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Essays on the Political Economy of Corruption and Rent-Seeking

A dissertation presented
by
Mircea Popa
to
The Department of Government

in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy
in the subject of
Political Science

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Essays on the Political Economy of Corruption and Rent-Seeking

Abstract

The dissertation is made up of three papers on the political economy of corruption and rent-seeking. Two of the papers make use of the historical experience of Britain to illustrate the theoretical points being made. The first paper shows that eighteenth-century Britain displayed patterns of corruption similar to those of developing countries today. To explain anti-corruption reforms, the paper develops a model in which the political elite is split between government officials and asset-owners. Government officials can act in one of two regimes: a corrupt one in which they are free to maximize their income from the provision of government goods, and one in which a regulated system leaves no room for individual profit maximization. Faced with a change in the level of demand for government goods, officials become able to extract rents at a level that leads to other members of the elite voting to enact reforms. The logic of the model is tested using a new dataset of members of the House of Commons and its main implications are validated.

The second paper develops a model of how the British political class came to give up its power to extract rents from the economy between the 1810s and the 1850s. The key of the explanation lies in understanding the bargaining process between economic agents who seek permission to engage in economic activity and a legislature that can grant such permissions.

The third paper analyzes the distributive effects of corrupt interactions between government officials and citizens. Corruption is modeled as a solution to an allocation problem for a generic government good G. Beyond a transfer from citizens to the government, corruption redistributes welfare towards "insiders" who share some natural connection to the government and to other insiders. Corruption also redistributes welfare towards those who are skilled in imposing negative externalities, and encourages the imposition of such negative externalities.

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Chapter 1

Elites and Corruption: A Model of Endogenous Reform and a Test Using British Data

Eighteenth-century Britain displayed patterns of corruption similar to those of developing countries today. Reforms enacted in the late 18th and early 19th centuries eliminated most of these patterns. This paper develops a model in which the political elite is split between government officials and asset-owners. Government officials can act in one of two regimes: a corrupt one in which they are free to maximize their income from the provision of government goods, and one in which a regulated system leaves no room for individual profit maximization, but monitoring effort is required. Faced with a change in the level of demand for government goods, officials become able to extract rents at a level that leads to other members of the elite voting to enact reforms. The logic of the model is tested using a new dataset of members of the House of Commons and its main implications are validated.

Introduction

In a society pursuing the maximization of aggregate welfare, government workers provide governance goods and earn an income in exchange for doing so that is enough to keep them from switching to other jobs, that is, they earn competitive returns. While the government is effectively a monopoly, supplying a service that cannot be supplied by private enterprise, in the ideal case government officials are prevented from taking advantage of this monopoly and maximizing their income: Laws establish the conditions under which government goods must be provided, and mandate returns on government activities that are enough for this to happen. For the purposes of this paper, corruption is defined as a a situation in which

government officials, using their monopoly power, do manage to maximize their utility from the provision of government goods. A similar definition of corruption has been adopted by Shleifer and Vishny (1993)—"the sale of government goods for private gain", and is implicit in the widely used definition provided by the World Bank (1997)—"the abuse of public power for private gain".

As the presence of corruption has been argued to have negative effects with respect to efficiency and distribution, a literature seeking to explain its determinants has developed. Empirical research efforts that use corruption as the dependent variable have mostly gone in two directions. One is that of cross-country studies, as there is significant variation in the levels of corruption encountered throughout the world (Treisman, 2007). Another direction has been to look at small scale variation in corruption in a certain organization, in the context of a natural or field experiment (Di Tella and Schargrodsky, 2003, Olken, 2007). This paper takes a third approach, by looking at large-scale changes in the level of corruption in a single country. This kind of variation is most relevant for the larger policy question at hand: what are the conditions under which a given corrupt country can enter a radical transformation that pushes its political, administrative, and economic system towards a state which is closer to the ideal case? The answer would be more interesting if it did not rely on electoral constraints to induce the change, as often the puzzle is precisely explaining why a given country has high corruption in spite of democratic political institutions, that is by keeping the electoral constraint constant. The answer would also arguably be more interesting if it did not rely on violent revolution by the citizens, as this does not seem like an attractive way of reducing corruption. What is needed therefore are examples where there was variation in the level of systemic corruption that was not given by variation in electoral mechanisms and outcomes or by popular revolutionary pressure.

These kinds of endogenous transformations are rare in the data. The case of Britain in the late 18th and early 19th century however, is an obvious candidate. An extensive literature in political economy has looked at, or has drawn inspiration from, the historical experience

of Britain when discussing institutional evolution, perhaps because the gradual and peaceful changes that England/Britain engaged in after the Glorious Revolution of 1688 are seen as especially successful. North and Weingast (1989) and Stasavage (2002, 2003) concentrate on the emergence of parliamentary control over aspects of public policy, Acemoglu and Robinson (2006) as well as Lizzeri and Persico (2004) analyze franchise extension through the Reform Bills of 1832 and 1867, and Cox (1987) looks at the emergence of modern party organizations that led to the preeminence of the executive over the legislative. This paper argues that in addition to these three institutional transformations, the elimination of corruption from public administration is another crucial change in the British institutional structure, and it too offers lessons that go beyond the case of Britain. So far there has not been a lot of attention paid by political scientists on this topic, and the body of work that does exist, by historians, tends to be descriptive rather than analytic.[1]

The starting point of the argument is showing that Britain in the 18th century had, using any reasonable definition, a lot of corruption. The patterns to be described in the following were given the name "old corruption" by radical contemporaries such as William Cobbett and John Wade, and the debates around them will seem familiar to any student of the developing world of today. Starting with around 1780, much of this system was reformed in a gradual fashion. The British political world of the middle and late 19th century might have still been iniquitous, un-democratic, and inefficient, and the economic world highly unequal in its distribution of resources, but the explicitly corrupt features of the 18th century were clearly gone. The most direct evidence for that comes from the work of W.D. Rubinstein (1983): While at the beginning of the 19th century, many individuals who had been nothing but public servants their entire careers left immense fortunes at the time of death, by the

[1]The most useful works by historians that address this topic directly are: First, W.D. Rubinstein's (1983) article "The End of "Old Corruption" in Britain 1780-1860" in which he uses probate records to look at the wealth of government officials; then Philip Harling's (1996b) book "The Waning of "Old Corruption": the Politics of Economical Reform in Britain, 1779-1846", in which he argues that the reforms were enacted by the elite to legitimize its dominance in an age of political upheaval on the continent; and Norman Chester's (1981) "The English Administrative System 1780-1870", a very detailed description of the changes in administration in that period.

middle of the 19th century this phenomenon was gone. Other pieces of evidence to be described lead to the same conclusion.

Britain's case is interesting because the changes came in a period in which electoral constraints were kept constant: the United Kingdom of 1830 was just as undemocratic as the Britain of 1780. Also, while some radicals in this period hoped to generate the same sort of popular uprising that had been experienced by France in Britain, it will be argued that this kind of revolutionary pressure was also unimportant. The end of old corruption was an entirely intra-elite process, which came about because of parliamentary and executive decisions which transformed the administrative system and the nature of public office. This paper shows, using a formal model, that the conditions inside the British elite of the late 18th and early 19th century were such that an exogenous shock given by the increased government activity during by the wars against the thirteen colonies and against France led to the replacement of the old corrupt system with one which sat closer to the ideal model.

The formal model shows that corruption can be understood as a way to achieve the production of government goods without paying the costs of setting up a professionalized bureaucracy. Under corruption, officials produce government goods in order to extract rents from this activity. When government activity is small as a share of the economy, the losses in citizen welfare from this system might be small in absolute value, and might not justify setting up the non-corrupt system. When the amount of government activity increases, the losses from corruption increase as well. The key factors determining whether this causes an endogenous reform of the corrupt system are the composition of the elite and the institutional structure under which interactions inside the elite take place. These two factors determine how many members of the elite are benefiting, either directly or indirectly, from corruption. The institutional structure and elite composition in 18th-19th centuries Britain was such that a majority of the elite did not benefit from corruption, and they therefore imposed reforms. Arguably, this would not be the case in contemporary settings, which might explain why similar transformations are hard to achieve in the contemporary world.

The empirical test of the theory relies on a newly-collected dataset of members of the House of Commons, together with their individual characteristics and voting record. Data on some 1700 Members of Parliament (MPs) comes from two main sources: voting data from Donald Ginter's (1995) collection of roll call votes in the pre-1820 House, as well as biographical data extracted from the History of Parliament collection of volumes using an automated procedure. This data is used to validate the the predictions of the formal model. Alternative theories that could be hypothesized to explain voting patterns are shown to fail to do so.

This paper contributes to the literature on institutional change by analyzing the disappearance of an institutional outcome which has proven to be highly resilient in other settings. In the model, change occurs as a result of an elite's response to changing external conditions, rather than as a result of popular pressure. The model therefore is a complement to Acemoglu and Robinson's (2006) classic model of franchise extension as a result of revolutionary pressure. The model also complements the work of Lizzeri and Persico (2004): in their paper, inefficiencies in government activity are caused by the electoral incentives of politicians, and therefore an increase in the inefficiency leads to the reform of the electoral incentives. In this model, inefficiencies arise from the technology of production of government goods, and therefore increases in the inefficiency lead to reforming this technology. As in Tilly's (1992) classic theory, war is the exogenous factor that changes the relative costs of different institutional setups. The external shock translates in institutional change that is Pareto-suboptimal for the elite because of the difficulty of enforcing Pareto-improving agreements between parties in a setting with no outside enforcement, as in Acemoglu (2003).

Old corruption: Britain in the 18th and early 19th centuries

Samuel Huntington (1968) was among the first to point out that the developed and relatively un-corrupt countries of today had been corrupt in the past. The argument that corruption was a central part of the British political system of the 18th century will be developed in the following. Simply put, before the 19th century, public office in Britain was for many officials a source of private profit first and foremost, even if the letter of the law indicated otherwise and in spite of the fact that this was often condemned.

The details of the British political system of this period have been extensively discussed elsewhere (Namier, 1929; Briggs, 1959; Woodward, 1962; Turner, 1999, are classic historical references). Great Britain (before 1801), and the United Kingdom (after the 1801 inclusion of Ireland), was an oligarchy with relatively strong control of the executive by Parliament, very limited franchise, and rather un-competitive elections. Sitting in Parliament was not remunerated and there were strict property qualifications for doing so. The king (or queen) was the head of the executive, but his or her role was constrained by a history of Parliament removing the monarch when he or she stepped outside of boundaries Parliament was comfortable with (in the Glorious Revolution of 1688), and by the personal characteristics of King George III (ruled 1760 - 1820), who was often incapacitated by illness. The monarch selected a prime minister and other members of the cabinet, and while a consistent practice of the cabinet resigning when it lost important votes in the House of Commons had not yet emerged, the make-up of the cabinet did reflect the balance of power in the House. As running in elections was a personal enterprise by the candidate himself, there were no parties in the modern sense that could constrain MPs' behavior (Cox, 1987; Briggs, 1959). MPs were often categorized in shifting and possibly overlapping groups such as the "Rockingham Whigs", "Pittites", "Foxites", etc. The names of these groups usually reflected the political leader which MPs were most loyal to, even if that political leader did not have ways of con-

straining or even rewarding their behavior. Most MPs took pride in professing independence of opinion rather than the following of a party line.

Elections were based on a limited franchise with very heterogeneous rules from one district to another. There were some eight types of franchise: County franchise, some six types of borough franchise, and the special seats for the two ancient universities. Voting was public, and local elites, most often the great landowners, did not hesitate in indicating what the appropriate choice was to the limited number of electors. The subservient relation between electors and patrons has been subject to much debate (Namier (1929) argues that the system was profoundly non-competitive, while O'Gorman (1989) argues in favor of a higher level of competitiveness than what is usually believed), but it is generally agreed that voters accepted the legitimacy of a system in which patrons and candidates offered positive incentives (gifts, money, liquor) as well as more subtle negative incentives in exchange for voters' support. Many districts however had no semblance of electoral competition, as one individual possessed all of the voting rights for the district, through owning all the land that gave rise to those voting rights—the notorious "rotten boroughs" such as Old Sarum. As the "influence" of the patrons was generally known and accepted, most elections were not contested: throughout the period, at every election, only about 20 to 30 percent of districts were contested.

The administrations of the period were generally conservative, or "Tory", using a later term, in that they did not follow the program of democratization or extension of civil rights to Catholics which was favored by the more progressive elites. Administrations generally, but not always, maintained comfortable majorities of MPs who approved of their actions in the House. Key events and personalities of the period are as follows: After 1773 the government of Lord North was rocked by the move towards independence by the thirteen American colonies and began an overseas war to prevent this in 1775. As was always the case in the 18th century, the way this massive war commitment was financed was through borrowing (Brewer, 1990). Perceived mismanagement of the war effort led to the loss of support in the

House for North in 1782, and he was the first prime minister to resign after losing a motion of no confidence. After a brief period in which more reformist "Whig" politicians formed the cabinet, in 1783 the twenty-four year old William Pitt became prime minister. Pitt was prime minister until 1801, and then again from 1804 to 1806, when he died. In the interlude, a Pitt protege, Henry Addington was prime minister. Pitt's administration is often called Tory, using the later sense of the word, as it favored cautious reforms, respect for the king's role in government and conservative economic policies. During his time, Britain entered its prolonged conflict with revolutionary France, which lasted from 1793, with interruptions, until 1815. This war effort was enormous when compared to the limited commitments of the 18th century, and was financed through a large increase in the public debt as well as through increased taxation. After a brief coalition "ministry of all the talents" in 1806, the sequence of Pittite/Tory cabinets was re-established and continued until 1830 when Wellington became the first sitting prime minister to lose an election to the Whigs of Earl Grey.

There are many aspects of the British political and administrative systems of the time which could be given as examples of their corrupt nature. Here they are grouped in four categories:

A. Sinecures. The principle of patronage in public appointments was universal, and it would not be replaced with competitive appointments until the second half of the 19th century (Chester, 1981). Some public office appointments, however, were more criticized than others: so-called sinecures, that is jobs without any real responsibilities, were routinely awarded by governments to friends, family, and those who could provide political support in Parliament. Some of the most obvious sinecures were the ancient positions at the royal court: chamberlains, Grooms of the Royal Bedchamber, the Master of the Buckhounds, etc. Those appointed to these positions did not perform such menial jobs, but merely collected substantial sums from the government purse. Such an appointee could expect from about £500 a year to £2,000 a year, using figures from the History of Parliament (1988). These

were very considerable sums by any measure.[2] Less obvious were positions which were associated with real government activities, but were clearly not meant to be performed by the title-holder: "comptrollers", and "auditors" of various government functions were typical examples of such positions. There also existed positions that did carry responsibilities, were generously reimbursed, but for which it was agreed that the title-holder would delegate the exercise of the job to a low-paid subordinate. The fact that this was tolerated is connected with the general view of what public office was, which is presented in point 2 below. There is a natural controversy over what constituted a sinecure, so it would be hard to establish the number of sinecures and their monetary value. A rough estimate of the number of major sinecures in the administration would be that there were one to two thousand, going by the fact that various estimates of how many had been eliminated sum up to more than 1,200, and a parliamentary committee from 1812 counted 342 still left (Foord, 1947). It is likely that the total sums wasted in this manner were not large as a share of total spending, but their symbolic nature made them a prime target for reformers. Access to sinecures, while not very publicly discussed, was seen by many as a normal perk of political power: governments were expected to reward their supporters in Parliament with such positions (Namier, 1929, is a classic account of how the patronage system worked).

