. Redeemed in 1793.
1744	£1,000,000	Loan to George II. Redeemed in 1793.

Source: see Bogart (2015) for details.

Table 3: Fiscal impositions and bribes before 1750

Year	Description
1620	James I demands £20,000 payment following the Company's capture of Ormuz
1636	Duties on pepper imports increased by 70%.
1660	Gift of £4000 to Charles II and James II at Restoration
1681-88	Annual Gift to King of 10,000 guineas
1685	Additional duty of 10% on imports of Indian linens and silks
1690	Additional duty of 20% on East Indian imports
1692	Tax on 5% on value of Company's stock
1692-95	Gifts to King and Bribes to MPs estimated at £200,000
1697	Additional duty of 5% on imports of Indian linens and silks
1703	Additional duty of 5% on imports of Indian linens and silks
1730	Payment of £200,000 to government to renew charter

Source: see Bogart (2015) for details.

The English monarchy also leveraged threats by private traders known as interlopers. Interlopers petitioned to enter the EIC's market and thereby capture some of their profits. Interlopers offered loans or political support as bribes. In the end, the monarch usually sided with the EIC against the interlopers, but the process was often protracted and costly.

The most famous interloper challenge came in the late 1690s (A list of all other documented challenges by interlopers is provided in table 4 below). For several decades prior,

interlopers had been unsuccessfully lobbying the Monarch to open the East Indian trade. Matters changed in 1697 when King William desperately needed a war-time loan. The EIC offered £700,000 at 4% interest. An interloper syndicate offered £2 million at 8% interest with the expectation that they would get the EIC's monopoly. To put these figures into perspective, the net value of the EIC's assets were a little over £1 million in 1695, and its annual sales were approximately £500,000.[7] King William accepted the offer of the interlopers, partly under pressure from the Whig majority in the House of Commons. An act of Parliament in 1698 gave monopoly rights over the trade to the 'New' East India Company as of September 1701. The Old Company began a lobbying campaign to re-establish its trading rights. In 1702, the monarch approved a merger between the New and Old Companies. The merger received royal sanction in 1709 following a £1.2 million loan to Queen Anne (see Scott 1912, pp. 150-189 for details).

Table 4: Interloper challenges to the monopoly

Year	Description
1604	James I gives charter to interlopers to trade in Asia.
1607	James I gives interlopers license to discover Northern passage to Asia.
1617	James I gives Scottish East India Company charter to trade in Asia
1635	Charles I gives Courteen Association license to trade in Asia.
1637	Charles I gives Courteen Assoc. charter to trade in places with no EIC factories
1649	Assada Adventurers appeal to Council of State for voyage to Asia.
1658	Richard Cromwell gives interloper license to trade in Asia
1681	Interlopers linked to Whigs petition Charles II to form a rival joint stock company
1689	Interlopers led by Papillion petition William to dissolve EIC and incorporate new.
1695	Act of Scottish Parliament gives Darien Company license to trade in Asia .
1698	Act of Parliament authorizes new East India Company with monopoly trading rights.
1730	Interlopers petition Commons to form company licensing trade to India for a fee.
1758	Tea dealers petition Treasury for licenses to import tea from China

Source: see Bogart (2015) for details.

As illustrated by the episode with the New Company, Parliament was not always friendly to the interests of the EIC. The House of Commons made a famous declaration in 1694 that

[7] Assets and liabilities are taken from Scott, Constitutions and Finance, (1912 Vol II, pp. 123-128, 177-179). Chaudhuri (1978) provides data on export and import revenues, which together I define as sales.

"all subjects of England have equal right to trade in the East Indies, unless prohibited by act of parliament" (see Desai 1984). As a consequence, Parliament was subsequently involved in all future renegotiation involving the EIC. Together the Monarchy and Parliament renegotiated the terms of the EIC's charter again in 1712, 1730, and 1740. In two cases (1730 and 1740), parliament helped to secured additional loans or payments from the EIC to the government.

During the 1770s there were more aggressive attacks on the EIC in Parliament. It followed from the EIC's acquisition of territorial revenues in Bengal during the 1760s, which led to new sources of revenue and abuse by Company officials. The first major Act of Parliament to regulate the EIC's management came in 1773. It created a Governing Council in India with 3 of the 5 members being appointed by Parliament, and the rest by the Company. The Regulating Act of 1773 did not alter the trading monopoly, but it required the EIC to pay £400,000 annually to the government. As it turned out, the EIC did not make the annual payments due to the weakness of trade during the American Revolution. The EIC had to postpone its tax payments and even required loans from the government (Sutherland 1962, Bowen 2005).

There were further attacks on the EIC in Parliament during the 1780s. A series of governments tried to extract financial concessions and gain control over the EIC. These included Lord North's coalition in 1780, the Fox-North coalition in 1783, and Pitt the Younger's government in 1784. The latter was the most successful as it led to Pitt's India Act (1784) which brought the EIC under greater government control.

The monopoly over trade with India finally ended in 1813 through an act of Parliament. It was undone by several factors, most notably a free trade campaign led by industrialists in Liverpool and Manchester. There was also a change of government in 1812 which undermined the EIC's support in the House of Commons (Philips 2013, Bogart 2015).

The free trade campaign ending the monopoly was one of many public campaigns to

influence East Indian affairs. There was an earlier free trade campaign in the 1680s and 1690s. It coincided with the New Company's entry into the market. Most of the free trade campaigns took the form of lobbying in Parliament, as well as the publication of pamphlets and books (Cherry 1953, Pettigrew 2013). There were also movements to open the directorship of the EIC and expand the powers of shareholders. Critics, like Adam Smith, often argued that the directors made decisions which benefited themselves at a cost to investors, traders, and the public more generally (Robins 2006).

The EIC usually responded to public pressures with its own lobbying campaign. For example, the EIC's director Josiah Child (1681) wrote a treatise arguing that critics of the EIC were "sinister, selfish, and groundless." Child made a broader claim when he argued that "since the discovery of the East-Indies, the dominion of the sea depends much upon the wane or increase of that trade, and consequently the security of the liberty, property, and Protestant religion of this kingdom."

2.2 Government Relations in India

The EIC also had conflicted relations with governments in India, one of its largest markets. The EIC operated under a different charter in India, first granted by the Mughal Emperor Jahangir in 1618. It required the EIC to make annual payments in lieu of custom duties and refrain from piracy in Indian coastal waters. In return the Emperor gave the EIC official recognition. Subsequent charters gave the EIC rights to build forts and forbade unauthorized extraction from Mughal officials throughout India. As it turned out, the Mughal emperor was unable to prevent local extraction. The EIC was regularly forced to pay extra duties when entering ports or traveling up rivers. In one famous case, the Mughal governor of Bengal introduced a 5% duty on silver imports and a 3.5% duty on exports, even though the EIC's charter forbade such charges (Robins 2006). According to Watson (1980), who studied the employees of the EIC in India, the problem of extraction was widespread.

For most of its early history, the EIC paid bribes and offered presents to local officials to appease them. In the 1680s, Sir Josiah Child, the EIC's director in London, embarked on a new strategy. In the wake of a disagreement between the EIC and Bengal officials, Child ordered an attack. A war then ensued between the EIC and the Mughal emperor, in which the EIC was defeated. The EIC agreed to pay an indemnity and the emperor allowed them to resume trading in India. Child's War proved costly for the EIC, with annual outlays equal to £100,000 for a series of years (Watson 1980).

Disputes with Indian governments continued to be a problem in the eighteenth century. The EIC tried to protect itself by expanding its naval power and building fortifications in Bombay, Madras, and Calcutta. In Madras, the EIC was successful in deterring further extraction (Chaudhuri 1978, p. 120). In Calcutta, military provocation aggravated relations with local rulers. By the 1750s the EIC was in open conflict with the Nawabs of Bengal, which famously led to their acquisition of territory. A similar set of events occurred near Bombay, where the EIC challenged the Marathas and other local powers and were ultimately successful in gaining political control (Watson 1980).

Hostile relations with other European companies also posed a significant problem for the EIC in India. The Dutch and English companies had several naval battles in the Indian ocean during the 17th century. Later in the 1740s and 1750s the English and French companies fought a series of land and naval battles. While the English were ultimately victorious, conflicts were costly in terms of lost ships, resources, and trade.

2.3 Summary of the policy environment

The preceding summary of the EIC's history suggests that its privileges were sometimes violated or renegotiated and also its trade was disrupted by the actions of domestic and foreign governments. In other words, the policy environment was not always favorable to the EIC. The history also suggests an association between policy changes and regime

changes in England. Examples include the renegotiation of the charter in 1686 one year after the ascension of James II, the merger of old and new companies following the Whigs losing a majority in 1702, and the attacks on the EIC in parliament in the early 1780s when governments changed. The EIC often had connections with the Monarch or party in power and once the government changed, it lost those connections, and thus some of its protections (Bogart 2015). In India, regime changes were also a factor. Attacks by Mughal officials on EIC traders worsened in the wake of Emperor Aurangzeb's death in 1707. According to Watson (1980), Mughal officials did not regard charters with previous emperors or officials as restricting their right to charge local duties. Thus when officials or emperors changed, as often happened, the threat of extraction increased.

The history also suggest a connection between policy changes and war. The English monarch earned substantial tax revenues from the EIC's trading activity, but in times of war these ordinary revenues were insufficient. The monarch seemed to gain more by forcing loans or other financial concessions from the EIC as it did during European wars in the 1690s, 1710s, and 1740s. In India, fighting between the European Companies, and between the Mughals and regional powers clearly disrupted trade. It also created uncertainty about the future policy environment as it was unclear how the EIC's relations with Indian government's would be affected.

The influence of public lobbying campaigns was also another factor. The varying capabilities of interest groups, along with the unstable political environment in England, meant that policies towards the EIC could change, sometimes in unpredictable ways.

3 Policy uncertainty and Investment

In this section, I propose several channels by which policy uncertainty affected the EIC's investments, along with an empirical framework for testing those channels. The idea is that regime changes, wars, and increased public pressures create uncertainty about future policies. In such circumstances, the EIC could delay their investments until uncertainty is

resolved or lessened.

To fix ideas, I develop a simple model of investment. The details are shown in the appendix and are briefly summarized here. Suppose there is a potential policy change where the government can extract profits from the EIC. The government incurs some political or reputation cost if it extracts, and thus it will only do so if the expected gains in extracted profits exceed the costs. Suppose the EIC knew the government's extraction costs. As a result, it can reduce its investments and hence its profits in order to make extraction non-optimal for the government. Note that the EIC has lost some profits, but it has prevented extraction, which is a worse outcome.[8]

Now suppose there is some uncertainty about the government's extraction costs, say because of a regime change, greater lobbying by free traders, or a fiscal crisis. The EIC expects at some future date to learn about these costs. If it invests today it takes a chance that it will over-invest and become an attractive target for a low extraction cost government. If it waits, it may lose some profits but it will learn about the costs and make optimal investment decisions later. As shown in the appendix, the EIC will delay its investment if there is a high probability that the government's extraction costs are low in the future, and if it is sufficiently patient.

Once the uncertainty is resolved the EIC may continue to invest little if it learns that extraction costs are low, or they might resume (or even accelerate) investment if extraction costs turn out to be high and thus more favorable to the EIC. In sum, uncertainty about the policy environment contributes to higher volatility, and possibly lower investment overall.