B. The public employee as an unregulated income maximizer. More fundamental than the outrageous but limited case of sinecures was the general perception of public office as private property to be used for enrichment by government officials, often in spite of laws saying otherwise. Using evidence from Chester (1981) the main features of the 18th century administrative system can be distilled as:

a. Public office as a form of property. A position in administration, once awarded, was *de facto* the property of the holder for life. This is even though nominally, by 1780, most offices were awarded at pleasure by the executive.

[2]Using 1780 as a reference year, £1,000 would be worth about £100,000 in 2010 using the retail price index as a measure of inflation, but about £1,200,000 using increases in average earnings (using the price indices by Officer, 2011).

b. Public offices were bought and sold. Officials could sell the office they had under control to an interested party, or could sell the "reversion" of the office, that is, they could set up a contract that transferred the office to the new holder right as the old holder died. This meant offices were often not only given away for life but in perpetuity. This happened even though there were statutes clearly prohibiting such practices. In 1725 the Lord Chancellor was impeached for selling an office, and was fined £30,000, but this did not prevent the practice from continuing.

c. Remuneration by fees in addition to salary. Most government officials, with the exception of cabinet members and the pure sinecurists who did not perform any activity, earned the vast majority of their income not from the salary paid from the government budget, which was often low, but from the fees collected from citizens whenever the official or his subordinates interacted with the public. If demand for a given activity increased, it was usual for the office-holder to hire more subordinates on his own, in order to respond to such increased market demand. In the military, officers received a sum from the government, and then had to pay for soldiers and provisions from that sum, taking the rest as their profit. The office holder was in practice an entrepreneur who was optimizing the provision of the government good in order to maximize income. The incentives for performing the job well, if any, came mainly from the need to have customers returning, not so much from the possibility of being replaced for poor performance on the job. The corrupt character of the fees system is that their level was not generally established by law, but rather was based on usage. In addition to the official fee, Chester notes that a need to pay "gratuities" also arose sometimes. The gratuity could be paid for "civility, favour, or extra service, but it could also purchase undue preference."

The fact that very senior government officials were subjected to parliamentary inquiries and impeachment votes for bribery and peculation suggests that bribery and embezzlement were present at the highest levels. The case of the War Secretary, Lord Melville (Henry Dundas), is the most famous. One of the most important members of Pitt's cabinet, he was

impeached for embezzlement of public funds, because of some £90,000 which had passed through his hands as government minister, received from unknown sources, but were not accounted for (Hansarda). He was acquitted in the impeachment trial in the House of Lords, after being censured in the House. The commander-in-chief of the Army, the Duke of York, was accused of trafficking army commissions with the help of his mistress. The future foreign secretary, Viscount Castlereagh, was accused of offering some positions in India as electoral bribery, and a group of officials appointed to administer ships captured from the Dutch in 1795 were accused of embezzlement of funds. The corruption that reformers were fighting against was clearly not only in the form of excessive pay, but also took the form of bribes, extortion, and embezzlement. The bribes and the fee system were natural complements: the existence of the fee system allowed officials to easily take money from private individuals, the path of which was easily then lost.

d. Exercise through deputy. Connected with the view of the public official as an owner and entrepreneur, it was often legally acceptable for a position to be exercised through "sufficient deputy". This also helped officials who held numerous offices at the same time, a situation which was tolerated.

e. The banking function associated with offices. One of the consequences of the self-contained, business-like nature of public office was that all money collected from citizens belonged to the officer until it was time to pay some of them to the Exchequer or to other departments. In the meanwhile, the officer could collect interest on the balance.

These features of public office are clearly indicative of a model where the government official acts like a utility maximizer who engages in interactions with citizens in which she can use her effective monopoly on the provision of the government good to extract rents. Most of these features had evolved as the *de facto* equilibrium outcome rather than being prescribed by laws. Legal provisions, generally accepted practices, as well as illegal but tolerated practices blended together to make public office a source of profit for its holder, much like it is the case in contemporary corrupt countries.

C. Government contracting not meant to maximize social welfare. When interacting with private entrepreneurs, both on the borrowing and the spending sides, the government did not transact in competitive markets, and therefore rents were available for those who participated in these transactions. Government contracts for buying various goods were not awarded through public tender until 1793, with political connections playing the key role before that (Foord, 1947; Brewer, 1990; Briggs, 1959). Access to government debt was also done in a non-competitive fashion. Until William Pitt became prime minister, access to this debt was not done through market mechanisms but rather through a direct award from the ministry: "The general practice was for the minister to settle, with a few select friends in the city, the terms on which they [the loans] should be made" (from Foord, 1947; also see Briggs, 1959).

D. "Influence": bribes for the press and for voters. The fact that elections in this period virtually always involved bribery of the voters or patrons, except for the case in which the candidate had his own "pocket borough", is well known (Namier, 1929). A transaction in which a private political entrepreneur pays for some citizens' votes from his or her pocket does not fit this paper's definition of corruption, so it will not be analyzed here. However, when the buyer of votes is the government and the funds being used are from the public purse, this clearly does fall under the definition. The Treasury was the most significant provider of such bribes, with the districts thus controlled being called "Treasury boroughs". The use of public funds to buy favorable press is also widely acknowledged.

While some radical writers doubted as late as the 1830s that the system of old corruption had been affected (John Wade's series of "Black Books" are the best example of this literature), a less charged analysis indicates that the system was largely gone by the 1820s. Notwithstanding all the injustices of British politics and society in the middle of the 19th century, all of the features of the corrupt system described above had been eliminated or greatly reduced. There are two types of evidence for that: On the one hand there exists evidence that the end results of a corrupt system ceased to be encountered after this pe-

riod. W.D. Rubinstein's (1983) work shows that the phenomenon of government officials leaving impressive fortunes at the time of death was gone by the middle of the 19th century. In addition to this, it is well established that by the 1820s the executive no longer had at its disposal the extensive system of patronage that allowed it to buy off majorities in the House of Commons, and that by 1830 the government could no longer buy off elections, as Wellington lost the election of 1830 as a sitting prime minister. In 1819 Prime Minister Lord Liverpool was complaining that he could no longer effectively use patronage to reward friends, and when Wellington became prime minister in 1828 he was "forcibly struck by the lack of patronage at his disposal" (Foord, 1947).

On a more immediate level, there is the undeniable evidence of the legislation from 1779-1820 which changed the nature of public office and severely limited the practices described in the sections above. The beginning of the reform period can be placed in 1779, with the emergence of a reformist movement in the House of Commons, which was closely associated with the political group of the Rockingham Whigs (followers of the Marquess of Rockingham). Leaders of this movement, among which Edmund Burke was a notable figure, attacked sinecures, the use of Civil List money to advance the interests of the Crown and government, and the presence of government contractors in the House. Bills to prevent government contractors from sitting in the House, and to regulate some sinecures were passed. The movement for economical reform was from now on permanently active in the House. In 1780 the House established that it lies within its competency to "examine and correct abuses" in the use of Civil List money (Foord, 1947). Between 1780-1787, a commission for analyzing the public accounts appointed by the House published fifteen reports on needed reforms in the administrative system. These recommendations can be summed up as arguing in favor of a modern "Weberian" bureaucratic system (Torrance, 1978). In 1782 Lord North resigned upon the House registering its disapproval of the government, a first, and the reform efforts continued during three short-lived Whig or coalition administrations. William Pitt, who became prime minister in 1784, adhered to a reformist stance with respect to the public

service, sinecures, and government contracting. While parliamentary activity on this front was more reduced in the turbulent 1790s, when the events in France led Pitt to adopt a more authoritarian regime and the progressive groups in opposition to have their legitimacy and loyalty questioned, after 1800 the movement for administrative reform again became very active in the House. In 1805, Lord Melville, the War Secretary was impeached for embezzlement of funds, and after that more inquiries into the behavior of senior government officials followed. The period 1805-1815 saw a very active effort to enact changes in the nature of public office. Looking specifically at the characteristics of the corrupt system outlined above, the following paragraphs summarize the changes based largely on Chester (1981) and Foord (1947).

The elimination of sinecures was one of the prime targets of reformers. As early as 1780, the House passed bills aiming to eliminate some sinecures, and successive prime ministers after that acted to reduce their numbers. Burke's Act of 1782 further eliminated some one hundred offices. The nature of the elimination however, was not straightforward: as the property rights of the official over his office were considered beyond doubt, elimination meant either not appointing a new officer when the old one died, or establishing that when the current holder will die the post will be eliminated, or compensating the holder of an office which was immediately eliminated with an appropriate sum of money. In this lies the explanation for the fact that as late as 1830 radical writers such as John Wade presented accurate lists of sinecurists in the administration: some positions which had been slated for elimination as early as the 1780s were still there in the 1830s, as their holders had not yet passed away. The Commissioners for the Public Accounts in the 1780s recommended the elimination of sinecure offices, but at the same time noted the necessity to respect the property rights of the holders, and thus recommended monetary compensation as a solution to the problem. Abolition when the office became vacant was achieved through acts of Parliament in 1783 and 1798, and also through administrative decisions by prime ministers to no longer fill places which became vacant upon the death of the holder. Prime Minister

William Pitt eliminated in this fashion hundreds of sinecures. When abolition was enacted immediately, adequate compensation had to be provided by the Treasury, either as a lump sum or as an annuity equal in value to the remuneration of the office. Parliamentary pressure towards inquiring into and eliminating sinecures intensified after 1805 and the House passed a bill in 1813 to regulate all sinecures. Even if many of the bills proposed in the House to inquire into and regulate sinecures were defeated, it became impossible for any administration in this period to have a policy other than the gradual elimination of all sinecures, which had not been the case before. Parliamentary committees on sinecure offices in the second decade of the 19th century found that the few hundred still left were slated to be abolished upon the death of the holder. Bills to establish a pension system for civil servants also helped remove the justification for sinecures as a form of pension. In 1809-1810 pensions for all civil service staff were established, and in 1817 the pension system was extended to political appointees. Connected with the sinecures issue, an act was passed in 1809 preventing the awarding of offices as a bribe.

Successive acts of Parliament and the executive also changed the *de jure* and *de facto* nature of public office: The ability of the office holder to buy and then dispose of his office as he saw fit was removed. An act in 1809 made selling offices illegal, with the notable exception of the Army (but not the Navy), where buying commissions was the accepted norm as late as the 1850s. The switch from remuneration by fees to salaries was achieved mostly through administrative action in individual departments: in 1782 the Treasury replaced the fee system with salaries, the secretary of state's office made the same change in 1795, the Navy Board in 1796, the War Office in 1797, and the Admiralty in 1800. The right to exercise by deputy was removed for individual offices by various acts of Parliament (details in Chester, 1981). The removal of the banking functions was achieved by joining the numerous accounts of the public administration into a single one at the Bank of England, the so-called consolidated fund established by Pitt in 1787.

The ability of the executive to provide rents through non-competitive contracting also

disappeared: After becoming prime minister, William Pitt began selling treasury bonds on the open market and began introducing competitive bidding for government contracts. After the beginning of the war with France in 1793 the purchase of army and navy provisions was transferred to an independent commission.

While private individuals paying bribes to voters continued to be the norm until much later, the government's ability to do this was severely curtailed. Foord (1947) details how this became impossible between 1780 and 1820. Burke's Act of 1783 required that money from the Civil List (the sovereign's funds) be divided into eight designated categories. Out of these, only one, the privy purse, was the king's private money to be spent as he wished. "Secret service" money, which were funds that the king could hand out to individuals of his choosing for services performed, was limited to a very modest £10,000. Curwen's Bribery act of 1809 made it impossible for the Crown to engage in transactions with borough patrons. The control that the executive exercised over some electoral districts came from it employing many individuals in those districts (e.g. in the Navy shipyards), rather than from its ability to secretly pay borough patrons.

There are many other examples of small and incremental reforms of the administration, some of which are technical in nature and better left to the historian of public administration. This paper concentrates on the political conflict over these changes. As would be expected, there was a lot of resistance in the House of Commons to such changes. Indeed, the existence of support for reforms is the mystery, and the existence of such support can only be explained in a very limited manner by electoral constraints, which were weak and did not become more binding in this period. The analysis of the political conflict in the House of Commons over these reforms, must make use of what limited evidence is left: as will be explained in the statistical section, votes in the House in this period were not public, and there was not even an official record for posterity of how MPs voted. Data on some thirty "divisions" (roll-call votes) in matters which are relevant for the subject at hand, is however available, and this data will serve as a test of the proposed theoretical model. These votes are not by any means

the full story of how corruption came to be eliminated in Britain (in fact they do not include some of the most important bills of the reform process), but they do serve as useful tests of hypotheses that emerge from the theoretical model.

Theory

In building a model of the reform in Britain, the following facts need to be taken in consideration:

The make-up of the political elite. Britain was an oligarchy in which a small number of men exercised effective influence in public affairs. The House of Commons was the arena in which conflicting views among these individuals were resolved, with the House of Lords serving as a veto point for the nobility. The large increase in the number of peerages awarded during George III's reign, and especially by William Pitt, meant that the House of Lords came to also reflect the existing power structure in society.[3] Virtually everyone in the House of Commons was either such an influential individual or his immediate representative. Some members of the House had a direct connection with the executive branch, by holding various public positions which were remunerated. A large part of this group is made up of military officers. Other members of the House relied on income from other sources, mainly the ownership of assets, whether land or capital. Relatively few individuals in the House earned a living by earning a wage on the private labor market. As being a member in the House was not remunerated, there existed a large contingent of individuals who had effective political power but did not earn an income directly from that.

Business-government connections. In most modern-day economies, politicians, whether in the executive or legislative, can affect the distribution of welfare in society through regulation of various activities. An obvious example of such an intervention is the creation of rents in the economy through restrictions in various markets (Krueger, 1974). The welfare

[3]Between 1776 and 1830, 209 new peerages were created, and the size of the House of Lords increased from 199 to 358 (McCahill, 1981).

of economic elites can obviously be affected by these interventions. This gives rise to the possibility of a deal in which economic elites tolerate behavior by politicians which is *prima facie* hurtful to their welfare, in exchange for positive treatment from the latter group.

The business-government connection in Britain in the 18th and early 19th centuries. The economic elite in Britain, made up of asset-owners and professionals, arguably had less need for professional politicians and government employees in advancing its interests than it is the case in the modern system presented in the previous paragraph. This is largely due to two factors: One is that the economic elite had direct access to political power through the legislature. An individual seeking a voice in politics could run (or pay) for office on his own without the need to be part of a political party, and perhaps more importantly, without the need to have any special political skills. The other, complementary, reason is that the primary locus of rent seeking was the legislature rather than the executive. Brewer (1990) presents the highly developed system of lobbies put in place by asset-holders to influence policy in their favor in the eighteenth century. The key aspect of this system of lobbying is that it primarily sought access to Parliament rather than to the executive or to public administration. Similarly, Root (1994) is a detailed account of how rent seeking functioned in Britain at the time: In contrasting it with France, Root argues that the crucial aspect of the British system of rent seeking was the preeminence of Parliament as a venue for advancing such objectives for interested parties, as opposed to the executive: "Parliament was a market for rights to control the economy [...]". It was the House of Commons that could impose tariffs and other taxes, and therefore generate rents for the successful lobbies, and it was the House that had to approve of any monopoly rights for entrepreneurs. Cox (1987) also emphasizes that before the middle of the 19th century, Parliament was the main source of legislation, and every MP could put forward any bill of his choosing. The case of the landowners' rent-seeking behavior and achievements is instructive: After 1793, trade limitations with the continent due to the war increased agricultural prices. Fearing a fall in prices, in 1804 and again in 1815 so-called Corn Laws imposed tariffs on the importation of

agricultural products that aimed to maintain these higher returns on land (Briggs, 1959). These laws came about through Parliamentary action, not because of the executive or public administration officials, and Parliament was made up largely of the asset-owners themselves rather than of professional politicians.

There were groups in the economic elite whose relation to the executive was much more like that between modern-day business-people and politicians. While imperfect, a distinction between economic elites that could advance their interests mainly though the House and those that also needed the executive can be made in the data: Three groups among the "bourgeois" MPs can be argued to be more likely to enjoy a special relation with the executive: those forming the India bourgeoisie, who were associated with the East India Company, those forming the West Indies interest, and those associated with the Bank of England. All three groups represented private companies with deep connections to the executive and public administration. (However, the distinction is imperfect in the data, because it is hard to know how much of one individual's assets were concentrated in these activities, as opposed to land-ownership or other kinds of trade.) Root argues that while in internal economic affairs, Parliament had preeminence, "the colonies were, of course, quite another matter. They were managed much the way the French ministries regulated the French domestic economy". The Board of Trade, made up of government ministers, and the various ministers that organized colonial policy (the Secretary for the Colonies, then the Home Secretary, then the War Secretary) handled legislation in the colonies in a manner quite different from constitutional practices in Britain. Consider first the example of the "India interest": the East India Company was a private enterprise which had been given a monopoly on Indian trade and also exercised governmental power in that territory. After 1773, a council appointed by the Crown regulated the exercise of this power, and after 1784 six members of the cabinet formed a commission that controlled the "political" actions of the company in the colony. The running of the business of the company effectively depended on the decisions of the British executive. The case of the West Indies interest is similar: Traders and estate-owners in this

group depended on governmental approval for the continuation of their quasi-governmental role in the Caribbean. The Bank of England was a quasi-governmental private institution which held a monopoly on the government's banking operations since 1694. The Bank of England and the East India Company, with their privileged role in the economic sphere, are at the center of John Wade's critique of old corruption in his "Black Books". North, Wallis, and Weingast (2009) also emphasize the dependence of these kinds of asset-owners to the government: "Because each of the three monied companies depended on their close connections with government for their privileges—and because other organizations could not easily become corporations—the companies, their stockholders, and their representatives were drawn by their interests to support the government".

The distinctive feature that separates modern-day political elites from that of 19th century Britain is therefore the existence of a group of independent asset owners and professionals that controlled the legislature. The fact that independent asset owners and professionals formed a majority in the House throughout the period under analysis is shown by Judd (1972). Figure 1 plots the share of total seats belonging to eight economic groups. As will be explained in the empirical section, landowners, physicians, manufacturers, merchants, lawyers and bankers were independent asset-owners or professionals, with the remaining categories of military officers and colonial businesspeople being made up of individuals who were directly or indirectly dependent on government officials. (A more appropriate name for landowners would be landowners-only, as every member of the House had to hold significant landed property to be allowed to be allowed to take office (Thorne, 1986). The other categories should all be understood as being in addition to the default landowner qualification.) Figure 1 shows that the independent part of the House, defined conservatively as explained above, formed a large majority of 65%-70% throughout the period under analysis. Judd does not include MPs who were government officials or employees as a separate category. The History of Parliament (Thorne, 1986) however, calculates the share of the House which could be considered as being made up of government officials (including ministers), sinecurists, and

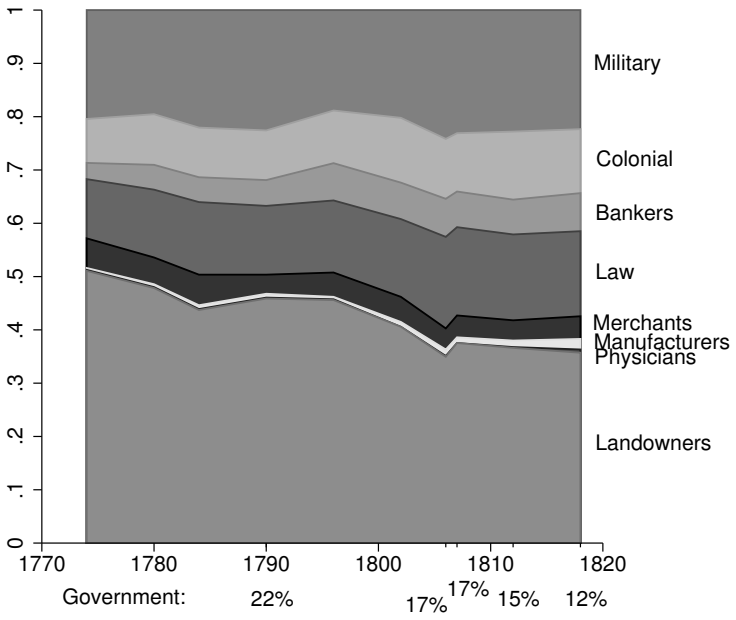


Figure 1: Share of eight professional categories in the House. Source: Judd (1972). The share of government workers computed form figures provided in Thorne (1986).

court employees at various points: in 1790 this was 22%, in 1806 and 1807, it was 17%, in 1812 it was 15%, and in 1818 it was 12%. Even allowing that a disproportionately large share of these officials came from the six "independent" categories above, this still leaves a majority of the House belonging to the independent group. These conservative calculations, however, probably greatly underestimate the true nature of the dominance of independent asset owners: Judd shows that when taking into account the considerable landed interests of Members who are also listed in a other categories, "[...], it appears reasonable to assume that about three-quarters of the 5,034 M.P.'s 1734-1832 [*sic*] were mainly concerned with land rather than with other forms of wealth."

Government outlays during the war. The American and French wars were significant shocks to the fiscal-military British state. The increase in government activity, as reflected in increased expenditures, taxation, and ballooning public debt was unprecedented. Figures 2 and 3 illustrate this by plotting government income, expenditure, and debt in this period.[4]

[4]The data is taken from Mitchell (1988). Nominal sums are deflated by using the retail price index computed from Officer (2011) to get sums in constant 1750 pounds. Much of the irregular aspect of the graphs can be explained by the fact that prices oscillated from one year to the other far more than they do



Figure 2: *Left*: Income and expenditure of the central government, constant 1750 pounds. Data from Mitchell (1988). *Right*: Public debt, constant 1750 pounds. Data from Mitchell (1988).

The large increase in expenditure after the 1775 beginning of the war in America pales in comparison to the larger shock given by the beginning of the wars with France in 1793. This will correspond in the theoretical model to an increase in the demand for a generic governance good. Acting as unregulated utility maximizers, government employees were free to take advantage of the increased demand for government products. Large increases in the fees collected by office holders during the wars, and their role in encouraging demands for administrative reforms have been noted by Foord, Chester, Harling, Brewer, and others.

The logic of reform presented in this paper can therefore be summarized by saying that the increase in government spending caused by the two wars led to a change in the behavior of the asset owners who controlled the levers of power. The system of uncoordinated rent extraction in exchange for the provision of government goods that prevailed in the 18th century might have been inefficient, but it was self-sustaining: the need to attract future tax or fee payments from citizens induced government officials to provide enough government goods, to dissuade those holding ultimate political power from reforming. As the losses from this system in a society with minimal government activity were small, there was no reason to

in modern economies. A graph for income and expenditure using nominal sums is far more smooth, and can be found in Appendix C.

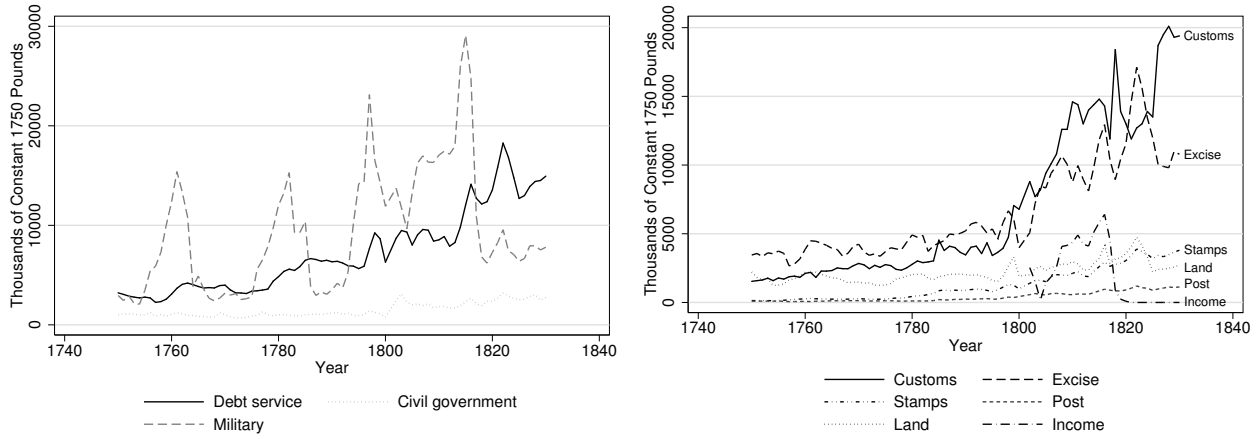


Figure 3: *Left*: Types of expenditures in constant 1750 pounds. Data from Mitchell (1988). *Right*: Sources of income in constant 1750 pounds. Customs taxes were taxes on foreign trade. Excise taxes were levied on a number of goods, such as soap or beer. The income tax was introduced in 1800, with marginal rates between 1% and 10%, and eliminated in 1816. Data from Mitchell (1988).

incur the substantial costs entailed by the establishment of a modern administrative system.[5] The increase in the amount of money that was up for grabs for the officials that came with the wars, in conjunction with the collective action problem faced by the government workers in the provision of a public good, meant that their ability to refrain from extracting an excessive amount of rents broke down, which made other elites reform the system.

This informal logic can be analyzed through a model of repeated interaction between players making up an elite: The members of the elite are either government officials, labeled group O, of size n_O, or economic elites labeled group E, of some large size n_E. (Individual players will be indexed by the corresponding lowercase letters o and e.) The two groups are represented in a legislature by subsets of their members. The government officials in the legislature are labeled group A, of size n_A. Economic elites in the legislature are subdivided in two groups, depending on their relation to the government officials: "Dependent" E players

[5]An illustration of the difference in costs between a reformed and a non-reformed department is the difference between the most professionalized government department at the time, the Excise, and other departments. While for example, in 1797 the War Office, was a simple operation with 58 employees, and the Admiralty had 45 employees, the Excise was a complex organization, in which a lot of effort went into policing the more than 6,500 non-corrupt officials. Brewer (1990) describes the functioning of the Excise in more detail.

whose incomes depend on the actions of government players are labeled group B, of size n_B, and E players whose incomes do not depend on the actions of government officials are labeled group C, of size n_C. Note that the same players would be referred to as being part of groups A, B, or C when discussing their voting behavior in the legislature, and as part of groups E and O when discussing their other actions. The situation which is most relevant for the case at hand is one in which members of group C form a majority in the legislature.

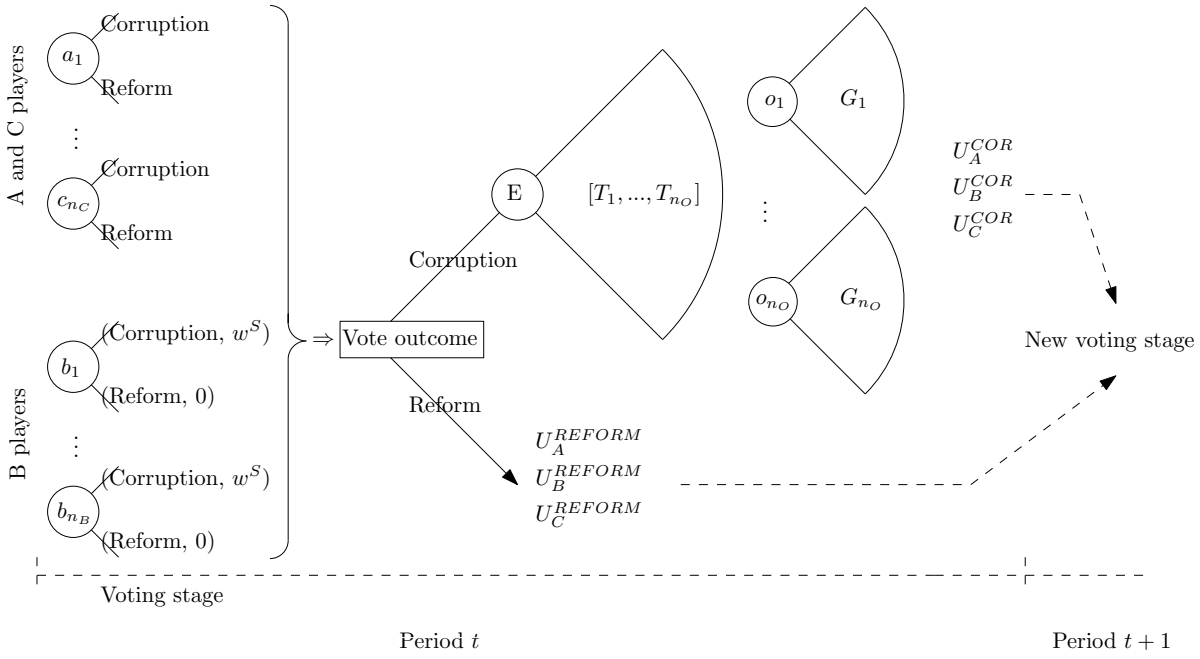


Figure 4: Illustration of the stages of the repeated game

The interaction between the players takes the form of an infinitely repeated game, in which each period they make decisions regarding the allocation of endowments, the production of government goods, and the status of corruption versus reform. This modeling approach is most closely connected with that in Acemoglu (2003). As in that paper, interactions between citizens and government agents are subject to a commitment problem, with cooperation arising as a result of repeated interaction. The game is illustrated in Figure 4. One period of the repeated game is made up of one interaction between the agents: In the first stage of the period, legislators decide between interacting in a corrupt or reformed system for that period, by taking a majority vote on a binary agenda containing the two

options. The standard assumption that the players do no use weakly dominated strategies in the voting equilibrium is made here. In case corruption is the outcome of this vote, in the next stages resources are committed for the production of the government good and its production takes place. In the second stage of the period, under corruption, economic elites make an allocative decision: they each have an endowment which they can use for private consumption or production of government goods. The government goods have to be produced by government officials in group O. Government goods can be produced from the tax income that economic elites hand out to government officials.[6] The total tax payment made by economic elites, T^T, is equally shared among them, so $T = \frac{T^T}{n_E}$ is the per-capita tax payment, and then is distributed to the government officials as the vector $[T_{o1}, ..., T_{on_o}]$, where $\sum_{o=1}^{o=n_O} T_o = T^T$.