[8]There is a corollary mechanism related to the risks of extraction. The EIC may reallocate its ships and mobile capital to secondary trades where it is more difficult for political authorities to extract. Reallocation to secondary markets is costly to the EIC because they yield less profit, but it may be preferable to lowering investment altogether (see the appendix for details).

3.1 Empirical Framework

The empirical framework draws on the literature studying firm-specific uncertainty and investment.[9] Many studies start with an error correction investment model which allows for a flexible adjustment of the capital stock to its long-run equilibrium. The following is a common specification which adds variables for uncertainty to the error correction model:

$$\Delta k_t = \alpha_1 + \beta_1 \Delta k_{t-1} + \beta_2 \Delta y_t + \beta_3 \Delta y_{t-1} + \beta_4 (\Delta y_t)^2 + \beta_5 \sigma_t + \beta_6 \Delta \sigma_t + \theta (y-k)_{t-1} + \varepsilon_t \quad (1)$$

where k_t is the natural log of the capital stock, y_t is the natural log of firm sales, and Δ represents the difference in variables from year t to $t-1$. σ_t and $\Delta\sigma_t$ are the level of uncertainty and changes in uncertainty in year t.[10] Uncertainty is often measured using the volatility of company stock market returns. I follow this approach below by creating a variable for the standard deviation of daily EIC stock prices over the course of a year, and the difference in the standard deviation of EIC prices from one year to the next.

In an important extension to this framework, several studies examine variables for uncertainty related to policy. Some studies use indicators for years leading up to elections, especially close elections, because they capture uncertainty about who will be making policy decisions (See Julio and Yook 2012). Others use variables for fiscal rules and capacity because it captures uncertainty about government spending and borrowing policies (See Feng 2001 and Fernández-Villaverde et. al. forthcoming). Finally, some studies use the frequency

[9] See Leahy and Whited (1996), Carruth et. al. (2000), Bloom et. al. (2007), Bond and Lombardi (2006), Fuss and Vermeulen (2008), and Stein and Stone (2013) among others.

[10] The key coefficients, β_5 and β_6, identify whether higher uncertainty or changes in uncertainty lower the growth of investment respectively. The coefficient β_1 captures dynamics, in which the growth of the firm's capital stock last year influences this years growth. The coefficients β_2 and β_3 capture the investment response to demand shocks, represented by the growth in sales. β_3 captures a convex response to sales growth. The coefficient θ is multiplied by the error correction term and measures the speed of adjustment to the long run-equilibrium. θ should be positive because when the log of sales exceeds the log of the capital stock then capital should grow to restore the long-run relationship.

of policy-related words in news media to measure uncertainty (Gulen and Ion forthcoming, Baker et. al. 2015).

Following these approaches, and drawing on the history of the EIC, I create several variables to capture various aspects of policy uncertainty. To measure regime instability, I use years where there was an election to the House of Commons, and distinguish those that changed the majority party in the Commons. I also use years where there was a change in the British monarchy and the Mughal emperor. To measure war instability, I use the ratio of government deficits to revenues, indicators for years when Britain was at war with European powers, years with wars in India involving the EIC, and years with wars among regional powers in India. Lastly, I use contemporary publications that mention the EIC and its trade as an indicator of public pressure.

Several of the variables within the regime instability, war instability, and public pressure categories are correlated with one another. Rather than treat each as independent, I construct the first and second principal components within each category. Let the first and second principle component for regime instability be $Regimeinstabilty_1$ and $Regimeinstabilty_2$. Similarly, the first and second components for war instability and public pressure are $Warinstabilty_1$, $Warinstabilty_2$, $Publicpressure_1$, and $Publicpressure_2$.

The general specification analyzed below is the following:

$$\Delta k_t = \sum_{j=1}^{2} \pi_{1j} Regimeinstability_{j,t-1} + \pi_{2j} Warinstability_{j,t-1} + \pi_{3j} Publicpressure_{j,t-1}$$

$$+\alpha_0 \cdot x_t + \alpha_1 \cdot x_{t-1} + \varepsilon_t \tag{2}$$

where Δ again represents the difference in variables from year t to $t-1$, k_t is the natural log of EIC shipping capacity, and x_{t-k} includes the variables in equation (1) as controls. The instability variables are lagged by one year $(t-1)$ because it takes time to observe and adjust investment plans. The exception is elections which are often known in advance or

can be anticipated. More general timing specifications are considered below. In particular, I include additional lags of uncertainty variables to test for investment 'rebounds.'

It is important to note that the vector of control variables x_t includes the standard deviation of EIC stock prices and the yearly difference, which are meant to capture 'general' uncertainty. Thus, the estimates of regime instability, war instability, and public pressure are not capturing unobserved shocks to the future demand and supply of EIC goods, which should be captured by the stock price volatility. As an additional control, I include the log difference between EIC and VOC shipping capacity in the previous year $t-1$. The EIC's investments should be higher when its capacity was much below the VOC. In such situations, greater investment by the EIC diminishes its capacity gap and would help to preserve or grow its market share. Specifications also include the one year lagged term for EIC and VOC capacity investment to capture dynamic effects from the previous year's investments.

It is also worth emphasizing that war can have indirect effects on investment by lowering sales. War disrupts supply chains and lowers demand for consumer goods. Notice that this indirect effect will be captured by the control variables for sales, and thus the war instability variables are designed to capture uncertainty effects.

The main identification issue concerns unobservable factors related to the uncertainty variables. While omitted variable bias is a valid concern, it is less likely to be a problem in this setting. Some histories suggest that the EIC was not a major actor in the Indian political and economic system before 1740 (Mehta 2005 p. 340). Thus for most of the period analyzed below (1661 to 1790), it is unlikely that shocks to the EIC's trade caused internal wars or regime changes in India. In Britain, the EIC had a larger relative influence, but still its trade probably did not cause wars with European powers or regime changes.

To address this issue further, I isolate exogenous changes in leaders. With the exception of the Glorious Revolution, changes in the English monarchy were caused by deaths. Deaths also explain the timing of all but one change in the Mughal emperor. Notably, however, two

Mughal emperors were murdered by their relatives in a palace coup. In one specification, I drop leadership changes in India caused by battles, murders, and coups and focus on those that came from deaths of natural causes.

Elections to the House of Commons are more concerning because the monarch could call a new election when it was dissatisfied with the present government. One possibility is the monarch called elections when the economy was struggling and thus the timing of elections may be correlated with unobservable factors that influenced EIC investment. I address this issue by making use of the Triennial act of 1694 and the Septennial act of 1716. These laws mandated elections if parliament extended beyond 3 or 7 years. Several elections after 1694 were mandated, and thus their timing was exogenous.

Another approach replaces EIC investment with VOC investment as a quasi placebo test. The VOC and EIC had similar trading activities. They both brought spices and textiles from Asia to Europe for sale. If there was a common shock to Asian supply or European demand, then one would expect that the two companies would adjust their shipping tonnage in similar ways. Thus if a policy uncertainty variable happened to be correlated with shocks to Asian supply or European demand then the coefficient should have the same sign for the EIC and VOC. If the uncertainty variable is unrelated to demand or supply shocks then the coefficient should be insignificantly related to VOC shipping growth. There is another possibility, namely that the VOC responded positively to a negative uncertainty shock hitting the EIC because it was a competitor. In this case, the coefficient should have the opposite sign for the EIC and VOC.

4 Data

The estimates of EIC shipping capacity are based on Sutton (1981) and Farrington's

(1999) ship-level data. Sutton lists 1237 ships in the service of the EIC from 1600 to 1834, including the ship name, its tonnage, number of voyages, the first and last year of the season it set sail from Britain, and its ownership status in relation to the incumbent EIC.[11] Farrington (1999) provides similar information but also includes the voyages of each ship, including all ports of call and the dates of arrival.[12] I use both sources, but the baseline series is based on Sutton because of its consistency in dating voyages and tonnage.[13] The baseline also focuses on incumbent EIC ships. Extensions add New Company and private ships.

This paper constructs the first EIC shipping capacity series using the tonnage of each ship and years of activity, which is equal to the last year of sailing minus the first year of sailing. An example illustrates the calculation. The African was a 240 ton ship which first sailed from London during the season starting in 1660 and for the last time in the season starting in 1664. I record the EIC as employing the African's 240 tons in 1660, 1661, 1662, 1663, and 1664. The same procedure is repeated for all ships in the Sutton database. More details on the distribution of tonnage and years of activity are provided in the appendix.

I also create a series for the shipping capacity of the VOC. The Dutch ship-level data comes from Bruijn, Gaastra, and Schöffer (1979) and contains tonnage and dates of all sailings.[14] I assign seasonal dates of first and last sailings to ensure comparability with the Sutton data. As shown in the appendix, the VOC capacity series ends in 1794, and begins

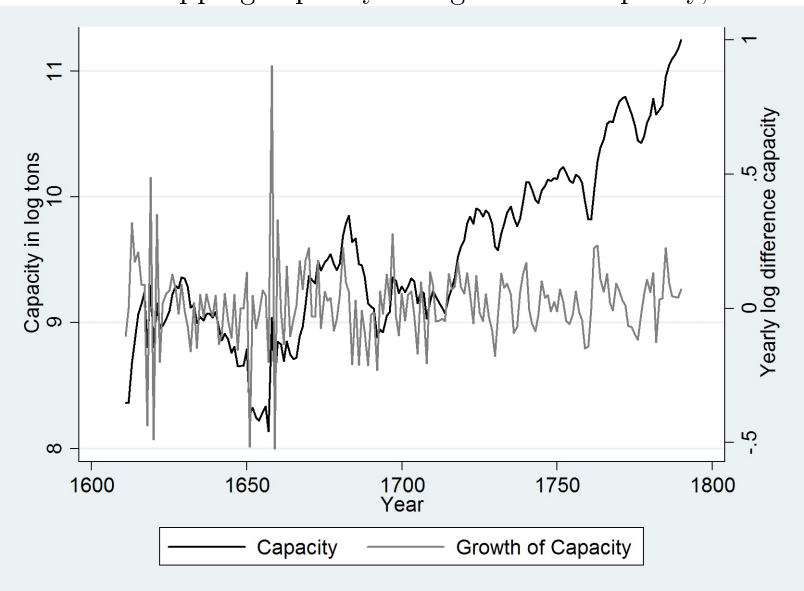
[11]Sutton (1981) relies on Krishna (1924) to identify ships from 1601 to 1672. Krishna uses a variety of sources, but in the period under study here (1660-1673) two main sources are used: Home Miscellaneous Vol. 15 and Court Book 25a (see Krishna p. 332). For 1673 to 1790 Sutton uses information from Ship Book, East India Company Records Vol. II at the British Library.

[12]I thank Emily Erikson for kindly sharing data on Farrington's data on ships and ports of call, which is used to study the behavior of captain's and discoveries of new trade (Erikson 2014).

[13]Dating is relevant because wind patterns meant that ships were outfitted in the fall and usually sailed in the winter and spring. Regardless of whether a ship sailed in December or January, Sutton dates the first or last voyage by the calendar year when the fall sailing season started. Thus one avoids assigning ships to December or January calendar years simply because of delays in outfitting or weather. Farrington's data can be organized by sailing season with additional work. Also note that Sutton reports tonnage for 98% of the ships, while Farrington reports tonnage for 83% of ships. When tonnage is missing I estimate it using the average tonnage for ships that first sailed in that year.