In stage three, each government official receives the share of the tax payment T_o, and decides how much of it to use for the production of G_o and how much to keep as their own rents R_o. The cost of producing one unit of G is 1 in terms of the numeraire. Each government official will produce a certain level G_o of government goods, and will keep the rest of the tax payment as a rent: $R_o = T_o - G_o$. The total amount of public goods produced is therefore $\sum_{o=1}^{o=n_O} G_o = G$.

After this, players receive their payoffs. All players have generic quasilinear utilities for private and public consumption. The utility function of E players is:

$$U_e \quad = \quad P_e + \alpha u(G) \tag{1}$$

The parameter α here serves to indicate changes in the utility of the public good, which are of interest for the theory—an increase in α means that the public good is more valuable relative to the private good. The $u(G)$ function has standard properties: $u'(G) > 0$ (the

[6]The assumption that economic elites act cooperatively in paying the tax, and therefore that each E player is bound to pay the tax that emerges from the group's optimality conditions is made here. This would correspond to a situation in which economic elites get to vote on the optimal contribution that each has to make, rather than making that contribution voluntarily, arguably a good description of the situation in Britain.

public good is desirable), $u''(G) < 0$ (decreasing marginal utility), $u(0) = 0$, and u twice continuously differentiable. Since the cost of production of one unit of G is 1, the optimal level of provision of the public good for the E players, G^{**}, is given by the Lindahl-Samuelson condition which sets marginal social utility equal to marginal social cost:

$$n_E \frac{\partial}{\partial(G)} u(G^{**}) = 1 \tag{2}$$

The private-goods utility P_e is equal to the income w_e for each E player minus any expenditures that must be made for the production of G: $P_e = w_e - \mathcal{T}$ where $\mathcal{T}$ is any kind of expenditure that the E player makes for G to be produced. The income of some E players can however be affected by O players: Government officials control a number of slots that generate income for those economic agents who are given the slots. An E player who is a legislator and can receive such a slot is labeled as being part of group B and has income either $w_b = w^{-S} + w^S$ in case the slot is awarded to b or $w_b = w^{-S}$ in case it is not awarded. Therefore w^S is the income that is accrued as a result of the slot being awarded to that economic agent, and w^{-S} is the rest of the player's income. Players in C (along with all other non-B members of E) simply have private incomes $w_c = w$ which are not affected by the actions of the government. The rest of the paper assumes all incomes are large enough so that the equilibrium tax payments can be made without resorting to credit, and also that w, w^{-S}, and w^S are constants, for simplicity.

The utility of government officials is similarly a quasilinear sum of utilities for private and government goods:

$$U_o \;=\; P_o + \alpha u(G) \tag{3}$$

Government officials value government goods to the same degree as everyone else. Their private utility is given by the "rent" that is left for each government official after the tax T has been paid by economic agents and the amount G_o of government goods has been

produced by each government official. Therefore

$$U_o = R_o + \alpha u(G) \quad (4)$$

$$R_o = T_o - G_o \quad (5)$$

The notable fact about the strategic situation facing any individual government official is that while she faces the full cost of providing the G that is in her responsibility, she only benefits from that G in a very small proportion: for a given player o, and assuming all other O players produce the total amount of government goods G, the cost of producing G_o government goods for o is G_o, but the benefit is only $\alpha u\left(G + G_o\right) - \alpha(G)$. Similarly, looking at continuous variation the marginal cost of producing more G is 1 but the marginal benefit is only $\frac{\partial}{\partial G}\alpha u(G)$, which is n_E times smaller than the cost. This is therefore a classic case of the collective action problem facing any uncoordinated system of production of a public good. When setting up the utility maximization problem for government workers, these terms will be very small for large n_E, so the following assumption will provide a simplification of the exposition:

Assumption 1: *n_E is large enough such that, in the officials' optimization problems, $\frac{\partial}{\partial G}\alpha u(G) \approx 0$ and $\alpha u(G + G_o) - \alpha u(G) \approx 0$.*

In case reform is the outcome of the vote, then government officials are no longer free to optimize how they provide the government good. In the reformed system, they get a fixed salary which reflects the opportunity cost of their labor and have to provide a fixed quantity of the good G. The salary earned by government officials is normalized to zero for simplicity, and they therefore have to use all of the tax payment for the provision of G. Also T is set at the level T^{**} that maximizes individual utility for the tax payers, indicated in (2). (The total amount of government goods G^{**} in (2) is $n_E T^{**}$). In order to maintain this system, economic elites have to pay the administrative cost c each period when the reformed system is in place. In the reformed system, therefore, the per-period private utilities of members of

the elite will be:

$$P_{e,Reform} = w_e - c - T^{**} \quad (6)$$

$$P_{o,Reform} = 0 \quad (7)$$

The government-goods component of the utility function remains unchanged.

The process by which the dependent economic agents in B interact with the government is modeled as a simple legislative bargaining process between each one of them individually and a representative of the O group who is interested in maximizing the utility of all O players (or of herself individually, the requirement would be the same in this case). Whenever a vote on corruption or reform is taken, government officials can condition the awarding of the n_B rents, worth w^S each, for that period, on the expressed votes of economic elites. The strategy used by O in any equilibrium is one that maximizes the likelihood of generating votes in favor of corruption (which will be shown to be optimal for government workers in case they themselves favor corruption over reform): for the n_B members of B, make a proposal for an extended policy vector to replace the simple binary agenda $\mathcal{B}^1 = (\text{corruption, reform})$ with the following composite binary agenda, where one component of the agenda is made up of a vector of size two: $\mathcal{B}^2 = \Big((\text{corruption}, w^S), (\text{reform}, 0)\Big)$. In this case, B players are voting on the agenda $\mathcal{B}^2$, not on the agenda $\mathcal{B}^1$, which is the one being voted on by the C players. Therefore, B players know that a vote for reform also means a vote to replace the rent w^S with 0, and adapt their best responses to the other players' actions accordingly.

The equilibrium of the one-period game, without repeated play, and in case C forms a majority in the legislature, is obvious once the incentives facing the individual government official are considered. The government officials cannot commit to not extracting the entire tax payment as rents, because each one of them individually loses only a small amount of public good utility by not providing any G, but would lose a large amount of private utility by using the tax payment to produce G. The subgame perfect equilibrium of the period

game can be computed through backward induction: In the third stage, without reform, each government official solves

$$\arg\max_{G_o} \; T_o - G_o + \alpha u(G) \qquad \text{s.t. } G_o \in [0, T_o] \tag{8}$$

The first order condition $U_o' = 0$ leads to $-1 = 0$, because the effect of the production of G by one government official on his or her own utility from overall G can be approximated by zero by Assumption 1 (derivation in Appendix D). This suggests the solution $G_o \approx 0$, which is the natural outcome of the strategic situation facing the individual government official. Knowing this, in the second stage, the economic elites solve:

$$\begin{aligned} &\arg\max_{T} \; w - T + 0 \qquad \text{s.t. } T \in [0, w] \\ &\qquad \Longrightarrow \; T = 0 \end{aligned} \tag{9}$$

Knowing that their entire tax payment would be captured by government officials, economic agents would not pay any taxes. This leaves them with the utility level $U_{e,Corruption} = w_e$. When voting in the first stage, players in C compare this to the payoff from reform, which is:

$$U_{c,Reform} \;\; = \;\; w - T^{**} - c + \alpha u(G^{**})$$

The condition for reform is $U_{c,Corruption} \leq U_{c,Reform} \iff w \leq w - T^{**} - c + \alpha u(G^{**})$, which leads to the first result:

Proposition 1: *Without repeated play, the unique subgame perfect equilibrium outcome of the game is determined by the condition* $c \leq \alpha u\left(G^{**}\right) - T^{**}$. *If this condition holds, all C players vote for reform in the first stage and reform is enacted. If the condition does not hold, corruption is the outcome of the game, the equilibrium tax payment is* $T^* = 0$ *and the equilibrium amount of government goods produced is* $G^* = 0$.

The condition that the administrative cost of reform is (much) smaller than the net utility that public goods provision can bring to the economy is natural for the case at hand: a lack of provision of G would correspond to an "anarchical" outcome in which no government services are provided, and the assumption that reform is to be preferred to anarchy is made for the rest of the paper:

Assumption 2: *For the analysis in the rest of the paper,* $c \leq \alpha u\left(G^{**}\right) - T^{**}$.

Under these conditions, reform would always be enacted in the one-period game. Repeated play, however, allows all players to reach better outcomes, and the fact that most corrupt societies have positive tax payments and positive production of the government good indicates that such a Pareto-improving equilibrium is the one on which players will focus. Repeated play allows the government to commit to extracting only a part of the tax payment as rents, which allows the C players to continue tolerating the corrupt system, because in this manner they can avoid paying the administrative cost of reform, and also get some government goods. Similarly, government officials have an incentive to seek to commit to not extracting the entire tax payment, as this allows them to gain some rents from corruption. In such a game, players can build a cooperative (corrupt) equilibrium, sustained by punishment strategies directed against individual government workers. The analysis of these cooperative equilibria follows here.

The information structure of the infinitely repeated game is one of perfect and complete information, and it is common knowledge to all players. The equilibrium concept is subgame perfect equilibrium. To maximize the likelihood of a cooperative equilibrium being sustained, players use "trigger" strategies that postulate the most severe punishment in case of a deviation from the prescribed cooperative behavior. The pure strategies used by all players in the cooperative/corrupt equilibrium therefore are: For C players: vote for corruption in the first stage of each period, then, along with all other E players, pay a bribe T_o^* to each o player in the second stage as long that o player provides at least G_o^* government goods and extracts at most R_o^* in rents; and switch to setting $T_o = 0$ forever for any official that deviates from

these conditions. For an O player: vote for corruption in every first stage of every period, then extract R_o^* and provide G_o^* in every third stage of every period, as long as at least the bribe T_o^* is received, and switch to setting $G_o = 0$ forever as soon as these conditions have been violated. In addition, O players condition the private utility of the B players on B players' votes, as described above. B players use strategies where they always vote for corruption, and pay the tax T^* every period in which corruption is present and T^{**} in every period in which reform is enacted. In such an equilibrium, E players punish deviations from cooperative behavior by individual O players by removing their tax payments rather than by reforming the entire economy. The fact that these punishment strategies are most likely to generate cooperative equilibria is explained in Appendix D.

The value functions of O players in this corrupt equilibrium and in the best one shot deviation are given by the following two recursive equations (the asterisk denotes the equilibrium path):

$$V_o^* = \frac{1}{1-\delta_O}\left(R_o^* + \alpha u\left(G^*\right)\right) \tag{10}$$

$$V_o^{OSD} = T_o^* + \alpha u\left(G^*\right) + \delta_O\left(\frac{0 + \alpha u\left(G^*\right)}{1-\delta_O}\right) \tag{11}$$

Here OSD stands for the best one-shot deviation for one player, and $\delta_O \in (0,1)$ is the discount rate of players in group O. For group O therefore, the value of staying in the cooperative equilibrium is that of receiving the rents R_o as well as the government goods for the foreseeable future. The value of the best one-stage deviation is that of capturing the entire tax payment once, and then receiving no further payments forever. Note that this requires that E players use strategies where faced with an individual deviation by one O player, they punish just that one O player, by switching to the one-period equilibrium in the interaction with him or her, rather than switching to the one-period (reform) equilibrium in all interactions. Because the actions of any individual government player do not affect players' total utility from government goods, by Assumption 1, when deviating from the

cooperative path of play and extracting the maximal rent, any government worker does not face a (meaningful) change in the total utility provided by the public good, as indicated in (11). For the postulated strategies to form an equilibrium, a necessary condition is that $V_o^* \geq V_o^{OSD}$.

The value functions on the equilibrium path and for the reform at the voting stage for the C players are:

$$V_c^* = \frac{1}{1-\delta_E}\left(w - T^* + \alpha u\left(G^*\right)\right) \tag{12}$$

$$V_c^{REF} = \frac{1}{1-\delta_E}\left(w - c - T^{**} + \alpha u\left(G^{**}\right)\right) \tag{13}$$

To these value functions needs to be added the value function for the punishment of one individual o player who deviated, in order to show that punishing that o player individually is credible. This individual-punishment value function is:

$$V_e^{*1} = \frac{1}{1-\delta_E}\left(w - T^{*1} + \alpha u\left(G^{*1}\right)\right) \tag{14}$$

Here T^{*1} is the optimal tax payments vector in which the constraint that the one o player who has deviated always receives 0 in payments. For these strategies to form a corrupt equilibrium it has to be that $V_c^* \geq V_c^{REF}$, and that individual punishments of o players, that lead to the value function V_e^{*1} if applied, are credible. Moreover, it has to be certain that if an equilibrium cannot be generated by the use of the individual punishment strategy, than it cannot be generated by other strategies, notably strategies that postulate switching to reform after individual deviations are observed. Appendix D shows that indeed the punishment is credible and a more effective punishment is not available to E players.

In the corrupt equilibrium, elites have to pay the equilibrium tax rate, which is used for rents for the government officials and for the production of G^* government goods. If C players institute reforms, these persist into the future under the given equilibrium strategies. Under the reformed system, they pay the administrative cost c as well as the tax T^{**}, which

is used entirely for the production of the optimal quantity of government goods G^{**}. At the other point when C (and all other E) players need to select an action, stage two of every period, it is easy to show that there are no profitable one-shot deviations for E players from the equilibrium strategy of paying T^*: any positive non-zero tax payment $T < T^*$ leads to its confiscation by the government officials, and the beginning of the reform phase in the next period. As having the payment be confiscated cannot be better than having some positive-utility government goods be provided, such a deviation would never be profitable. Any profitable deviation in which a total tax payment of zero is desirable for the E players can only arise off the equilibrium path, as Assumption 2 ensures that C players would always prefer enacting reforms in stage one rather than making a zero tax payment later on.

Any allocation of T, R and G that makes the two participation constraints, for O and C players hold can generate a cooperative/corrupt equilibrium. The following analysis establishes necessary conditions for at least one such equilibrium to exist, and shows that a sufficient increase in the demand for public goods, as indicated by α, will always lead to the breakdown of any such corrupt equilibria.

The individual official's participation constraint is a simple trade-off between receiving a rent forever and stealing the entire tax payment now, so to see if cooperative equilibria exist as α increases, the official's constraint can be kept holding with equality. Doing this leads to the following equilibrium condition (derivations of the following three results are found in Appendix D):

$$R_o^* = (1 - \delta_O)\, T_o^* \tag{15}$$

The rest of the tax payment T^* will be returned as government goods, therefore

$$G_o^* = \delta_O T_o^* \tag{16}$$

$$G^* = n_E \delta_o T^* \tag{17}$$

This shows that effective marginal cost of one unit of G for the E group under corruption

is $\frac{1}{\delta_O}$, higher than the cost of 1 under reform (because from a $\frac{1}{\delta_O}$ payment, only 1 will be used for public good production). From this it follows that the equilibrium tax payment T^* is defined implicitly by the modified Lindahl-Samuelson condition that sets marginal total utility equal to marginal total cost under corruption:

$$n_E \alpha \frac{\partial}{\partial(G)} u(G^*) = \frac{1}{\delta_O} \tag{18}$$

This condition implicitly defines T^*, by implicitly defining G^*. Therefore, under corruption the tax payment is higher and/or the quantity of public goods is lower than under reform, but under corruption the administrative cost c is not paid. The cooperation condition given by $V_c^* \geq V_c^{REF}$ is therefore (derivation in Appendix D):

$$(\alpha u(G^*) - T^*) - (\alpha u(G^{**}) - T^{**}) + c \;\; \geq \;\; 0 \tag{19}$$

Appendix D shows that this condition is equivalent to requiring that the consumer surplus under corruption plus the cost of reform are higher than the consumer surplus under reform. It is clear that for low values of α this condition will always hold for positive c. For example, as $\alpha \to 0$, both equation (18), which defines T^*, and equation (2), which defines T^{**}, indicate $\frac{\partial}{\partial(n_E T)}(n_E T^*) \to \infty$ which leads to $G^* \to 0, T^* \to 0$ and $G^{**} \to 0, T^{**} \to 0$. This would make the condition for corruption be $c \geq 0$, which is always true. However, as the demand for public goods increases, as indicated by an increase in α, the condition will be violated. The proof of this proposition is provided in Appendix D. The intuition is simple: as public goods become more important, economic elites would like to invest "a lot" in public goods. A cut of this investment needs to be given to the government officials to keep them cooperating, and as the required investment becomes higher, this cut will also become higher, hence the losses generated by tolerating corruption will themselves become higher.

Proposition 2: *There always exists an α^{RC} beyond which reform is preferred by C players to corruption. If $\alpha > \alpha^{RC}$, then all C players vote for reform, while if $\alpha \leq \alpha^{RC}$,*

corrupt equilibria can be sustained.

If the reform condition holds for group C, then group B would not vote for reforms, as they would get the same result (reform), but lose the extra profits (this is under the assumption that O players have a reason to condition the behavior of B players). The fact that all players belonging to a group vote the same, even if any one player switching their vote would not affect their utility unless they happened to be pivotal, is given by the assumption that the players do not use weakly dominated strategies in the voting equilibrium. An interesting question is whether it is possible for the O players themselves to prefer reforms to corruption. While under corruption they gain rents, it may be that the underprovision of the public good makes them also prefer reforms instead of corruption, for severe levels of underprovision. The condition for an O players to prefer reform to corruption is

$$V_o^{REF} \geq V_o^* \tag{20}$$

$$\frac{1}{1-\delta_O}\left(\alpha u(G^{**})\right) \geq \frac{1}{1-\delta_O}\left(R_o^* + \alpha u(G^*)\right) \tag{21}$$

$$R_o^* \leq \alpha u(G^{**}) - \alpha u(G^*) \tag{22}$$

However, the following result shows that as α increases, A players become less likely to prefer reforms, so if they are non-reformist at low levels of α, they are sure to stay that way. (The proof is presented in Appendix D).

Proposition 3: As α increases it will be the case that $R_o^* > \alpha u(G^{**}) - \alpha u(G^*)$ and hence A players become sure to prefer corruption.

As long as A players do not prefer reform, it is an equilibrium behavior for them to condition the behavior of B players in order to induce them to not vote for reforms either.

It is instructive to consider what would happen in case a B player was pivotal, instead of a C player, in the realistic case in which O players do not want reform. Now all non-B players use the same strategies as above, with B players being the ones who must be

dissuaded from voting for reforms. In this case, a vote for reform means losing a share of the his or her income for the B player expressing it, so the condition for maintenance of the corrupt equilibrium that applies to a pivotal B player, instead of (19), becomes (derivation in Appendix D):

$$V_b^* \geq V_b^{REF} \tag{23}$$

$$(\alpha u(G^*) - T^*) - (\alpha u(G^{**}) - T^{**}) + c + w^S \geq 0 \tag{24}$$

The choice of corruption or reform in case a B player is pivotal is given by the following proposition (proof in Appendix D):

Proposition 4: *If a B player is pivotal, there always exists an α^{RB} beyond which the pivotal B player prefers reform. However, it is always the case that $\alpha^{RB} > \alpha^{RC}$.*

For reasonable values of the parameters, it will be the case that $\alpha^{RB} \gg \alpha^{RC}$. This is because the term w^S is the income of the B player that is dependent on the government, and it is likely to be much larger in absolute value than the other terms in the inequality. This suggests why in many corrupt societies economic elites that have political power tolerate the corruption of government officials, even though they lose some utility by doing so.

The main empirical predictions of the model are that an increase in the demand for government goods will make the pivotal C group of players switch their behavior from tolerating corruption to voting against it. Government workers, if against reform at low levels of the demand for public good, are sure to remain against as the demand increases. If favorable to reform at low levels of the demand, government workers are sure to become against reform as the demand increases. Rigorously, B players are predicted to vote against reforms in case O players do not want reforms and therefore have a reason to condition B players' behavior. However it should be noted that once it is known that C players will institute reforms, the only reason A players have to constrain the behavior of B players through the extension of their agenda from $\mathcal{B}^1$ to $\mathcal{B}^2$ is if the assumption of not using

weakly dominated strategies is also made for them with respect to this. Otherwise, since the outcome of the vote is known, then A deviating from a strategy of conditioning the awarding of rents on votes is also an equilibrium strategy, which would mean that B players are not constrained to vote for corruption.

Empirical analysis

Data

Roll-call data from the period under analysis is extremely limited, as meetings of the House were not public, and an official list of the votes did not begin to be recorded until 1836. Whenever the House "divided" (voted yes or no on a motion), one or more MPs, called tellers, would make a list of the MPs who voted for, and one or more MPs would make a list of the votes against. These lists were not then kept in the archives, only the aggregate results of the vote. However, some of these lists did survive and made it to the public. Donald Ginter (1995) has assembled all the remaining division lists between 1760-1820 in a series volumes, and this will constitute the source for roll-call data. Because these are unofficial lists, they have some limitations: First, only a limited number of divisions have survived, so data on some of the most interesting votes of the period is lost for posterity. Second, because the yes and no lists were recorded separately, for some divisions only one of the two has survived in its entirety, with the other list only partially available. Third, sometimes the exact numbers of for and against votes from these lists differs by a few from the official records, probably a result of their un-official nature. In spite of all their limitations, Ginter's division lists offer an unique insight into the activity of the House of Commons in this period.

A model seeking to explain these voting patterns needs independent variables relating to the characteristics of the MPs expressing the votes. Extensive information on the members of the House in this period can be found in the History of Parliament (HP) (1998) series of volumes. The parts of the HP which are relevant for the analysis here are those on the

years 1754-1790 (3 vols., ed. by Namier and Brooke, 1964), and on 1790-1820 (5 vols., ed. by Thorne, 1986). The HP presents biographies of each MP in these periods. A sample entry is presented in Appendix B. These biographies are the main source for coding the independent variables, which deal with the individual characteristics of each MP and their electoral district. As there are over 1700 MPs which enter the dataset, and the relevant texts sum to over 6000 pages, manual extraction of the needed information would be prohibitively difficult. An automated procedure was employed instead to extract the needed information from the text of the HP. This procedure has the advantage of transparency and replicability when compared to human coding: the criteria by which the various variables have been coded are transparent and are consistently applied to each entry. A discussion of the algorithms used to extract the data is available in Appendix B. The dataset also contains some variables assembled by Judd (1972), who provides lists of merchants, bankers, directors of the Bank of England, "nabobs" and other MPs with colonial ties, and manufacturers. These lists are useful for coding the key occupation variable.

For the occupation variable that captures belonging to groups A, B, and C from the theory, MPs have been categorized into occupational groups following the categories used by the HP, Namier, and Judd. All three sources follow some categorization that revolves around the groups government officials, military, business/bourgeoisie, and landowners. There can be a lot of overlap between these categories, as there was no prohibition on someone, for example, being a government official and having substantial business interests and a high military rank at the same time. MPs have been categorized in eleven occupations, which will correspond to eleven dummy variables in the empirical models. The possibility of overlap between groups is maintained, as described below.

Group A

Military: A large number of members of the elite held some military rank, but for many, these ranks were gained in their youth, and they did not progress to a career in the military.

Therefore only MPs who gained the rank of at least Colonel in the Army and that of at least Rear-Admiral in the Navy are classified as being part of the military. These individuals can reliably be characterized as career military officers, who depended on the government for their well-being, at least in their role as officers.

Government officials: Unlike the other occupation variables, this one can vary over time: for each MP, he is coded as a public official only in the years in which he is indicated to hold a public position in the the HP. While public servants and sinecure-holders tended to keep their public jobs until their death, those holding political offices could have been holding them for only a short period. The HP lists, for each MP, all public offices he has held, together with the years of service. All employment related to the central government is included, but mostly symbolic positions such as that of sheriff, which belonged to the local administration and were a natural result of the influence an individual might have held in his home region are excluded. The full description of the algorithm used can be found in Appendix B.

Group B

It is harder to precisely delimit the members of group B. Judd presents a list of MPs that had investments in the colonial companies, and who were associated with the Bank of England, but these individuals also had other business interests, which might have mattered more to their calculations than the investments in assets whose returns were directly dependent on the government. However, finding support for the fact that these individuals were on average more likely to vote against reforms than those who were clearly members of group C would be supportive for the logic of the theory. The three groups listed under B for the purposes of the empirical model are as follows. *India bourgeoisie:* The members of this group were generally very rich and were often called *nabobs*. This variable is coded using the lists provided by Judd. *West Indies bourgeoisie:* This is a group made up of individuals who had substantial business interests in the Caribbean. *Bank of England:* Judd presents a list of

bankers in the House and distinguishes between those associated with the Bank of England, a private but quasi-governmental institution, and other bankers.

Group C

For group *C*, *bankers (not with the Bank of England), merchants, manufacturers* and *physicians* are each coded using a list from Judd. Variables that warrant some discussion are:

Lawyers: Many MPs had some legal qualification, but it is harder to know how many relied on this as a substantial source of income, as getting a legal education and being called to the bar were often natural steps towards other professional careers. Judd does not list lawyer MPs, so this information was extracted from the text of the HP as described in Appendix B. The algorithm does not rely on legal education, which was held by many MPs, but instead codes as a lawyer an individual who: 1) had been called to the bar (and therefore was a barrister), or was among the few who were are listed as solicitors and attorneys, and 2) is not established to be a merchant, military man, manufacturer, or physician by Judd.

Landowners: As explained, a more appropriate name would be "landowners-only". Without doubt, most members of the House held some property in the form of land. Those who were not listed in any professional category are however considered by Judd and the HP to be the residual category of pure landowners, not involved in business or government. An individual is coded a landowner-only if he was not part of the other categories when expressing his vote. Individuals in this category held property in the form of land and this was their only role in the economy.

The other individual-level variables have been extracted from the text of the HP. First, those relating to the personal background of the MP:

Public school education: Namier and Judd emphasize the role of public school education for forming a common class spirit among the oligarchy. This variable is coded as 1 if the MP is listed in the HP as having attended one of the seven public schools identified by Judd. *University education* and *Grand Tour* (a multi-year tour of Europe in youth) also speak to

the MPs' exposure to reformist ideas.

First son: Being a first or younger son was crucial in the social structure of the times. Strict primogeniture rights awarded the estate of the father to the first son only, with no possibility of splitting it. Aristocratic titles as well were passed on only to first sons. Younger sons mainly had to provide for themselves. Typical career paths for younger sons of the oligarchy were the military, government, the colonies, law, or business. *Aristocratic title:* MPs could accede to an aristocratic title either by inheriting it from someone or by having it be granted by the executive to them.

It is also useful to identify MPs that belonged to the Whig group in the House. While it is the case that MPs were identified as belonging to a group because of their voting patterns, rather than having their voting being determined by belonging to a group, the Whigs and their progressive and anti-court attitudes might be suspected to have affected the voting patterns of their members through their very distinctive ideological characteristics. Variables indicating adherence to the Whig ideology are either *membership of the Whig Club*, or *membership of Brooks' Club*, which was a social club frequented by individuals with Whig views.