[14]Bruijn et al.'s data are now available through http://resources.huygens.knaw.nl/das/index_html_en

Figure 1: EIC shipping capacity and growth of capacity, 1610-1790



Source: see text.

to decline dramatically from 1791 as the VOC faced a crisis in its final years. Therefore in comparing the two companies I focus on the period before 1791.

The EIC capacity series from 1610 to 1790 is shown in black in figure 1. In gray the yearly log difference is shown. It approximates the annual growth rate of capacity, and will be the main investment variable in the empirical analysis. Notice that capacity growth exhibits high volatility before 1720. Also periods of exceptional volatility, like the 1650s, the 1690s, and early 1700s match periods where histories suggest policies were uncertain.

I create several alternative series to explore robustness. 'Net investment' is calculated as the difference between the tonnage of ships sailing for the first time, and the tonnage of ships that sailed for the last time in the previous year. I divide net investment by the stock of tonnage in the previous year to get the rate. The net investment series is further decomposed into an investment rate, the tonnage of ships sailing for the first time divided by the existing stock of tonnage, and an exit rate, the tonnage of ships that sailed for the last time in the previous year divided by the stock. I also calculate the net investment rate restricted to ships over 299 tons, in order to capture investment in larger ships that were

more specific to the East Indian trade (Solar 2013).

Three more alternative investment series are constructed. First, I add New Company and private ships to include interloper shipping capacity. Second, I add ships that are in Farrington but missing in Sutton.[15] Third, I examine voyages to identify ships that are likely to be idle based on long gaps between arriving in Britain and sailing again to Asia. The idleness adjusted capacity series is otherwise similar to the baseline series except that if a ship is idle for a sailing season, then its tonnage is not counted for that year.[16]

A summary of the investment series between 1661 and 1790 is shown in table 5. The baseline yearly log difference in capacity has a mean of 0.019 which implies an average growth rate of approximately 1.9%. The other investment series exhibit a similar average. Most are highly correlated with the baseline, with the exception of the investment rate and exit rate.

Table 5: Summary statistics for EIC investment series

Variables	Mean	Stand. Dev.	Min.	Max	Correl. w/ baseline
Yearly log diff. in capacity, baseline	0.019	0.101	-0.231	0.277	1.00
Net investment rate	0.024	0.103	-0.195	0.319	0.99
Investment rate	0.145	0.091	0	0.402	0.68
Exit rate	0.121	0.078	0	0.344	-0.53
Net investment rate, large ships	0.025	0.100	-0.203	0.319	0.95
Yearly log diff. in capacity, including NC ships	0.019	0.103	-0.231	0.357	0.94
Yearly log diff. in capacity, with utilization	0.018	0.138	-0.408	0.539	0.86
Yearly log diff. in capacity, with Farrington	0.018	0.102	-0.212	0.302	0.98
N					130

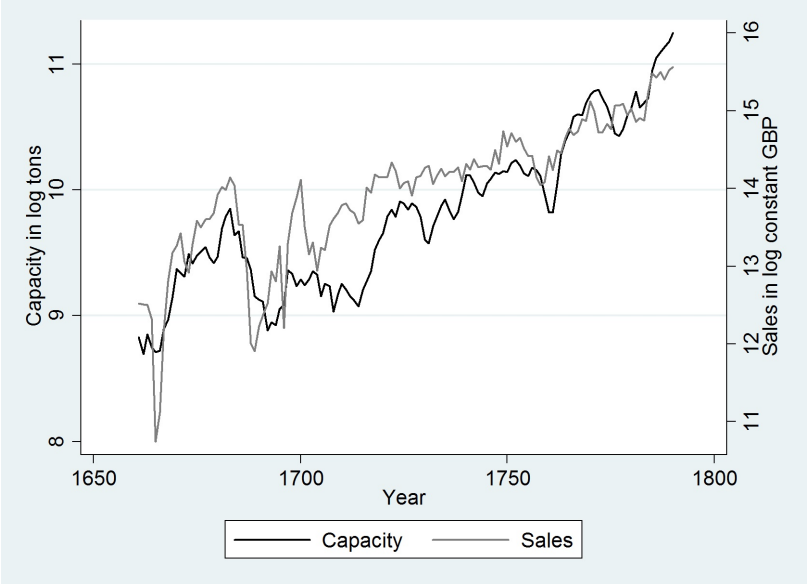
Sources: see text.

Chaudhuri (1978) provides yearly EIC revenues from imports to Britain and exports to Asia from 1660 to 1760. I sum them to get a series on total sales revenues and divide by

[15]The combined Farrington and Sutton capacity series is not necessarily better. Farrington reports more ships in the EIC service, but Farrington is more conservative in stating tonnage. Thus there may be less error using Sutton's estimates which are better on tonnage.

[16]I identified all ships in Sutton with more than two years between voyages on average. I then matched all ships in Sutton with Farrington. If a returning ship did not sail the next season, then the ship was classified as idle. A similar procedure is used for each following season until a ship sails again.

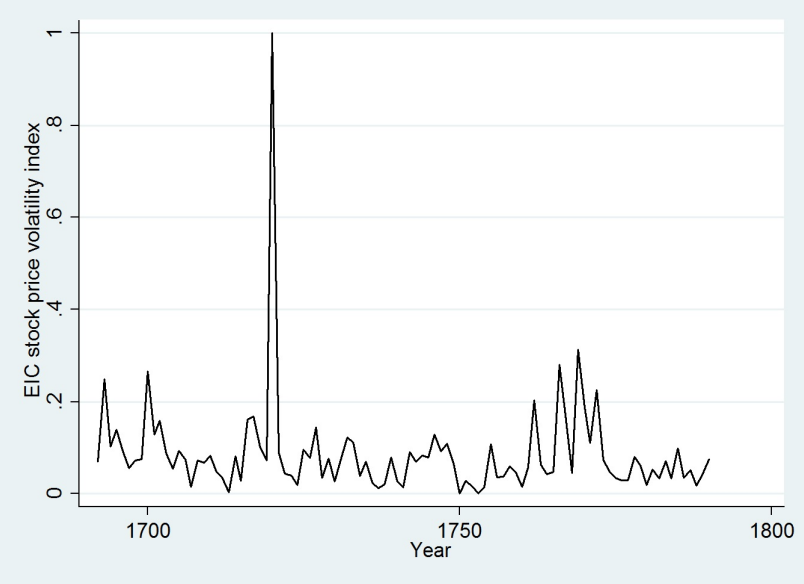
Figure 2: EIC capacity and sales in logs, 1660-1790



Source: see text.

Broadberry et. al. (2011)'s GDP deflator to construct a constant price series.[17] Unfortunately, there is no sales data for the EIC before 1660 so the fully specified investment model cannot be estimated for earlier years. After 1760 there is additional sales data to extend the analysis to 1791. Macpherson (1812, p. 419-420) provides a series on export revenues from 1710 to 1810 and import revenues from 1776 to 1810. I use the sum of these two series for sales revenues from 1776 to 1810. From 1757 to 1776 there is a series on import revenues from the sale of Indian goods in a select committee report (Great Britain, House of Common 1918). I use an index of Indian import revenues from 1760 to 1776 to link the series on import revenues from Chaudhuri and Macpherson. Together with Macpherson's series on export revenues from 1760 to 1776, I then obtain sales revenues from 1760 to 1776. Figure

Figure 3: Stock Price Volatility Index



Source: see text.

2 plots the series on EIC capacity and sales in logs. It is clear there is a close relationship.

4.1 Stock Price Volatility

Stock price volatility serves as a general measure of uncertainty. There is weekly stock price data for the EIC from 1692 to 1697 and daily stock price data from 1698 to the mid nineteenth century.[18] I calculate the standard deviation in weekly or daily stock prices over the calendar year as a measure of volatility. I then use the maximal and minimal values to create an index between 0 and 1. The trends are shown in figure 3. The peak in 1720 reflects the famous South Sea Bubble, where the EIC share price rose and then declined along with other corporations. Volatility is also high in the 1760s and 1770s when the EIC faced new government regulations, and also when it gained new revenue streams in India.

4.2 Regime instability variables

The identity of the English monarch and dates when the monarch changed are taken from standard political histories of Britain (Holmes 1993, Holmes and Szechi 1993, Evans 2014). The same sources also identify years with elections to the House of Commons.[19] I code an election that was mandated by the Triennial Act or Septennial Act if there were three legislative sessions since the last election from 1694 to 1715 and seven legislative sessions since the last election from 1716 to 1791. Before 1694 there were no mandated elections.

The identity of majority party in the Commons and elections that changed the majority party are also coded. There was a court party that held a majority in the 1660s and 1670s. The Whig party formed in the 1670s and remained cohesive from then to late 1760s. The other leading party in the same period was the Tories. It held a majority in the Commons on several occasions from 1690 to 1715. From 1660 to 1767, I classify all elections where the majority party changed from Court to Whig and then from Whig to Tory and vice versa. From 1768 to 1790 political parties were not as clearly defined, but nevertheless some elections marked a shift in the leading coalition in the Commons. I code each of these elections and combine them with elections changing the majority party from 1660 to 1767.[20]

The identity of Mughal emperors and the dates of their reign are taken from Dunbar (1949). The long reign of Aurangzeb (1656 to 1707) was followed by a period of frequent turnover in emperors in 1707, 1712, 1713, and 1719. The emperor changed again in 1748,

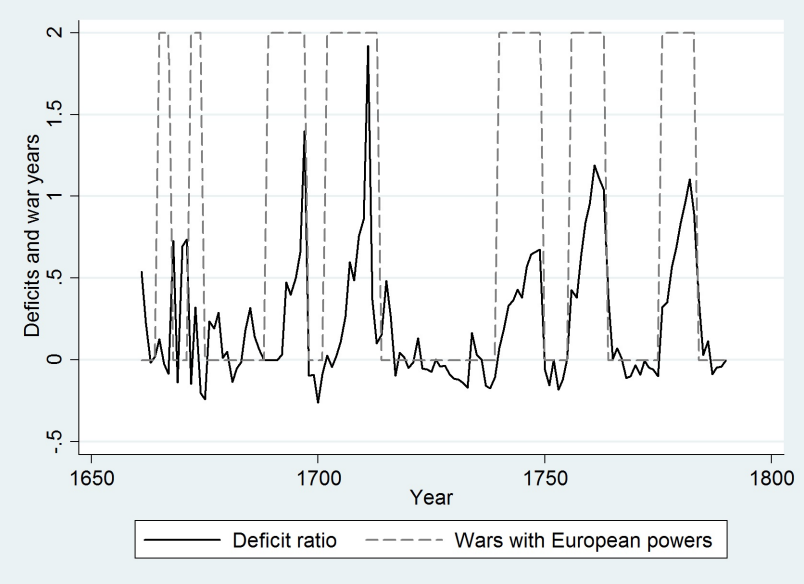
[17] Chaudhuri's import series covers 1664 to 1760 and the export series covers 1660 to 1760. From 1660 to 1663 I use an index of export revenues to estimate sales revenues. Complete data on EIC sales before 1660 is lacking, and constructing such a series requires strong assumptions.

[18] East India Company Stock price data are available from Global Financial Data, https://www.globalfinancialdata.com/index.html. There is no high frequency data on stock prices before 1692.