Electoral characteristics of MPs' constituencies are also important, as they need to be kept constant when evaluating the effect of occupation on voting patters. These characteristics are indicated by the following variables: *Contested election:* Did the MP arrive in the House through a contested election when expressing any given vote? Constituency-level data provided by the HP is used to code a dummy variable for this. *Size of the constituency:* This is generally considered an indicator of the amount of "influence" that could be exercised over the voters. The HP uses a division of constituencies between small (under 500 voters), medium (500-1000 voters), and large (over 1000 voters) and the dataset uses these categories as well. *Type of franchise:* There were eight types of franchise, that is criteria for deciding who in a given constituency was allowed to vote: county franchise, various types of borough franchise, and university franchise.

The dependent variable is the vote expressed by an MP in one of thirty divisions between 1779 and 1819 which are relevant for the research question at hand. The dataset therefore has an MP-vote format. The list of divisions and the justifications for their inclusion in the dataset are given in Appendix A. The full list of available divisions can be found in Ginter (1995). In all cases, a 1 for the vote variable corresponds to a pro-reform vote. In all there are 7141 votes expressed by 1708 MPs. The dataset includes only divisions which were explicitly about the topics that have been described as being part of the corrupt system: sinecures, government contracts, remuneration of public officials, impeachment efforts, and audits of the executive's expenditures. The first ones are from the 1779-1780 period and relate to the "economical reform" program whose main promoter in the House was Edmund Burke. Divisions on bills to prohibit government contracts from being awarded to members of the House, to remove some positions which were considered sinecures, and to audit the pensions which were secretly handed out by the executive are included here. Bills on soliciting public contributions to the executive, and for the reduction of sinecures from 1794 and 1797 are also included. Another set of divisions is on the corruption scandals involving major government officials after 1805: the secretary of the Navy, Lord Melville, commander-in-chief of the Army, the Duke of York, the future foreign secretary Viscount Castlereagh, and Prime Minister Spencer Perceval. A large number of divisions after 1813 are on proposals to set up a committee to audit the expenditures from the Civil List, which reformers argued were often corrupt in nature. Another set of bills are about the abolition of sinecures explicitly. After 1815, efforts to establish a pension system for officials were also promoted by reformers, and this is reflected in a few divisions. Three divisions on electoral bribery and the sale of offices are also encountered towards the end of the period, with the last bill included in the sample from 1819.

Statistical model

The first type of statistical model used to test the theory is a logit model in which the main variables of interest are the occupational dummies:

$$v_{it} = L(\beta_1 g_{1it} + ... + \beta_{11} g_{11it} + \gamma X_{it}) + \varepsilon_{it}$$

Here L is the logistic function. This model corresponds to the use of a dataset in which for each MP i one or more votes of yes or no are recorded, indexed by t. The dependent variable v_{it} is binary. Variables g_{1it} to g_{11it} are dummies for the eleven occupational groups identified above. The vector X_{it} collects possible control variables, and γ collects the coefficients on these variables. The error terms are ε_{it} and are assumed to be arbitrarily correlated within one MP's votes. An intercept is not included, to help with the presentation of the results: without an intercept, a logistic function of the coefficients β_1 to β_{11} represents the predicted probability of voting in favor of reforms given that an MP is a part of that group, rather than the difference from some baseline group. Also, the logistic transformations of the confidence intervals bounds represent the bounds of the confidence intervals for the predicted values.[7] A Wald test for equality of coefficients can be used to test whether one group's predicted probability is different from another's. In case the control variables in X_{it} are included, they need to be set at a fixed level to be able to make a prediction for vote share using the coefficients on the g variables of interest. Since all controls will be dummies, they will always be set at their modal/median value whenever presenting results of models that use controls. Since there is reason to believe that one MPs' votes will be correlated from a division to the other, arbitrary autocorrelation and heteroskedasticity inside an i group is allowed through the use standard errors clustered at the MP level in all models.

A second type of model groups individuals in the three A, B, and C groups, according

[7]The same results can be obtained in a model with an intercept, with predicted vote shares obtained from summing up the coefficient on the dummy of interest to the coefficient on the intercept, and confidence intervals for predicted vote shares as confidence intervals for this linear combination of coefficients.

to the description provided above. Now the model is:

$$v_{it} = L(\beta_A A_{it} + \beta_B B_{it} + \beta_C C_{it} + \gamma X_{it}) + \varepsilon_{it}$$

The logistic transformations of the coefficients on the A, B, and C dummies are also interpretable as predicted vote shares, and three Wald tests for the equality of the coefficients between the three groups are always presented. Again, the possible control variables are set at their modal/median values. All confidence intervals and tests are based on standard errors clustered at the MP level here as well. To aid in interpretation, results are generally presented graphically, indicating the p-values for the relevant statistical tests on the graphs.

This model accommodates two concerns that might be raised about the possibility of using the available data to test the theory: the existence of missing votes, and the fact that the "influence" of borough patrons might bias the results.

Missing votes. The nature of the roll-call data from Ginter means that often the full dataset for a division is not available. There are two different types of missingness: First, missingness which is due to the imperfect recovery of both the majority and the minority list. As can be seen in Appendix A, for many bills, while both the majority and minority lists have been recovered, they differ somewhat from the voting totals, indicating that some votes have been lost. This kind of missingness can safely be assumed as random, and will not affect the bias or consistency of the estimates, but merely make the sample smaller. The second kind of missingness is that due to cases in which only one list has been recovered. In the data, it is the case that reformers' names became public more often than anti-reformers' names, so the share of the reform vote will be overestimated in the full sample. In these cases, the predicted pro-reform vote shares for the various groups will be overestimated, but the differences in voting behavior between groups will be maintained. This kind of missingness does not affect the estimates of marginal effects of the independent variables on the dependent variable because it is not generated by the independent variables: a reduction

of the number of "no" votes in the dataset does not change the proportion of the various occupational groups who voted for or against, but merely reduces the sample size. To show that the results are not generated by the missingness of some "no" lists, two sets of results are presented: in the body of the paper, results on the full (unbalanced) sample, and in Appendix C, the same models on the restricted, balanced, sample. It will be the case that the two sets of results are very similar in terms of differences in voting behavior between the groups, indicating that the missingness due to non-recovery of some lists does not affect the validity of the findings.

Influence of patrons and "parties". In most contemporary legislatures, a vote by a legislator might reflect his or her preferences on the issues at hand only to a small extent, with the need to follow the party line as the predominant motive. (Of course, it could also be the case that legislators join parties that advance their preferences in the first place.) In the period under analysis, this is less of a concern, as parties in the modern sense did not exist. What did exist was the connection between the MP and the patron of the district that the MP represented, ranging from situations in which the MP was the "owner" of the district, and did not need to take into account anyone else's interests, to situations in which he was a mere placeholder for the patron.

The interests of the patron could generate omitted variable bias if it were the case that pro- or anti-reform preferences of patrons caused them to choose to support candidates from certain occupational groups for their districts. If the interests of the patron are not correlated with the occupational group of the MP however, then no bias emerges. If the district patron-MP connection is what generated the connection between occupational group and voting behavior, then it is expected that when the relation is analyzed in subsamples where the patrons' influence is low or missing, the connection between occupation and voting behavior should disappear. There are two ways of identifying such subsamples: First, it is well established that "influence" depended a lot on constituency size: the smaller the constituency, the more likely it was that it was under the control of a patron (Briggs, 1959).

When the analysis is restricted to these large constituencies, the effect of occupational group on voting behavior fails to change, which indicates that omitted variable bias due to patrons' influence is not a valid concern, except for the case of the B-type MPs, as will be explained. Similarly, districts in which elections had been contested were less likely to be under the strong influence of a patron. Again, results on this subsample will be similar to results on the full sample, so omitted variable bias will be shown to not be a concern.

Another concern about possible omitted variables is that the political "party" with which an MP identified might have constrained his behavior. This is in general hard to argue for, as the political groups identified by the various commentators clearly reflected MPs voting patterns, rather than the other way around. Krehbiel (1993) is an exposition of the idea that observing similar voting patterns among members of a legislature does not mean that membership of parties is a significant determinant of voting patterns. The crucial reason why parties did not themselves determine MPs' votes in Britain at the time was that there were no party organizations that could have helped or hindered the MPs' re-election. However, in the case of the group of Whigs, it could be argued that their distinctive ideology acted as a sort of constraint on MPs' behavior because of the social network that made up the "Whig world" (Mitchell, 2005). Controlling for belonging to the Whig group is clearly an example of post-treatment bias, because a result of the treatment variable is controlled for (an MP was a Whig mainly because he had certain preferences, not the other way around). Results where belonging to the Whig group is controlled for are however included, and they again do not show the relation between occupation and voting behavior breaking down.

Results

Before presenting the tests of the theory, other possible explanations of voting behavior in the sample are analyzed, to show that they are not good or complete models of the observed data. To test these hypotheses, Table 1 presents logit regressions (with an intercept) of the voting dummy on a number of predictors. The first set of theories that could be argued

to explain the reforms have to do with the emergence of the bourgeoisie as an important political player, and the conflict between the aristocracy and the bourgeoisie. By its nature, corruption has a pre-modern aspect to it, and the relations of patronage and extraction that it entails are not unlike the feudal relations between the various strata of the aristocracy and the commoners. A new class of business-people would not be expected, if it itself was not somehow brought into the system, to be in favor of a system of extraction by politicians, so a reasonable hypothesis would be that the rise of the bourgeoisie meant the appearance of a class who was opposed to corruption. As the theoretical model shows, this is not the case if the business-people can be brought into the system by being offered protection for their rents by the politicians, in exchange for them tolerating corruption by the politicians.

Indeed, in spite of the intellectual tradition arguing in favor of its importance, the bourgeoisie versus aristocracy dichotomy fails to generate any traction in explaining the observed events in the data. In table 1, models 1-2 show that a simple dummy for bourgeoisie, coded as 1 if the MP belonged to the categories merchant, India/West Indies bourgeois, banker, lawyer, manufacturer, or physician is not at all significant in predicting observed voting patterns. Why this is the case should be obvious from the discussion in this paper: individuals in these categories varied widely in how much they benefited from the corrupt system, with the colonial business-people and the bankers in the Bank of England having a special relation with the executive which made them unlikely to challenge politicians' privileges. Similarly, models 3-4 show that a dummy for an aristocrat MP fails to predict voting behavior. Why this is the case should also be obvious: far from being a unitary group, the aristocrats varied in their relation with the corrupt system, from those who were professional politicians or depended on sinecures for their livelihood to the great landowners who fought against politicians' privileges. The second set of claims that can be tested relates to the MPs' personal backgrounds. MPs varied in their exposure to education and the world outside Britain, as well as in their status in life as first or younger sons. In models 5-6, it is shown that these personal background variables fail to explain voting patterns in any meaningful way (the

Table 1: Relation between biographical and electoral variables, and pro-reform votes

Pro-reform vote	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Bourgeoisie	.060	.103								
	(.63)	(.39)								
Aristocrat			.024	-.369						
			(.85)	(.76)						
University					.091	.055				
					(.47)	(.64)				
Public school					.174	.171				
					(.16)	(.16)				
Grand tour					.050	.033				
					(.87)	(.91)				
First son					.108	.119				
					(.38)	(.31)				
Contested elect.							.226	.260		
							(.04)	(.01)		
Large const.									1.376	1.38
									(.00)	(.00)
Medium const.									.725	.823
									(.07)	(.03)
Small const.									.483	.521
									(.19)	(.15)
Constant	-.222	.110	-.211	.157	-.377	-.015	-.269	.067	-.993	-.679
	(.00)	(.11)	(.00)	(.02)	(.00)	(.00)	(.00)	(.30)	(.00)	(.05)
Balanced samp.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
No. of obs.	5776	7141	5776	7141	5640	6977	5776	7141	5776	7141
Pseudo-R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03

Logit regressions with standard errors clustered at the MP level.

first son dummy is also not significant on its own).

The fact that electoral constraints influenced MPs' reform votes is not a surprise. In the models in which the impact of occupational group on voting is tested, these factors need to be kept constant, because of the need to explain whatever variation in reform preferences there is outside that generated by citizens' natural desire to limit corruption. Models 7-8 show that indeed MPs that had entered the House through a contested election were more likely to vote for reforms. In models 9-10, it is also shown that the larger the constituency, the more likely the MP is to vote for reforms (the baseline category in these models is "unknown"). It is well established that larger districts were those in which popular opinion mattered more, so it is to be expected that MPs elected in these districts would be more reformist.

Popular opinion has also been argued to be a cause of the reforms, by taking the form of revolutionary pressure (Harling, 1996b). The extent of popular revolutionary movements in Britain during the French Revolution is debated. Hobsbawm (1996) argues in favor of the

existence of an extensive revolutionary movement in Britain at the time, while Woodward (1962) argues the danger of revolution was exaggerated by the ruling class. In the "revolutionary pressure" view, the fear of French-style revolution is what led the British elite to enact reforms. This approach overlooks the extensive intra-elite conflict over the reforms, as well as the fact that the reforms began some 10 years before the French Revolution. This paper argues that there is no evidence that the safety of the British political or economic establishment was seriously questioned by contemporaries. This is based on two pieces of evidence: The first is the evolution of interest rates on government debt in this period. If investors doubt that the political system will survive, they would ask for higher interest rates to compensate for the increased likelihood of government debt being repudiated. Figure 5-left plots the nominal rate of interest on long-term government debt in the period under analysis. There is no obvious spike in the rate to correspond to increased fear of popular revolution. Indeed, in the years after the Revolution started in France, the interest rate reached historical lows. The high in interest rates in the late 1790s can be entirely explained by a bout of inflation due to the suspension of convertibility to gold in 1797, which drove nominal interest rates higher. The pattern of interest rates in this period corresponds to a situation in which investors came to expect slightly higher average inflation than usual, but are very far from suggesting a realistic concern on the part of contemporaries with serious political break-down in Britain.[8]

This view of stability is reinforced by movements in the prices of stocks. Using stock prices as indicators of concern with political developments has an established tradition (see Cutler et al., 1998; Fisman, 2001). Figure 5-right plots an index of share prices assembled from Mitchell (1988). Again, stock prices do not behave differently from the historical norm, seeing a rise after the beginning of revolution in France, a fall in the late 1790s as taxation

[8]In 1799 and 1800, inflation spiked to 20% and 30% respectively as the government appeared to use the inflation tax to help finance the war. Appendix C presents a graph of a roughly-calculated real interest rate, by subtracting the yearly inflation from the yearly nominal interest rate. Since the retail price index used as a measure of inflation swings widely from one year to the other, the real interest rate thus calculated swings as well, but does not show any increasing or decreasing pattern in this period.