[19] Together there were 6 changes in the monarchy and 27 elections from 1660 to 1790.

[20] The elections of 1679, 1685, 1689, 1690, 1695, 1700, 1701, 1708, 1710, 1715, 1774, 1784 are coded as elections that brought a new majority in the Commons (see Holmes 1993, Cruickshanks, Handley, and Hayton 2002, Evans 2001)

Figure 4: Deficit Ratios and Wars, 1661-1790



Source: see text.

1754, and 1760. Notably the emperor died by natural causes only in 1707, 1712, 1748, and 1760.

4.3 War instability variables

The dates of European wars are taken from the standard histories of Britain noted above. Dincecco (2011) provides a series on the English government deficit ratio, defined as (expenditure-revenue)/revenue. Figure 4 shows the movement of deficits with each European war. The deficit ratio is close to 0 in years of peace, and large and positive in years of war. It generally rises with each year of war and peaks between 0.6 and 1.8 in the final years.

Two types of warfare in India are coded: (1) wars involving the EIC directly and (2) wars in India not involving the EIC. So-called 'EIC wars' are identified from Riddick's (2006) chronology of British India and cross referenced with Sharma (1970) another chronology. 'Internal wars in India' are identified in Jaques (2007), which provides a comprehensive listing of battles and sieges throughout the world.

4.4 Public Pressure

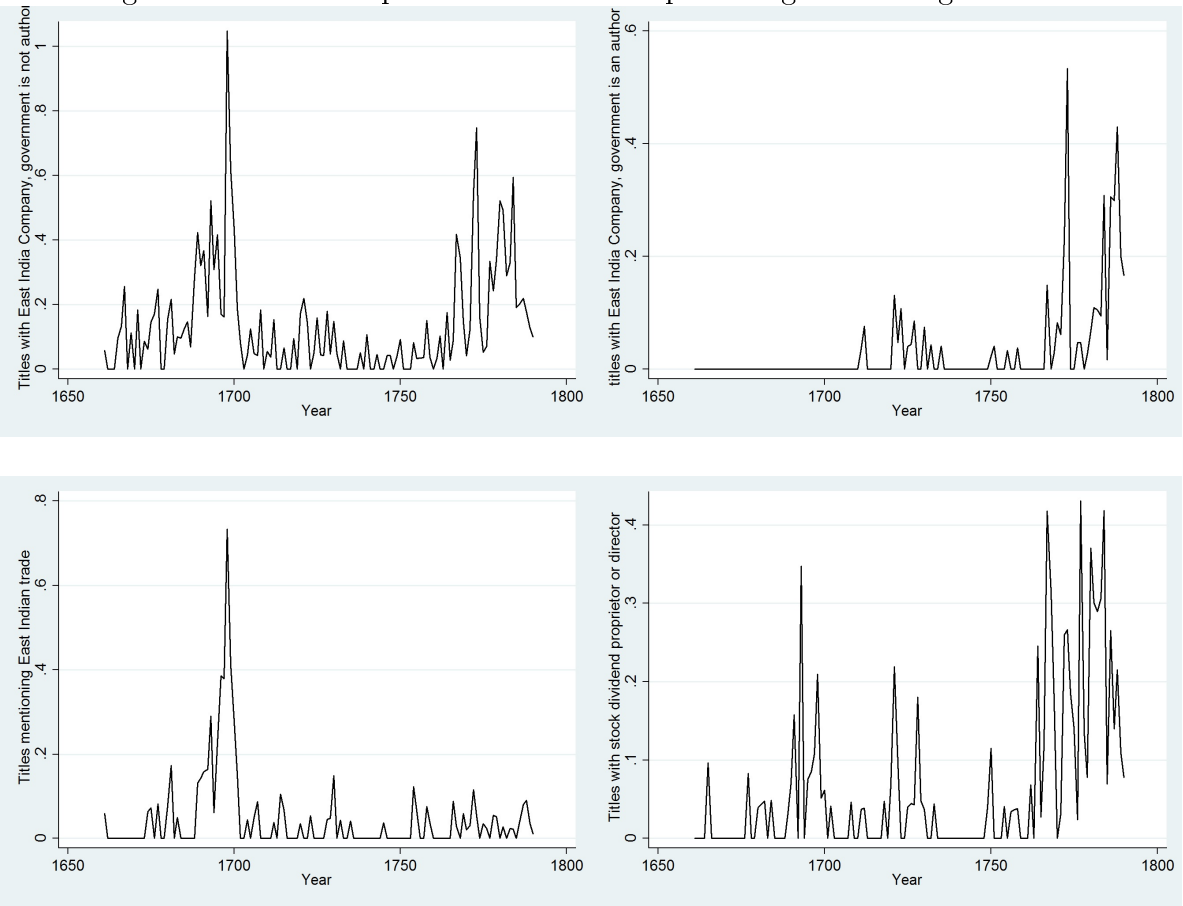
Baker, Bloom, and Davis (2015) use newspapers articles on the economy as an indicator for policy uncertainty in the US economy. I follow this approach and use counts of the number of publications related to the EIC. The English Short Title Catalog identifies the titles of all printed works from the 1500s through 1800.[21] I start by searching for all titles containing the words East India or East Indian between 1600 and 1790. After deleting repeat entries, 1284 titles remain. I then assign titles into four categories. The first category contains the words 'East India Company' and the House of Commons, Lords, or Monarch is the author. The second contains the words 'East India Company' and the government is not the author. The third contains the word 'trade.' The fourth captures financial and governance issues and contains the words 'stock' or 'dividend' or 'proprietor' or 'director.' Note that some titles were classified into more than one category. Also 258 titles did not fit any of these four categories and are not included in any series.

A few examples illustrate the four categories. The House of Commons authored the following in 1783, "Debates on Mr. Secretary Fox's bill, for vesting the affairs of the East India Company in the hands of certain commissioners, for the benefit of the proprietors and the public." An anonymous author wrote the following in 1730, "A scheme for raising £3,200,000 for the service of the government, by redeeming the fund and trade now enjoy'd by the East-India Company, and reserving to the publick an annuity of 96,000 l. for the disposition of parliament." In 1696, Robert Ferguson authored "A treatise concerning the East-India-trade: being a most profitable trade to the kingdom, and best secured and improved by a company and a joint-stock." Finally, in 1729 an unknown author published a "A letter to a director of the East-India Company."

I scale the number of EIC titles by the total number of books printed as there was an upward trend in publishing. Figure 5 shows the four series as a percentage of all publica-

[21] For the English Short title Catalog see http://estc.bl.uk. There were clearly some titles that referred to the same work but had slightly different words or characters. I dropped duplicates.

Figure 5: East India published titles as a percentage of all English titles



Source: see text.

tions. There is a common pattern in several series, but each contains some independent variation. EIC titles where the government is not the author, where trade is mentioned, and where stock, dividends, proprietor, and directors are mentioned are a high percentage in the 1690s, which was a period with much policy discussion, especially concerning the EIC's monopoly. Government authored EIC titles and mentions of stocks, dividends, proprietors, and directors are highest in the 1770s and 1780s, another period of much policy discussion.

4.5 Principal components and summary statistics

A principal component analysis was conducted for the regime instability, war instability, and public pressure variables. Details of the principal component analysis are summarized in the appendix. The first component of regime instability mainly captures British elections. The second component mainly captures changes in the English monarch and the Mughal emperor. The first component of war instability mainly captures wars among European powers, wars involving the EIC in India, and British government deficits. The second component mainly captures war in India not involving the EIC. The first component of public pressure mainly captures the series with mentions of the EIC regardless of author and mentions of dividends, stock, proprietors, and directors. The second component mainly captures mentions of East Asian trade.

Summary statistics for the six principle components, stock price volatility, and the control variables in the model are shown in table 6. Each uncertainty variable is converted to an index between 0 and 1 based on the maximum and minimum values.

Table 6: Summary Statistics for explanatory variables

	Mean	Stand. Dev.	Min.	Max	N
Panel A: Uncertainty Variables					
Regime Instability PC1	0.088	0.197	0	1	130
Regime Instability PC2	0.266	0.144	0	1	130
War instability PC1	0.317	0.267	0	1	130
War instability PC2	0.625	0.268	0	1	130
Public Pressure PC1	0.154	0.198	0	1	130
Public Pressure PC2	0.354	0.112	0	1	130
EIC Stock Price Standard Dev.	0.087	0.111	0	1	99
ΔEIC Stock Price Standard Dev.	0.000	0.150	-0.91	0.93	99
Panel B: Control Variables					
Yearly log difference in sales	0.025	0.308	-1.578	1.088	130
(Yearly log difference in sales)^2	0.095	0.285	0.000	2.490	130
Ln EIC Sales - Ln EIC Tonnage	4.146	0.453	2.030	4.826	130
Ln EIC tonnage - Ln VOC Tonnage	-1.101	0.475	-1.819	0.429	130
VOC capacity growth	0.007	0.103	-0.359	0.332	130

Sources: see text.

5 Results

The results of the baseline model using the first principle components of regime instability, war instability, and public pressure are shown in column (1) of table 7. Robust standard errors are reported throughout. Similar results were obtained using Newey-West standard errors with four lags and are available upon request. The results show a negative and significant effect from the first component of regime instability, indicating that elections were associated with lower investment. The war instability and public pressure first components show no significant effect, indicating that European and EIC-involved wars, deficits, and general discussions of the EIC, its finances, and governance are not associated with lower investment. The coefficients on the sales and capacity variables are not reported to save space. Most are significant predictors of investment as expected.[22]

[22]There is a positive effect from higher contemporaneous sales growth and its square implying that investment increases in a convex manner with sales growth. The positive sign on the lagged level of sales minus capacity points to an adjustment process where investment increases if the previous years sales were high relative to existing capacity. The results also show a negative effect on lagged EIC capacity relative to VOC

The specification in column (2) adds the second principle component for regime instability, war instability, and public pressure. The results show a negative and significant effect from the second component of public pressure, indicating greater discussion of trade is associated with lower investment. The second components for regime and war instability are negative but not precisely estimated. Thus wars in India, changes in the English monarch, and the Mughal emperor are not as clearly associated with lower investment.

Table 7: Baseline regression result

	(1)	(2)	(3)
	Coefficient	Coefficient	Coefficient
Variable	(Stand. Err.)	(Stand. Err.)	(Stand. Err.)
Regime Instability PC1	-0.099**	-0.109***	-0.109***
	(0.040)	(0.041)	(0.037)
Regime Instability PC2		-0.089	-0.031
		(0.066)	(0.063)
War instability PC1	-0.024	-0.019	0.011
	(0.032)	(0.033)	(0.034)
War instability PC2		-0.029	-0.016
		(0.032)	(0.031)
Public Pressure PC1	-0.000	0.008	0.017
	(0.053)	(0.044)	(0.037)
Public Pressure PC2		-0.174**	-0.179***
		(0.071)	(0.059)
EIC Stock Price Standard Dev.			0.233**
			(0.106)
ΔEIC Stock Price Standard Dev.			-0.109***
			(0.041)
VOC Controls	Yes	Yes	Yes
Sales and Capacity Variables	Yes	Yes	Yes
N	130	130	99
R-square	0.25	0.30	0.40

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level. The VOC controls and sales and capacity variables are described in table 6.