Figure 5: Left: Interest rates on consols (perpetual bonds) issued by the British government. Data from Mitchell (1988). Right: Stock prices index of British companies. Data from Mitchell (1988).

increased and trade with the continent was blocked, and then a recovery to the historical trend. (The huge increase in 1822 is due to a speculative bubble in mining stocks.) These movements in prices are not at all compatible with an expectation of revolution in Britain or of significant violent changes in the economy and polity. The fact that the intra-elite dynamic rather than external pressure is what led to the reforms is also confirmed by the lack of an increase in electoral competitiveness in this period. Between the 1760s and the 1820s, approximately 25 to 30 percent of districts were contested in every election (Appendix C), so whatever electoral pressure did exist, it was constant throughout the period.

The stability in economic indicators and political competitiveness should not obstruct the large shock that did affect Britain in the period under analysis. The wars with the colonies and especially with France did bring an unprecedented change to British politics and economics: government activity increased a lot as resources needed to be mobilized to fight the wars. The theory predicts that MPs should form anti- and pro-reform coalitions based on their interests with respect to politicians' corruption when the demand shock occurs.

The implication that reform should be observed whenever the demand for government activity surpasses a threshold is easily verified by noting that reform efforts are dated as beginning in 1779, right as the expenditure levels plotted in Fig. 2 were reaching a new

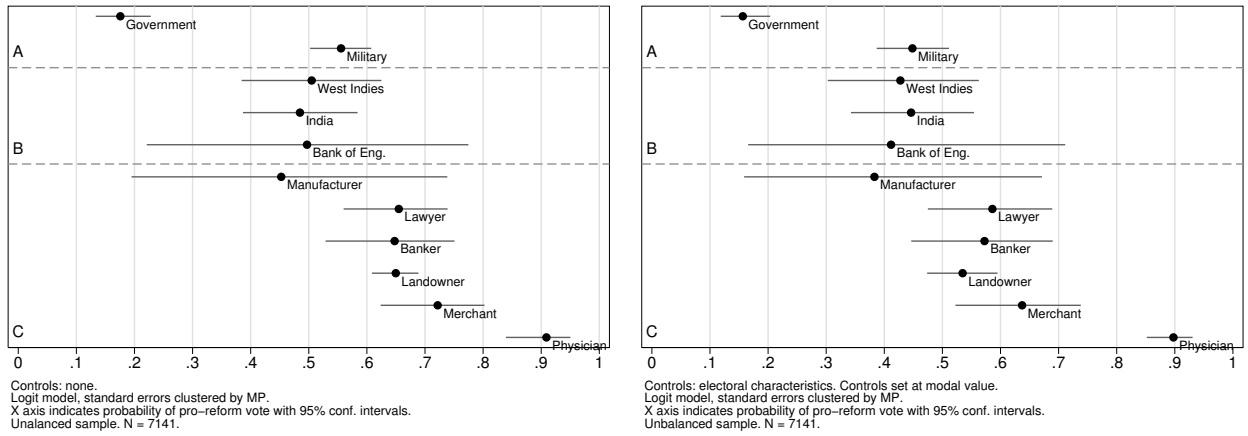


Figure 6: Left: Voting behavior by occupational group, no controls. Right: Voting behavior by occupational group, controls: electoral characteristics.

historical high. Reform efforts became intensified after the unprecedented increase in government expenditures that started after the 1793 beginning of the conflict with France. No bills relating to the sort of reforms discussed here can be found before that in either Ginter (1995), or in Hoppit's (1997) exhaustive list of failed legislation, or in the historical account of administrative reform by Chester (1981).

The more subtle predictions about how the various groups will vote in these matters require direct analysis of of roll call data. The logit models that use the occupational categories variables illustrate how the eleven categories are predicted to vote, and also allow for tests of hypotheses about the voting patterns of groups A, B and C. Figure 6-left presents the predicted vote shares and 95% confidence bands when including just the occupational dummies, without controls. (The corresponding models for the balanced sample are all presented in Appendix C, and always show similar results.) Government and military MPs are less inclined towards reforms than the coalition of independent bourgeoisie and landowners, with the dependent bourgeoisie group in the middle. Figure 6-right presents the same model, controlling for electoral characteristics of the district the MP came from: whether there was a contested election, the size of the constituency, and the type of franchise. This model is instructive because of the need to explain variation in voting patterns that cannot be

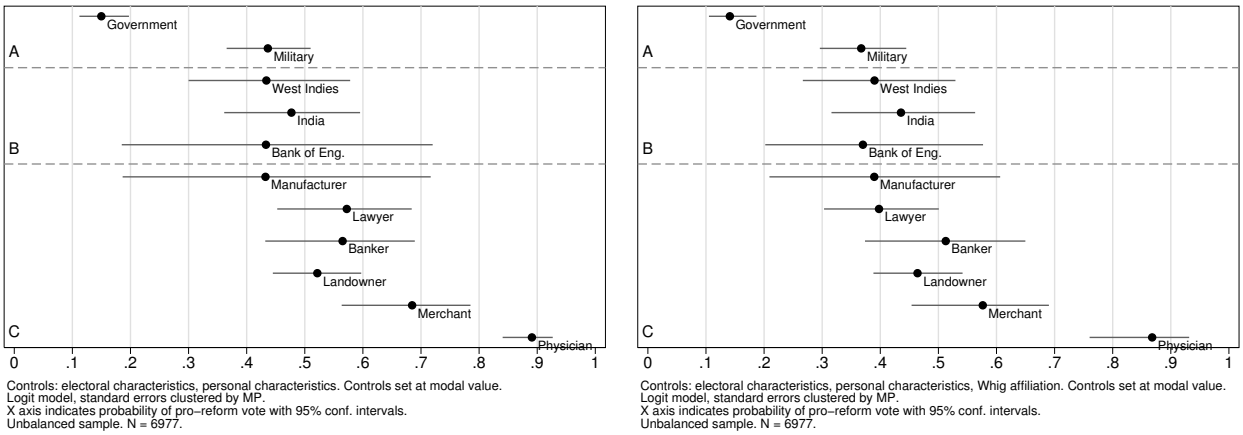


Figure 7: Left: Voting behavior by occupational group, electoral and personal background controls. Right: Voting behavior by occupational group, electoral and personal background, and Whig membership controls.

explained by electoral constraints. Again, government and military MPs were less favorable to reforms than merchants, landowners and other members of group C, with the dependent businesspeople somewhere in the middle.

Figure 7-left presents a model in which the personal characteristics of the MP are added as controls: university education, public school education, the "grand tour", first son status and aristocratic title. These controls fail to affect the general relation between the occupational groups and voting behavior. Figure 7-right adds the two controls for belonging to the Whig group: membership in the Whig Club, and membership in Brooks' Club. While these controls generate post-treatment bias, adding them does not remove the general trend in the results.

The theory predicts that there should be a significant difference between the voting behavior of members of groups A and C, with those in A less likely to support reforms than those in C. Figures 8-9 again present results without and then with controls, as well as the p-value for equality of coefficients on the estimates of the three groups' voting shares. These results indicate that group C is always expected to vote in a more reformist manner than group A, with the differences being in the range of 20-25 percentage points. Given the

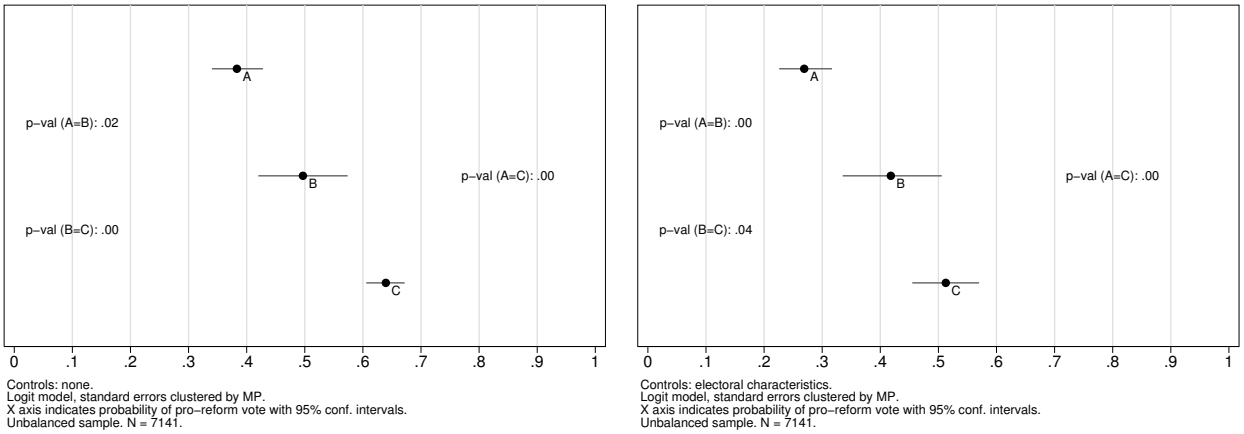


Figure 8: Left: Voting behavior of groups A, B, and C, no controls. Right: Voting behavior of groups A, B, and C, electoral controls.

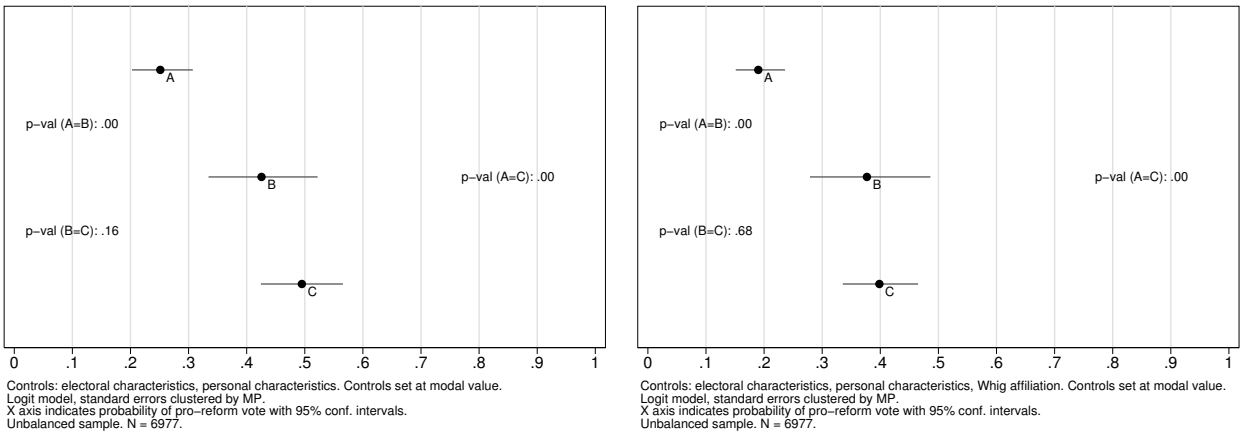


Figure 9: Left: Voting behavior of groups A, B, and C, electoral controls, personal controls. Right: Voting behavior of groups A, B, and C, electoral controls, personal controls, Whig affiliation.

measurement error assumed to be present in the the data, these differences are important.[9] Group B MPs are in between, and the difference between them and group C MPs becomes smaller as controls are introduced. Given that the measure of belonging to the B group cannot distinguish those MPs who also had other business interests, and therefore would better be categorized as C, this was to be expected. However, note that there does exist a clear difference between the colonial merchants and their counterparts without colonial interests in the models in figures 6-7. This shows that individuals who had some business interests that were dependent on the government for their returns did vote in a less reformist fashion than their counterparts who did not own such government-dependent assets. For example, in the model in figure 7-left, where electoral and personal characteristics are controlled for, the differences between India merchants and the regular merchants or between West Indies merchants and regular merchants are always significant at the .00-.02 level. An explanation for why B players appear to vote in a more reformist fashion than predicted by the strict interpretation of the model will is offered the following paragraphs by taking into account the omitted variable of influence at the district level.

To check whether the preferences of district patrons are an omitted variable driving these results, the analysis can be restricted to either only large constituencies or to only constituencies where the election had been contested. Figure 10-left presents the results for the sample of large constituencies only, in a model in which electoral and individual characteristics are controlled for (the results without controls are similar). The difference between groups A and C is maintained, which shows that it was not generated by the interests of borough patrons influencing both the sorts of MPs that got elected in their districts as well as their voting patterns. Group B is now more similar in behavior to A than to C. This suggests that, when unconstrained by the interests of the patrons of the boroughs in which they ran, members of group B are more likely to oppose reforms than the full-sample models

[9]Measurement error in the independent variables, would bias the coefficients of the logit model towards zero. A coefficient of zero on an occupational dummy corresponds to a predicted vote share of .5 when applying the logistic transformation, so the bias towards zero that is usually expected in the presence of measurement error in the independent variables means bias towards .5 predicted vote share in these models.

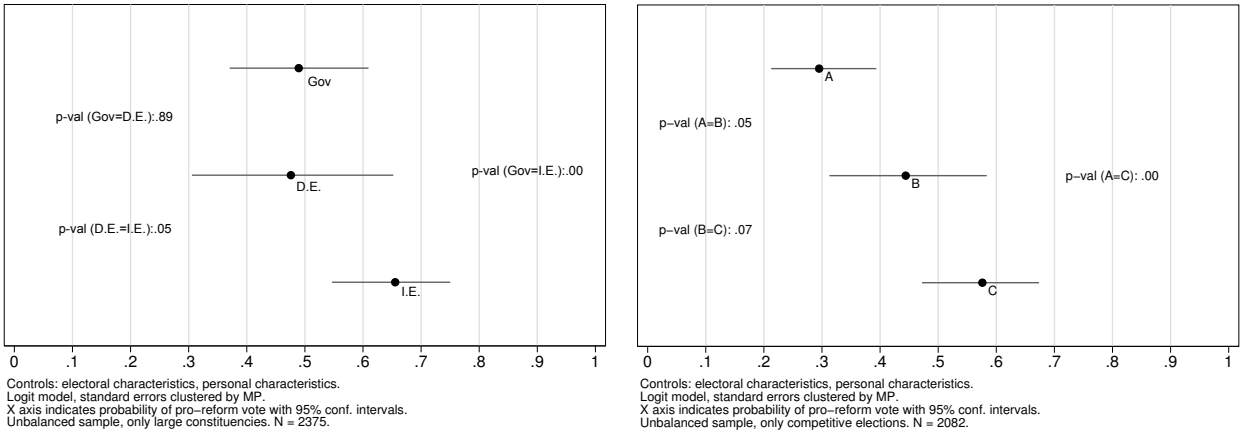


Figure 10: Left: Voting behavior of groups A, B, and C, electoral and personal controls. Only large constituencies. Right: Voting behavior of groups A, B, and C, electoral and personal controls. Only competitive constituencies.

suggest. Therefore, it appears that the reason the B players in the sample vote in a more reformist fashion than what was expected of them has to do with the need to balance their interests with those of borough patrons: when unconstrained, they vote against reforms, but since most borough patrons can be expected to be large landowners, who are argued to be reformist, then it was to be expected that when having to consider the interests of borough patrons, B players would vote more in a more reformist fashion than they would otherwise have done. B-type individuals arguably depended more than other type of MPs on patrons' influence for their election: since they were often individuals who had lived for a long time abroad, or who lived in London, they did not generally have a natural home constituency which they could win without the help of a patron. Therefore, the empirical analysis provides encouraging evidence that the voting behavior of B-type individuals is that predicted by the model, with this conclusion being muddled in the data by the difficulty of distinguishing between B and C players, and by the "influence" variable which makes B players appear more reformist than they really were. However these two considerations do not affect the key fact that A and C groups differed vastly in their voting behavior, which is the key of the theoretical model.