The specification in column (3) adds the standard deviation of the EIC's stock price and the difference in the standard deviation from the previous year. Recall these variables

capacity. This result implies that the EIC increased its investment when its capacity was low relative to its main competitor.

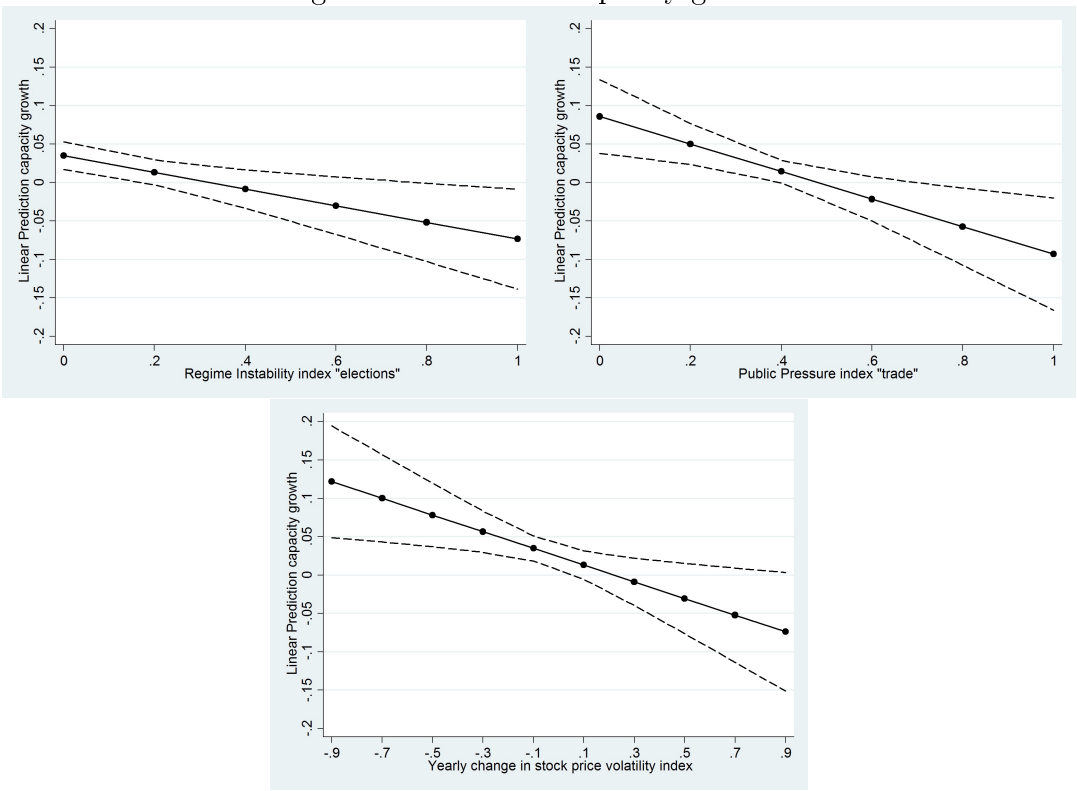
are designed to capture the level and the change in general uncertainty facing the EIC. The results show that higher stock price volatility increases investment, while the change in stock price volatility reduces it. These results are broadly in line with related studies using stock price volatility.[23] The coefficients reveal the relative magnitudes of policy uncertainty versus general uncertainty. As an illustration, suppose there was no stock price volatility in the previous year and then this year the volatility reached the maximum observed from 1690 to 1790. The change in the standard deviation of the stock price would be one and according to the estimates capacity should fall by approximately 0.11 log points. For comparison suppose that regime instability associated with elections increased from zero to its maximum of one, then the coefficient estimates imply capacity should also fall by 0.11 log points. If public pressure associated with trade increased from zero to its maximum of one then investment should fall by 0.18 log points. Thus certain forms of policy uncertainty can reduce investment by at least as much as general uncertainty.

The relative magnitudes are also shown in figure 6 below. It shows predicted capacity growth over the full range of regime instability associated with elections and public pressure associated with trade. By comparison the bottom graph shows predicted capacity growth over the full range of changes in general uncertainty measured by yearly changes in the standard deviation of stock prices. Uncertainty from public pressure has a similar negative effect as general uncertainty, while regime uncertainty is smaller in magnitude.

Dutch East India Company (or VOC) capacity growth provides useful information because it had a similar trade as the EIC but it was not directly affected by uncertainty in England. Columns (1) and (2) in table 8 replace EIC capacity growth with VOC capacity growth as the dependent variable. The second column includes stock price volatility measured in the shorter time period, 1692 to 1790. None of the uncertainty variables is significantly related to VOC capacity growth. Especially notable is that regime instability 1, public pressure 2, and the standard deviation of the EIC stock price are not significantly

[23]See Carruth et. al. (2000), Bond and Lombardi (2006), Bloom et. al. (2007).

Figure 6: Predicted Capacity growth



Notes: Dashed lines represent 95% confidence intervals. The estimates are based on column 3 in table 7.

related to VOC investment.

The third column in table 8 shows a specification where the difference between EIC and VOC capacity growth is the dependent variable. This specification puts more emphasis on the second principle component of regime instability which mainly weights changes in the English monarch and Mughal emperor. The difference lies in the VOC's mildly positive response to regime instability 2 as shown in columns (1) and (2) of table 8 and the EIC's mildly negative response as shown in table 7. The implication is that the VOC to a degree took advantage of regime changes largely affecting the EIC and expanded its capacity while the EIC to a degree decreased its capacity in response. Public pressure also contributed to the EIC's loss in relative capacity, but the effect is not precisely estimated. War instability is insignificant because it had mild negative effects on both the EIC and VOC.

Table 8: Results using the VOC capacity growth as dependent variable

	VOC	VOC	EIC-VOC
	(1)	(2)	(3)
	Coefficient	Coefficient	Coefficient
Variable	(Stand. Err.)	(Stand. Err.)	(Stand. Err.)
Regime Instability PC1	-0.037	-0.030	-0.072
	(0.036)	(0.037)	(0.058)
Regime Instability PC2	0.040	0.083	-0.129**
	(0.049)	(0.057)	(0.064)
War instability PC1	-0.011	-0.021	-0.008
	(0.041)	(0.047)	(0.061)
War instability PC2	-0.049	-0.066	0.020
	(0.040)	(0.041)	(0.058)
Public Pressure PC1	0.078	0.063	-0.070
	(0.053)	(0.058)	(0.080)
Public Pressure PC2	-0.004	0.005	-0.170
	(0.073)	(0.088)	(0.115)
Stock Price Standard Dev.		0.014	
		(0.105)	
ΔStock Price Standard Dev.		-0.099	
		(0.063)	
VOC Controls	Yes	Yes	Yes
Sales and Capacity Variables	Yes	Yes	Yes
N	130	99	130
R-square	0.10	0.12	0.12

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level. The VOC controls and sales and capacity variables are described in table 6.

Greater uncertainty has the potential to create a drop in investment and then a rebound as uncertainty is resolved and firms accelerate investment to make up for missed opportunities. It is possible that the EIC's investment similarly rebounded several years after policy uncertainty shocks. The EIC may have also anticipated some uncertainty shocks which would suggest a simultaneous response rather than a lagged response. In order to test for anticipation and rebound effects, I use the dynamic specification in equation (3). It has contemporaneous uncertainty variables along with one and two-year lags. It also includes contemporaneous and lags of the standard deviation of the EIC stock price. The controls x_t, x_{t-1}, and x_{t-2} include contemporaneous and lags of sales growth and previous EIC and

VOC capacity growth. The square of sales growth, the error correction terms, and the relative capacity of the EIC and VOC are included with only one lag as before. For simplicity, I dropped the second components for regime instability and war instability, and the first component for public pressure. The results are similar if they are included.

$$\Delta k_t = \sum_{j=0}^{2} \lambda_j Regimeinstability1_{t-j} + \sum_{j=0}^{2} \varphi_j Warinstability1_{t-j} + \sum_{j=0}^{2} \varsigma_j Publicpressure2_{t-j}$$

$$+ \sum_{j=0}^{2} \nu_j stockpriceSD_{t-j} + \alpha_0 \cdot x_t + \alpha_1 \cdot x_{t-1} + \alpha_2 \cdot x_{t-2} + \varepsilon_t \quad (3)$$

Table 9 reports the main results for the dynamic specification. Regime instability associated with elections (PC1) has a contemporaneous and one-year lagged negative effect. The second lag is positive and significant suggesting there is a rebound effect for regime instability. War instability associated with deficits and European and EIC wars (PC1) is significant and negative in its first lag and positive and significant in its second lag. Thus in the dynamic specification war instability also appears to have raised uncertainty, lowering investment in the following year and then a rebound in the second year. Public pressure relating to trade (PC2) shows a similar pattern lowering investment in the following year and then a rebound in the second year. The cumulative effects are shown at the bottom, along with the p-value for the joint significance of contemporaneous and lagged effects. Regime instability and public pressure lowered investment over all three periods, but the cumulative effects are not significantly different from zero. These findings suggest that policy uncertainty mainly created volatility in EIC investment.

Table 9: Dynamic Specification

Variable	Coefficient (Stand. Err.)	Coefficient (Stand. Err.)	Coefficient (Stand. Err.)
Regime Instability PC1 t	-0.036	Public Pressure PC2 t	0.005
	(0.032)		(0.119)
Regime Instability PC1 t-1	-0.110***	Public Pressure PC2 t-1	-0.309***
	(0.035)		(0.094)
Regime Instability PC1 t-2	0.088**	Public Pressure PC2 t-2	0.181*
	(0.039)		(0.098)
War instability PC1 t	0.063	Stock Price Standard Dev. t	0.001
	(0.054)		(0.001)
War instability PC1 t-1	-0.131**	Stock Price Standard Dev. t-1	0.002***
	(0.052)		(0.001)
War instability PC1 t-2	0.090***	Stock Price Standard Dev. t-2	-0.000
	(0.033)		(0.001)
Cumulative effect Regime	-0.058	Cumulative effect Pressure	-0.123
P-value	0.42	P-value	0.18
Cumulative effect War	0.022		
P-value	0.535		
		All Controls	Yes
N	97	R-square	0.51

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level. The VOC controls and sales and capacity variables are described in table 6.

5.1 Robustness

The robustness of the main results are examined using several alternative specifications and variables. The first set uses alternative capacity series. One adds all ships sailing to Asia in the Sutton database, including interlopers. A second incorporates idleness of capacity. A third adds ships missing in Sutton that are included in Farrington. Results for the three alternative series are reported in table 10. The specification is similar to column 3 of table 7 which includes a single lag of uncertainty variables. The conclusions are largely unchanged. The only difference is that public pressure associated with trade loses significance when interloper ships in Sutton are added. Moreover public pressure associated with the Company, its finances, and governance are positive and significant. It appears that

some pressures encouraged interloper shipping, which makes sense because the policy debate was partly about opening the market.

Table 10: Robustness I: alternative capacity growth series

	(1) All ships including NC ships Coefficient	(2) Incorporating Utilization Coefficient	(3) Add ships from Farrington Coefficient
Variable	(Stand. Err.)	(Stand. Err.)	(Stand. Err.)
Regime Instability PC1	-0.100***	-0.159***	-0.107***
	(0.033)	(0.043)	(0.030)
Regime Instability PC2	-0.035	-0.014	-0.037
	(0.062)	(0.072)	(0.051)
War instability PC1	-0.005	0.008	0.008
	(0.036)	(0.039)	(0.036)
War instability PC2	0.004	0.008	-0.022
	(0.031)	(0.035)	(0.031)
Public Pressure PC1	0.068*	-0.064	0.005
	(0.036)	(0.052)	(0.036)
Public Pressure PC2	0.053	-0.111*	-0.110**
	(0.050)	(0.061)	(0.046)
EIC Stock Price Standard Dev.	0.191*	0.197**	0.202**
	(0.097)	(0.098)	(0.096)
ΔEIC Stock Price Standard Dev.	-0.075**	-0.090**	-0.095**
	(0.036)	(0.043)	(0.036)
VOC Controls	Yes	Yes	Yes
Sales and Capacity Variables	Yes	Yes	Yes
N	99	99	99
R-square	0.46	0.40	0.41

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level. The VOC controls and sales and capacity variables are described in table 6.

The next set of robustness checks examines another alternative to capacity growth: investment rates. Column 1 in table 11 uses the net investment rate as the dependent variable and finds similar patterns. These results are to be expected as the net investment rate is very similar to the growth of capacity. Column 2 replaces the dependent variable with the net investment rate for large ships only (more than 299 tons). The results are very similar, suggesting there is no evidence that uncertainty affected larger, or more asset specific ships.

Columns 3 and 4 report specifications that use investment rates and exit rates as the dependent variable. They show that greater regime instability lowered investment rates, but not exit rates. Public pressure associated with trade is positively and significantly related to the exit rate, but not the investment rate. The last result suggests that in part the EIC responded to greater uncertainty associated with discussion of trade by scrapping ships or by redeploying them to other trades. Another interesting result concerns war instability associated with deficits and European and EIC conflicts (PC1). It raises the investment and exit rate. The positive effect is perhaps surprising. It is likely that the EIC anticipated more risks for their ships in times of war and thus they invested more to protect their cargo.

Table 11: Robustness II: Investment rates

	(1)	(2)	(3)	(4)
	Net invest rate	Net invest rate	Invest rate	Exit rate
	all ships	large ships	all ships	all ships
	Coefficient	Coefficient	Coefficient	Coefficient
Variable	(Stand. Err.)	(Stand. Err.)	(Stand. Err.)	(Stand. Err.)
Regime Instability PC1	-0.111***	-0.095***	-0.090***	0.022
	(0.035)	(0.031)	(0.029)	(0.032)
Regime Instability PC2	-0.038	-0.036	-0.027	0.006
	(0.064)	(0.056)	(0.067)	(0.041)
War instability PC1	0.013	0.015	0.054*	0.042**
	(0.036)	(0.035)	(0.031)	(0.021)
War instability PC2	-0.019	-0.023	-0.027	-0.011
	(0.032)	(0.031)	(0.028)	(0.022)
Public Pressure PC1	0.014	0.006	0.035	0.013
	(0.039)	(0.037)	(0.041)	(0.033)
Public Pressure PC2	-0.187***	-0.185***	0.036	0.224***
	(0.061)	(0.061)	(0.058)	(0.056)
EIC Stock Price Standard Dev.	0.238**	0.222**	0.227**	0.016
	(0.107)	(0.108)	(0.088)	(0.066)
ΔEIC Stock Price Standard Dev.	-0.115***	-0.076*	-0.049	0.046
	(0.041)	(0.038)	(0.043)	(0.045)
VOC Controls	Yes	Yes	Yes	Yes
Sales and Capacity Variables	Yes	Yes	Yes	Yes
N	99	99	99	99
R-square	0.41	0.44	0.49	0.41

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

The VOC controls and sales and capacity variables are described in table 6.

In any analysis of a long-time series, there is a concern that the parameter estimates are not stable. In this setting, one could argue that conditions changed after 1760 when the EIC gained territory in India and the Mughal Empire disintegrated. After mid-century, British political and fiscal institutions also arguably evolved and perhaps made the policy environment more stable. To investigate parameter stability, I also estimate the baseline model restricted to years before 1761. Column (1) in table 12 does not include stock price volatility. One finding is that both components of regime instability associated with elections and changes in the Monarch and Emperor are now negative and significant. Also the first component of war instability associated with European and EIC wars, and British government deficits is negative and significant. Lastly, public pressure from trade now has a negligible effect.

In column (2) of table 12 the stock price volatility variables are added. In this specification, the second component of regime instability and the first component of war instability lose their significance. It is not immediately clear whether changes in the estimates reflect the different sample (observations from 1662 to 1692 are dropped) or the addition of the stock price volatility variables. To address this issue, column (3) includes observations from 1693 to 1760 but drops the stock price volatility variables. The coefficients are very similar to column (2) indicating that it is mainly the restricted sample (1693 to 1760) which reduces the effect of war instability and regime instability in column 2.

Overall the parameter stability tests suggest some further conclusions. First, regime changes involving the Monarchy and Emperor could have negative effects on investment. The same is true of European wars and their associated fiscal strains. But their effects seem to be isolated to the period before 1760. One possibility is that British and Indian institutions were different in that period. Second, public pressures associated with trade had stronger effects after 1760. This is interesting because it suggests critics of the EIC, like

Adam Smith, were more prominent in this period in generating policy uncertainty.

Table 12: Robustness III: Observations restricted to years before 1761

	(1)	(2)	(3)
	Coefficient	Coefficient	Coefficient
Variable	(Stand. Err.)	(Stand. Err.)	(Stand. Err.)
Regime Instability PC1	-0.109**	-0.116***	-0.122***
	(0.050)	(0.043)	(0.042)
Regime Instability PC2	-0.152**	-0.055	-0.052
	(0.059)	(0.063)	(0.060)
War instability PC1	-0.083**	-0.063	-0.068*
	(0.037)	(0.041)	(0.040)
War instability PC2	-0.032	-0.035	-0.031
	(0.038)	(0.044)	(0.044)
Public Pressure PC1	-0.143	-0.089	-0.073
	(0.097)	(0.084)	(0.082)
Public Pressure PC2	0.041	-0.039	-0.037
	(0.125)	(0.116)	(0.110)
EIC Stock Price Standard Dev.		0.174**	
		(0.073)	
ΔEIC Stock Price Standard Dev.		-0.129***	
		(0.048)	
Years in sample	1662-1760	1693-1760	1693-1760
VOC Controls	Yes	Yes	Yes
Sales and Capacity Variables	Yes	Yes	Yes
N	99	68	68
R-square	0.36	0.46	0.21

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level. The VOC controls and sales and capacity variables are described in table 6.

Another robustness check examines the effects of individual uncertainty variables rather than using the principle components. The results are reported in table 13 using the sample period 1693 to 1791. The first set of regime instability variables, new monarchs, and new Mughal Emperors, are not significantly related to lower investment, which is consistent with earlier results. Note that changes in the Mughal emperor caused by natural deaths have a different effect than any type of change in the Emperor, but again the differences are not precisely estimated. Some of the election variables are negatively related to investment, consistent with what was found with the first component of regime instability. The most

significant are those that were mandated and changed the majority party. Mandated elections are particularly revealing because their timing was fixed. Among the war instability variables none stands out, again consistent with the earlier results. The deficits variable is the closest to being negative and significant. The EIC titles that discuss trade had the largest negative effect on investment, consistent with what was found earlier for the second component of public pressure. The general conclusion is that instability in parliamentary politics and public pressure reduced investment. These results coincide with several studies which show a negative effect from elections and higher news based measures of uncertainty (e.g. Julio and Yook 2012, Gulen and Ion forthcoming, Baker et. al. 2015).

Table 13: Robustness IV: Individual uncertainty variables

Variable	Coefficient (Stand. Err.)	Coefficient (Stand. Err.)	Coefficient (Stand. Err.)
New English monarch	-0.004	EIC wars in India	-0.008
	(0.037)		(0.018)
New Mughal emperor	-0.089	Internal wars in India	-0.003
	(0.058)		(0.019)
New Mughal emperor, natural deaths	0.052	Titles, govt. not an author	0.042
	(0.064)		(0.083)
Elections	0.028	Titles, govt. an author	0.121
	(0.025)		(0.088)
Elections mandated	-0.048	Titles, trade	-0.222*
	(0.039)		(0.113)
Elections mandated & change party	-0.100**	Titles, stock, dividend, etc.	0.070
	(0.038)		(0.100)
Deficit ratio	-0.044	Stock Price Standard Dev.	0.277***
	(0.082)		(0.103)
War with Euro. power	0.023	ΔStock Price Standard Dev.	-0.099**
	(0.028)		(0.042)
		All Controls	Yes
N	99	R-square	0.46

Notes: Robust standard errors are reported. *, **, *** indicates statistical significance at the 10%, 5%, and 1% level. The VOC controls and sales and capacity variables are described in table 6.

Several other specifications were run which included more explanatory variables. Adding dummy variables for each Emperor, Monarch, and political party in power does not change

the main results. Moreover, none of these regime controls is significant. Adding the tax to GDP ratio as another control does not change the main results, and is not significant.[24] Adding a variable for English naval capacity in absolute and relative terms to other European powers does not change the earlier conclusions either (see Modelski and Thompson 1988 for data). But these results show that higher relative naval capacity reduced EIC capacity growth, suggesting that the British Navy acted as a substitute for the EIC's navy. Adding indicators for changes in Indian provincial rulers also does not change the main results.[25] One interesting finding is that EIC investment was higher following changes in the Nawab of Bengal. One explanation is that local instability in India created expectations of greater military and trading opportunities for the EIC.

6 Conclusion

The English East India Company or EIC received valuable trading privileges from governments in England and India, but at times it operated in an uncertain policy environment due to wars, conflicts with governments, and public pressures. This paper examines whether policy uncertainty lowered the EIC's investments in shipping capacity. It creates a new time series on shipping capacity from the early 1600s to the early 1800s. It also develops new measures of policy uncertainty drawing on the historical and economics literature. The main results show that greater regime instability associated with elections to the House of Commons and greater public pressure in England associated with trade issues significantly lowered EIC investment. Their effects are comparable to changes in stock price volatility

[24] O'Brien and Hunt (1993) provide a series on central government tax revenues. It includes the sum of direct taxes (mostly land), indirect taxes (customs and excise), earnings from the mint, and earnings from Crown assets. Loans are not included. I divide the O'Brien and Hunt tax revenue series by Broadberry et. al. (2011)'s GDP series to create a tax to GDP ratio. The tax to GDP series exhibits the well known rise after the Glorious Revolution of 1688.

[25] I included the years with a new Nawabs of Bengal, new Nawabs of Carnatic, new Maratha leaders including the Peshwas. Dates are taken from Dunbar (1949), Walsh (2006), and Robb (2011).

which also lowered investment.

The paper builds on a number of studies that analyze the performance of East India Companies in England and Europe. The results shed new light on why the EIC's trade was volatile and why it fell behind the Dutch Company before the mid 1700s. This paper also contributes to the broader literature dealing with policy uncertainty and investment. It is novel in analyzing one of the world's most important corporations over a 100-year period, and it compares the effects of policy uncertainty with general uncertainty measured by stock price volatility. It also focuses attention on public utilities, which are particularly sensitive to policy uncertainty. Lastly, the narrative and econometric evidence here shows that the British government, including parliament, could not always make credible commitments to the EIC. Contentious regime changes and fiscal crises were a problem for early corporations in Britain. Public pressure was another factor, and from the perspective of the EIC, it contributed to a more uncertain policy environment.

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7 Appendices

7.1 Theoretical appendix I: Investment and extraction risks

Government extraction of EIC profits is related to the commitment problem, well known in the theoretical literature.[26] The idea is that absent effective constraints, rulers have an incentive to extract profits from firms. Extraction undermines incentives for investment because the more a firm invests, the more profits it generates, and the more is extracted by the ruler. This section shows presents a simple model of the commitment problem and then includes it in a policy uncertainty setting in the following section.

Consider a three period model. In period 1, the EIC decides on the number of ships s to hire and send to Asia for trade. In period 2 the monarch decides whether to renegotiate the charter, and if so how much to demand in payments e from the EIC. If there is no renegotiation in period 2, then in period 3 the EIC's orders its s ships to return to England with cargo and it earns $\pi(s)$ profits, where $\pi(\cdot)$ is the profit function. With no renegotiation, the monarch extracts nothing from the EIC but it gets $u(g)$ where $u(\cdot)$ is the monarch's utility function from money and g is the monarch's ordinary tax revenue. If there is renegotiation in period 2, then the EIC decides whether to return its ships with their cargo. If the ships return the EIC earns $\pi(s) - e$ in profits. If ships do not return the EIC dumps the cargo in the sea and earns zero profits (dumping can be relaxed). If the EIC returns its cargo then the monarch gets $u(g + e) - f$ in utility, where f is the monarch's cost of renegotiating the charter. One component of f is the loss in reputation from violating the EIC's privileges. In

[26] See Person and Tabellini (2002, ch. 12) for a review of the literature on commitment problems.

the future firms will not invest as much and the monarch will lose revenues. Offsetting the reputation loss there may be political gains because the EIC was a controversial company. One could also think of structural components coming from the strength of checks and balances. If the monarch has to spend much time and resources convincing parliament or the courts that it has the right to renegotiate then f will be higher. Lastly, note that if the EIC dumps its cargo in the sea the monarch gets $u(g) - f$ in utility, in which case it extracts nothing but it still suffers the costs of renegotiating.

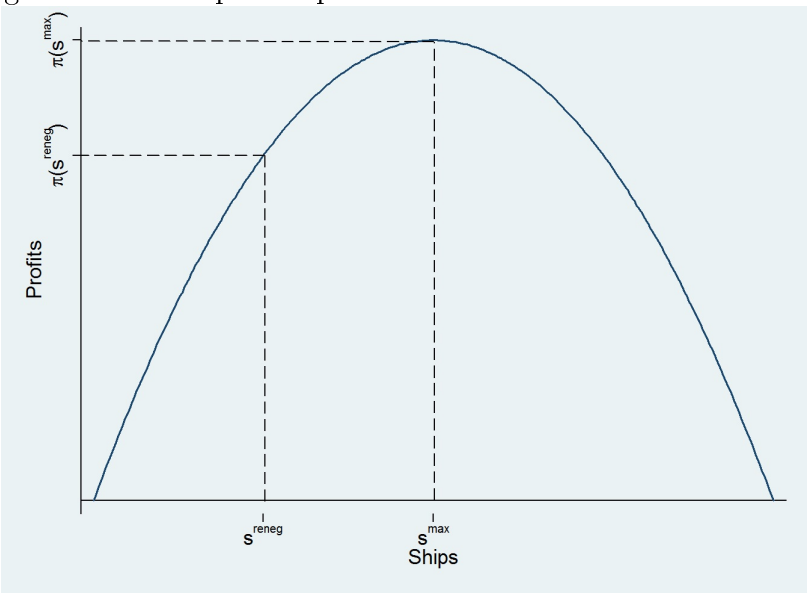
A few assumptions make the analysis easier. The profit function $\pi(\cdot)$ is assumed to be continuous and differentiable in s. It achieves its maximum at s^{max}, which is the number of ships the EIC would choose if there was no threat of extraction. I also assume that the utility $u(\cdot)$ is increasing and concave in g and e . The monarch always likes more money, but at a diminishing marginal utility. I also assume that if the monarch's expected utility from renegotiating and extracting is the same as not renegotiating, then it prefers not to renegotiate. This implies ties go in favor of honoring the charter.

The model is solved using backward induction. Suppose in period 3 there has been no renegotiation and the EIC has hired s ships. The EIC will return its ships and earn $\pi(s)$. There is no reason to dump. If there is renegotiation the EIC returns its cargo only if $\pi(s) - e \geq 0$. If $\pi(s) - e < 0$ it is better to dump and earn zero profits.

In period 2 suppose the monarch decides to renegotiate. Its utility will be $u(g + e) - f$, which implies it will demand $e^* = \pi(s)$ in payments. Demanding less than $\pi(s)$ will lower the monarch's utility and demanding more than $\pi(s)$ will lead to dumping and a zero payment for the monarch. The monarch will choose to renegotiate in period 2 if its utility from renegotiating is strictly higher than not, or $u(g + \pi(s)) - f > u(g)$. Notice there is a minimum number of ships at or below which the monarch will not renegotiate. Let the minimum number s^{reneg} be defined by the equation $u(g + \pi(s^{reneg})) - f = u(g)$.

Turning to period 1, the EIC chooses its optimal shipping capacity s^*. The EIC will choose a capacity such that $s^* \leq s^{reneg}$ because otherwise it expects the monarch to demand $e^* = \pi(s)$ in payments and the EIC earns zero profits. There are two potential outcomes depending on the maximal capacity s^{max} under no threat of extraction. If $s^{max} < s^{reneg}$ then the EIC will choose $s = s^{max}$ because at any other capacity it earns lower profits by definition. If $s^{max} \geq s^{reneg}$ then the EIC will choose $s = s^{reneg}$ because it expects the monarch will not renegotiate and that it will earn profits $\pi(s^{reneg})$. The choice of ships is illustrated in figure 7 when $s^{max} \geq s^{reneg}$. The EIC invests in fewer ships and earns lower profits than if they faced no threat of extraction. If f or g increases then s^{reneg} will shift to

Figure 7: EIC ships and profits under the threat of extraction



the right in figure 7.[27] In other words, increasing the monarch's tax revenue and the costs of renegotiation raises the minimum number of ships at or below which the monarch will not renegotiate. Lower f or g has the opposite effect.

An extension of the model considers whether the EIC redeploys its existing fleet in response to a change in f and g. Suppose that in period 1 the EIC has a fleet of ships s^f moving cargo from Asia to England. The existing fleet is assumed to be the EIC's best response to f and g in previous years. Now suppose there is a change lowering f. Let $s^{reneg} < s^f$ be the optimal number of ships given the new environment, which implies that the EIC expects some extraction if it maintains operations. In the model above, there is nothing the EIC can do but dump its cargo, but now suppose the EIC can redeploy some proportion of its fleet to trade elsewhere, like the trade within Asia, known as the country trade. Suppose the EIC earns a profit $r(s)$ from redeployment, but that $0 < r(s) < \pi(s)$ for all $s < s^f$ and $r'(s) < \pi'(s)$ all $s < s^f$. In other words redeployment always earns less profits at the margin absent the threat of extraction. The main advantage of redeployment is that the monarch cannot extract profits from the country trade as it does not arrive in England. Thus when there is a change lowering f or g, the EIC will adjust its Asian-

[27] The reason is that $\partial s^{reneg}/\partial f > 0$ and $\partial s^{reneg}/\partial g > 0$. To see this let $I = u(g + \pi(s^{reneg})) - f - u(g)$. By the implicit function theorem, $\partial s/\partial f = \frac{-\partial I}{\partial f}/\frac{\partial I}{\partial s} = 1/[\frac{\partial u(g+\pi)}{\partial \pi} + \frac{\partial \pi(g)}{\partial s}]$. The denominator is positive because $u(\cdot)$ is increasing in profits and $\pi(\cdot)$ is increasing in ships if $s \leq s^{max}$. Similarly $\partial s/\partial g = \frac{-\partial I}{\partial g}/\frac{\partial I}{\partial s} = [\frac{-\partial u(g+\pi)}{\partial g} + \frac{\partial u(g)}{\partial g}]/[\frac{\partial u(g+\pi)}{\partial \pi} + \frac{\partial \pi(g)}{\partial s}]$. The numerator is positive because of the concavity of $u(\cdot)$. The denominator is positive as before.

European fleet to $s^a = s^{reneg}$ and its redeployed fleet is $s^r = s^f - s^{reneg}$. The EIC's profit becomes $\pi(s^{reneg}) + r(s^f - s^{reneg})$. It exceeds the alternative of zero profits when the EIC maintains its Asian-European fleet at $s^a = s^f$, or $\pi(s^{reneg})$ if it dumps the cargo from $s^f - s^{reneg}$ ships. The main implication is that changes in f or g may lead to the exit of ships from the Asian European trade due to increased risks of extraction. Following the same logic, the EIC might also choose to leave some of its ships idle, saving operating costs.

7.2 Theoretical appendix II: Investment under Policy Uncertainty

The following theoretical framework illustrates the EIC's decision whether and how much to invest under policy uncertainty.[28] I focus on uncertainty over the costs of renegotiation but there could also be uncertainty about the monarchs tax revenues g which will produce similar results. Suppose that in period 1 the EIC has an opportunity to hire ships and it believes with probability p the renegotiation cost will be f^l and with probability $1-p$ the cost will be f^h, where $f^l < f^h$. Intermediate values of p like 0.5 are meant to capture the most uncertainty. The reason is that in period 2 the probability p becomes 0 or 1 and the variance disappears. Supposing that the EIC knew the monarch's costs with certainty its optimal number of ships would be s^l when $f = f^l$ and s^h when $f = f^h$. In each case it earns just enough profits not to be extracted. To simplify notation let the EIC's profits under certainty be denoted π^l and π^h, corresponding to $\pi(s^l)$ and $\pi(s^h)$.

It can be shown that if the EIC hires ships in period 1 it will choose either s^l or s^h.[29] If it chooses s^l it earns π^l no matter what happens. If it chooses s^h it earns π^h with probability $1-p$ and zero with probability p because all its profits get extracted when the renegotiation costs are low. Deciding between these two choices the EIC will hire s^l ships if $\pi^l \leq (1-p)\pi^h$ and otherwise it will hire s^h ships. Rearranging terms implies it will hire s^l if the probability p exceeds some threshold $p^l = 1 - \frac{\pi^l}{\pi^h}$. Less ships is preferable if the probability of the bad state (low renegotiation costs) exceeds the relative difference between high and low profits.

The EIC also has the choice to delay in period 1, learn the costs of the monarch, and then hire ships in period 2. At that point the EIC will choose its optimal number of ships s^l when $f = f^l$ and s^h when $f = f^h$. From the perspective of period 1, the option value of delaying investment is the discounted expected profits that the EIC will receive, or $\beta p\pi^l + \beta(1-p)\pi^h$,

[28] See McDonald and Siegel (1986), Caballero (1991), Dixit and Pindyck (1994), and Abel and Eberly (1994) for theoretical models on uncertainty.

[29] The expected profits are π^l if $0 < s \leq s^l$,$(1-p)\pi^h$ if $s^l < s \leq s^h$, and 0 if $s^h < s$. Thus they are maximized at two ship choices: s^l or s^h

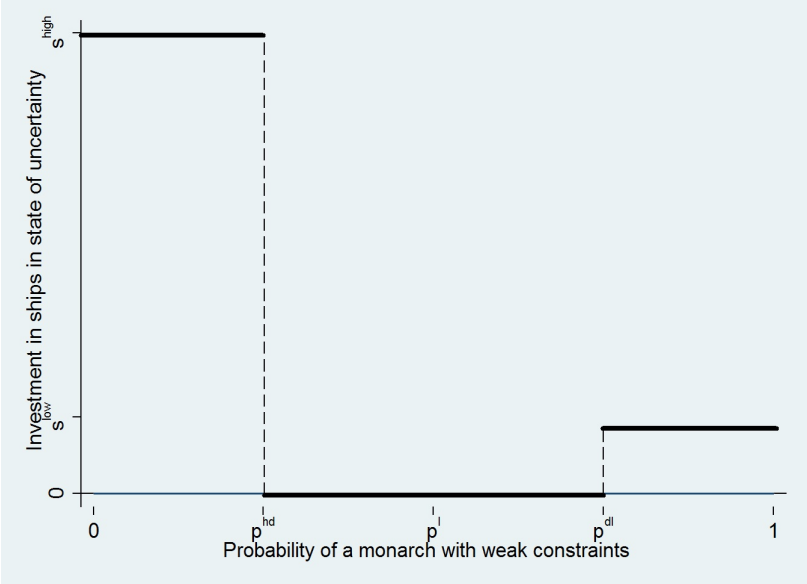
where β is the time discount factor. Notice there is an assumption here that the EIC has the same investment opportunity in period 2. Also investment is irreversible so that if ships are hired in period 1; they cannot be scrapped at full value and hired again in period 2. Both of these assumptions appear reasonable as the EIC was a monopoly and its sailings were largely irreversible. The qualification is that ships could be redeployed at some loss in profits as I argued above.

Drawing on the theory of investment under uncertainty, the EIC will choose to hire ships in period 1 if the expected profits at that time exceed the option value from delaying. As its expected profits in period 1 depend on p, π^l , and π^h there are two different scenarios. In scenario 1, $p \geq p^l$ and the EIC's expected profits are π^l because it never gets extracted. It can be show that the expected profits π^l are higher than option value of delaying $\beta p\pi^l + \beta(1-p)\pi^h$ if and only if the probability p exceeds some threshold $p^{dl} = \frac{\beta\pi^h - \pi^l}{\beta\pi^h - \beta\pi^l}$. I refer to the threshold as p^{dl} because it marks the probability at which the EIC shifts from delaying to hiring s^l in period 1. Notice that p^{dl} rises with higher values of β. Delaying becomes more attractive with greater patience all else equal. In scenario 2, $p < p^l$ and the EIC's expected profits are are $(1-p)\pi^h$. The expected profits are higher than the option value if and only if $p < p^{hd} = \frac{(1-\beta)\pi^h}{(1-\beta)\pi^h - \beta\pi^l}$. Here the threshold probability for delaying as opposed to investing in more ships increases with higher values of β.

Fixing the values of π^l and π^h there are different investment outcomes in period 1 across two or three regions for the probability. The three region case occurs when the EIC is sufficiently patient that delaying becomes a strategy. Otherwise it always invests low or high numbers of ships in period 1.[30] Figure 8 illustrates the three region case. For probabilities $p < p^{hd}$ the EIC will invest in the higher number of ships in period 1. Going with more ships is preferable because the bad state (low renegotiation costs) is unlikely. For $p^{hd} < p < p^{dl}$ the EIC does not invest in period 1 and delays its decision to period 2. Here the level of uncertainty is high so there is value in delaying. For $p \geq p^{dl}$ the EIC invests in low numbers of ships in period 1 because the bad state is likely.

[30] There is a third region if $p^{dl} > p^l$. After rearranging this occurs when $\frac{\pi^l \pi^h}{2\pi^h\pi^l - (\pi^l)^2} < \beta$ or when patience is high.

Figure 8: Investment in EIC ships under uncertainty



7.3 Principal Components and Figures for key variables

Appendix tables 1, 2, and 3 show the results of the Principal component analysis.

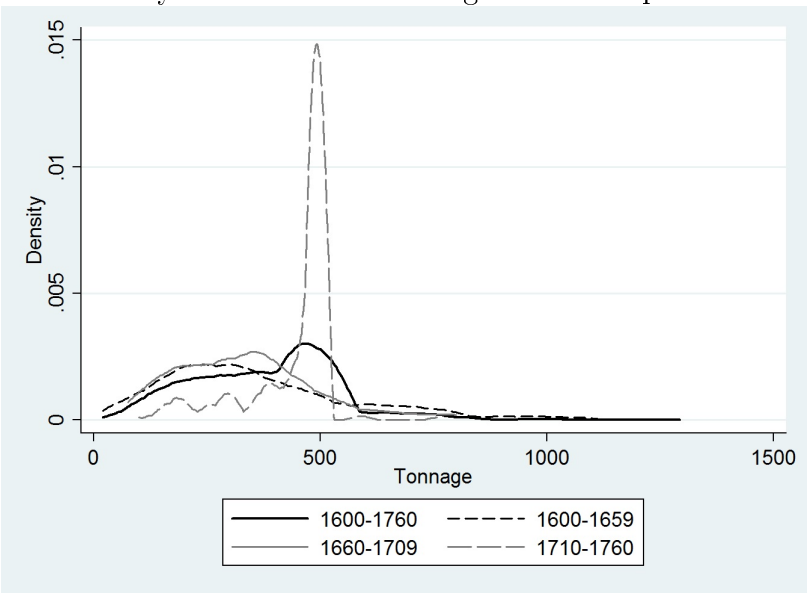
Appendix table 1: Principal Component Analysis

Variable	Regime Instability PC1 Eigenvectors	Regime Instability PC2 Eigenvectors
New English monarch	.071	.843
Elections mandated	.613	-0.065
Elections mandated change party	.491	-0.242
Elections	.547	-.058
New Mughal emperor	.278	0.471
Eigenvalue	2.146	1.063
Difference	1.082	.195
Proportion	.429	.212
Cumulative	.429	.642
Variable	**War Instability PC1 Eigenvectors**	**War Instability PC2 Eigenvectors**
Deficit ratio	.655	-.271
War with Euro. power	.652	-.001
EIC wars in India	.362	.186
Internal wars in India	.117	.944
Eigenvalue	1.676	1.027
Difference	.649	.127
Proportion	.419	.256
Cumulative	.419	.675
Variable	**Public Pressure PC1 Eigenvectors**	**Public Pressure PC2 Eigenvectors**
Titles, govt. not an author	0.610	0.213
Titles, govt. an author	0.420	-0.588
Titles, trade	0.372	0.729
Titles, stocks, dividends, etc.	0.559	-0.275
Eigenvalue	2.258	1.111
Difference	1.147	.657
Proportion	0.564	0.277
Cumulative	0.564	0.842
N		130

Notes: For definitions of variables see data section.

The following graphs show kernel density estimates for the tonnage and years of activity for EIC ships. Several points are worth noting about the distribution of tonnage across ships from 1600 to 1760. Tonnage is disperse over the period from 1600 to 1760, but much tighter around 499 tons from 1710 to 1760. There are two reasons. One is that ships got larger

Figure 9: Kernel Density Estimates for Tonnage of EIC ships in Sutton, 1660-1760



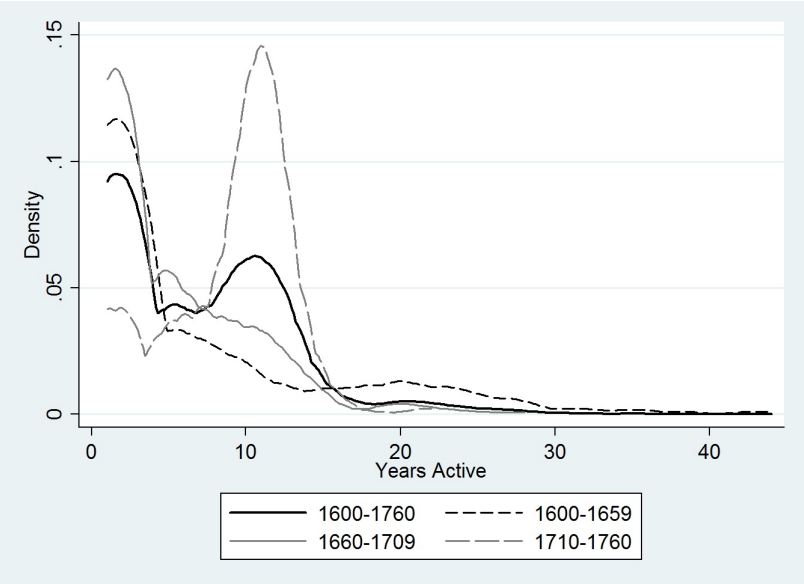
Source: see text.

on average over time. Second, there was a requirement to employ a chaplain on ships over 500 tons and many EIC ships were registered just under 500 to avoid this regulation. The size of ships is significant because larger ships are more specific to the Asian trade as most coastal and Atlantic ships were under 300 tons.

There are two peaks in the distribution of years active around 1 year and 11 years. After 1710, the number of one-year ships falls and most average 11 years. One year ships were different from most other ships as they generally had lower tonnage. Also some ships were sent to Asia with the intention of never returning, and some are likely to be one-year ships because non-returning ships do not reoccur in the data.

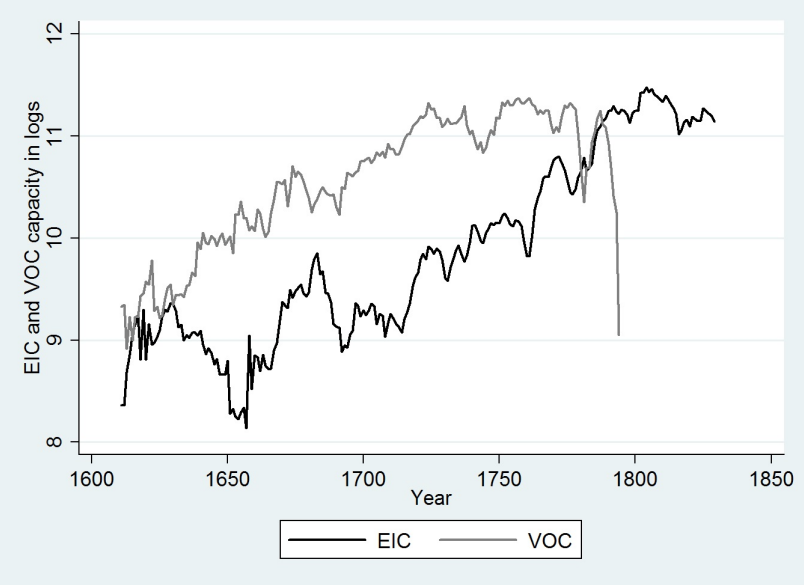
The next figure shows a comparison of the log of EIC capacity (black) with the log of VOC capacity (black). Note the rapid drop in VOC capacity in the early 1790s.

Figure 10: Kernel Density Estimates for Years of Activity EIC ships in Sutton, 1660-1760



Source: see text.

Figure 11: EIC and Dutch East India Company (VOC) shipping capacity, 1610-1830



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