Figure 10-right presents the same model on the sample of only competitive elections, thus in districts in which "influence" was less important. Again, the difference between the voting patterns of members of group A and group C is clear, and B sits somewhere in the middle. These results show that even in districts in which there was less need for MPs to balance their preferences with those of borough patrons, the distinction in voting patterns predicted by the model is maintained, which shows that omitted variable bias due to the lack of information on the constraints imposed on the MP by borough patrons does not seriously affect the results in the full sample.

Discussion of the results

This paper offers an explanation for how Britain came to engage in administrative reforms to eliminate corruption in the late 18th and early 19th century. Britain had a political and economic structure that facilitated the switch to a reformed, relatively un-corrupt, system of public administration. A large part of the political elite was made up of individuals who derived their income from sources other than government or government-protected activities. When faced with the exogenous shock of an increase in the demand for government goods, this part of the elite was pushed into supporting a system where monitoring costs are paid but extraction is limited. The need for politicians' favors for the asset-owners was limited by an institutional structure which allowed asset-owners to advance their own interests through the House of Commons, so there was little the officials could offer in exchange for toleration of their corruption.

The model implies that there should exist a relatively brief period in the political development of a country when such endogenous reforms can be enacted through the mechanism presented in this paper. Some or all of the conditions which are needed for the model to produce a reformist outcome seem to fail in many contemporary developing countries, which might explain why they do not switch to the reform equilibrium even when govern-

ment activity increases. In these countries, if representative institutions exist, professional politicians often take up all the seats, a natural result of modern party-dominated politics. Therefore all members of the representative institutions are members of the A group from the model, and other citizens need to relate to the political system otherwise than through direct participation. Also, asset owners, whether inside or outside of the legislature, seem to be easily bought into the system by being offered government contracts and favorable regulation, which is easier to do in a modern economy with high tax-gathering and regulatory ability on the part of the executive. In such a setting an increase in government expenditure, far from encouraging reformist moves inside the elite, would merely lead to more corruption.

Chapter 2

Legislative Bargaining and Open Access: Economic Reform in 19th Century Britain

Recent literature in political economy has put forward a set of developments in law and policy in 19th century Britain as the crucial institutional changes that allowed it be the first country to engage in modern economic growth. This paper develops a model of how the British political class came to give up its power to extract rents from the economy between the 1810s and the 1850s. The key of the explanation lies in understanding the bargaining process between economic agents who seek permission to engage in economic activity and a legislature that can grant such permissions. In an uncoordinated bargaining process the unique equilibrium outcome is that each citizen that seeks a permit will obtain one from the legislators for a payment of nearly zero. To avoid such an outcome, legislators design mechanisms that limit their freedom to bargain with the citizen, and help them achieve a higher payoff. Before the reforms, a patronage system through which the executive controlled Parliament worked as such a mechanism. The removal of the patronage system, far form making the legislature more powerful in its relation with outsiders, led to it accepting the free allocation of permits for economic activity, and hence to liberalization.

Introduction

The case of Britain in the 18th and 19th centuries has played a central role in the literature on comparative political and economic development: some of the most important contributions are North and Weingast (1989), Acemoglu and Robinson (2000, 2006), Lizzeri and Persico (2004), North, Wallis and Weingast (2009), Cox (1987), Stasavage (2003), and Root (1994). Not only was Britain the first nation to engage in modern economic growth, but

its peaceful and gradual path from authoritarianism and relative poverty to democracy and wealth recommend it as an important case for research in comparative development. A large part of the literature is in broad agreement with the idea that an especially favorable political equilibrium that emerged in Britain after the late 17th century generated an institutional framework which was favorable for economic development. Broad features of this institutional framework are secure property rights, free enterprise, and the rule of law.

Only recently however, did the literature progress to a stage where specific instances of institutional change are put forward as explanations for Britain's economic progress. North, Wallis, and Weingast (2009), and Mokyr (2009) are some of the first major works that go beyond talking about general notions such as secure property rights and free enterprise to putting forward detailed lists of changes in the legal and political framework in Britain which can explain its economic development. Both sources emphasize the importance of changes in economic policy and legal framework starting in about the second decade of the 19th century for later economic development. North, Wallis, and Weingast concentrate on "open access"—the emergence of free incorporation of private enterprise, that is the possibility of establishing a joint-stock, limited liability company, which only happened after key changes of legislation in 1825, 1844, and finally in 1855. Mokyr presents a longer list of similar changes, which include, in addition to free incorporation, the elimination of monopolies by chartered companies, the relaxation of banking laws to permit the formation of a modern banking system, the emergence of free trade, the elimination of limitations on the free movement of labor, and others. All these changes are similar, in that they all mark the shift from a system where economic activity is tightly controlled by those who hold political power for their own profit (be they the monarch or Parliament), to one in which access is free. As the distortionary effects of limitations on economic activity, and the necessity of open access to such activity are well established (see for example Bates (1981) or Acemoglu (2009)), the shift can form an explanation for the sustained rise in average income levels in Britain after about 1830 (Maddison, 2008). While the importance of free incorporation for development, as well

as the necessary conditions that must exist in a society for its emergence are convincingly presented in North, Wallis, and Weingast, a model of the mechanism by which this happens is not presented. Mokyr presents an argument for the importance of beliefs and ideas for these changes, but similarly does not develop a model of how they emerge in equilibrium.

This paper presents such a model and and argues in favor of the idea that its logic fits the facts of the British historical experience. A list of the changes in law and policy that form the subject of the analysis is presented in section 2. There is, obviously, a large historical literature on each one of these developments. Each one had its own peculiarities, its own set of conflicting interests, and its own story of how precisely it came about. (Detailed historical accounts include Harris (2000) for the emergence of free incorporation, and Irwin (1997) for the emergence of free trade, among many others.) However, in addition to the detailed historical aspects, there is arguably something connecting all of these changes, beyond their positive effect on economic growth. They all happen within a relatively short time period, mostly between 1820 and 1855. They all mark a similar shift from access to various economic activities on the basis of "permits" allocated by Parliament to free access to all those who desire to do so. And they all come about in rather non-dramatic ways as a result of decisions of Parliament that make official a new situation in which this is the only possible equilibrium. This paper seeks to complement the existing literature by political scientists, historians, and economic historians on each one of the individual changes, by presenting a unified framework to analyze them all.

The core of the theoretical argument is the following: Keeping everything else constant, rational, utility maximizing politicians will seek to use their ability to regulate the economy for their own profit (Stigler, 1971). If the state has the ability to limit the freedom of economic agents to engage in various activities (which any normally-functioning state should have), then those controlling political power would seek to profit from this ability by exchanging permissions to engage in economic activity for payments by those desiring such permits. The literature on rent generation and rent distribution is too large to summarize here,

but it should be noted that throughout history, in the absence of electoral constraints, or other factors that work against this tendency, such as the need to stay competitive in war (Tilly, 1992), such regulation has been the default state of political and economic systems (Buchannan and Tollison, 1980). Britain in the period under analysis is an example in which the political class renounces this prerogative and makes the "permits" available for anyone who desires them. A political class that acts as a unitary rational actor would not do so, so it is important to analyze how the British political class came to allow these changes in that period.

Before about 1820, Parliament showed no strong inclination toward such liberalization. Over-sized and disciplined majorities acted rationally in maintaining a system where those seeking incorporation, monopoly rights, and other privileges, had to seek a charter from Parliament. Those seeking the charters were normally expected to give something in exchange, whether actual monetary payments such as those made by the East India Company, employment, shares, political support, and other advantages for legislators and their families. The discipline of majorities was maintained not through party organizations, which were largely non-existent (Namier, 1929), but rather through the patronage system: While legislators were certainly free to vote however they wanted, large numbers of them were also aware that votes that are not according to the wishes of the administration would lead to the partial or total elimination of patronage income, which was freely dispensed by the executive. Patronage was under the control of the the executive even if there was little doubt that ultimate political control lay with the Commons, which controlled taxation and the ultimate use of any funds raised by the state. One beneficial aspect for majorities in the Commons of the fact that they gave up the control over patronage to an executive, was that the executive could use this control to maintain discipline in Parliament (Namier and Brooke, 1964).

It will be argued that one role of the distribution of tax income through the circuitous mechanism of the patronage was that of solving the legislators' collective action problem: Consider the problem faced by a legislature which can distribute permits for economic ac-

tivity through majority voting. An agent seeking such a permit has to pay a bribe/transfer to half of the legislators. The legislators can make proposals about the price they would be willing to exchange their vote for, but ultimately the agent has to agree to a given allocation by actually paying the bribe. That is, the interaction between them can be modeled as a legislative bargaining problem, in which legislators are free to make proposals regarding the distribution of the bribe, but the citizen has veto power on any allocation. It will be shown that in such a situation, the citizen can get the permit with an essentially zero expenditure: Any given legislator prefers to be inside a majority that votes for the permit and get some income, rather than be outside and get nothing. Any legislator that lies outside of the coalition would therefore be willing to replace a member of the coalition for a very small payment, which is better than the zero he or she is currently getting. Even if there are no legislators outside the coalition, and everyone gets a bribe, a subcoalition will always be willing to give the citizen a better deal by charging a lower total price, but distribute that lower total price among fewer coalition members. The model in section 3 develops these intuitions formally, by showing that the unique equilibrium outcome of the bargaining process is one in which a "cheap" majority is formed in which the legislators sell the permit for a bribe that collapses to zero as the discount rate increases. The problem is closely connected to the non-existence of the core in generic multidimensional preference aggregation problems.

Such an outcome is disastrous for the legislature, and this is perhaps why few real-life legislatures work in this manner. Legislators usually find it useful to limit their freedom by forming an organization, such as a party, which prevents them from accepting offers that are good for them personally in the short run, but lead to a bad outcome for the group as a whole, and ultimately to a bad outcome for themselves. Before about 1820, the patronage system formed such a disciplining mechanism. In a version of the model in which legislators give up their short-term control over tax payments in the economy to the executive, which then distributes the income back to them, a coalition of legislators can achieve a much better result for its members than in the case of uncoordinated bargaining: Given an appropriately large

patronage payoff, the legislators can end up capturing *all* of the surplus in the bargaining process, if the executive implements an appropriate mechanism, in which deviations from an agreed-upon voting behavior attract a loss of patronage. Moreover, legislators would agree to the continuation of these limitations on their behavior whenever they are given a chance to do so, so the system is stable. The coalitions formed in this case need to be super-majorities, as there need to be enough members of the coalition that need to be paid off by the agent seeking the permit for such an attempt to be impossible. Indeed, the majorities formed under the patronage system were apparently inefficiently large, a fact which can be understood through the lens of this model.

In the period leading up to 1820 the patronage system was disbanded in Britain, for reasons quite exogenous to the argument here (Popa, 2012). On the face of it, Parliament in the 1820s was much more powerful next to the executive than it had been until then, because it now had full control of the tax revenue and could not be controlled by the government through patronage. But the flip-side of this apparent freedom was the breakdown of coordination indicated in the argument above. Permit-seekers in this period started being able to obtain the permits for free, leading to a situation where access was liberalized. In societies in which the patronage system exists, or in which authority is centralized in a single actor, as opposed to a legislature operating by majority rule, such a breakdown due to a collective action problem would not happen. The case of Britain in the 19th century, namely the combination of rule by a legislature and the lack of a patronage mechanism or modern party system, led to this striking development.

Liberalization in 19th century Britain

Access to economic activity in Britain was anything but free well into the Industrial Revolution. The key features of the unreformed economic system were:

1. *The lack of full incorporation rights for businesses.* Two key features of the modern

business organization are the separation of ownership and control through the shareholding system, and limited liability—the fact that shareholders are responsible for the losses of the company only up to the value of their shares. The reasons why these features are crucial for complex economic activity to develop will not be further discussed here (see North, Wallis, and Weingast (2009) for one argument). An entrepreneur in 18th and early 19th century Britain could not establish such a company at will. The Bubble Act of 1720 established that incorporation can take place only with a parliamentary charter and such charters were not forthcoming: only 61 companies were listed on the Course of Exchange (London Stock Exchange) in 1811, compared with 258 by 1825 (Harris, 2000). Incorporation was a privilege that only the best-connected individuals could acquire, with other entrepreneurs having to settle with less efficient forms of organization, such as the partnership or the trust. While the official fees that were needed for an incorporation charter were relatively low, barriers to newcomers were formidable: Harris succinctly summarizes the incorporation process before the reforms by saying that "[i]incorporation was granted or refused on the basis of the level of opposition of conflicting vested interests."

2. *The prevalence of monopoly rights in the most lucrative markets.* A summary of the activities of chartered monopolies is offered in Harris (2000): Trade with India and China was the exclusive privilege of the East India Company. Banking was highly regulated: the Bank of England (a private company at the time) had a virtual monopoly on large scale banking, as other banks were forbidden from becoming incorporated or having more than six partners. Marine insurance, a crucial activity was also subject to a duopoly granted to the Royal Exchange Assurance and London Assurance in 1720, in exchange for a cash payment directly to the Civil List (the money used by the king for patronage) of 300,000 pounds from both companies. Navigation itself was subject to regulation that required that any trade with Britain be done only using British ships. In any market in which there was only one or few incorporated companies, those companies had an advantage next to competitors equipped with a more rudimentary form of organization, which gave them noncompetitive

market power.

3. *Limitations on trade.* The most notorious limitation on trade were the so-called Corn Laws, which were designed to give British landowners protected returns on their land. Harley (1994) presents some of the other limitations: "The customs protected British textile manufactureres, from Irish linen and Indian cotton, iron masters from cheap Swedish iron and much else." Before the 1840s tariffs insulated protected interests (mainly those in the land-intensive activities) from external competition: the average tarriff level was about 55% in 1820 (Harley, 1994).

Changes in laws and policies regarding these limitations start appearing into the second decade of the 19th century, and are accelerated from the 1820s to the 1850s. Taking each of the three points above, relevant reforms are:

1. The emergence of free incorporation took a circuitous route between 1825 and 1855. The historical details of this development are presented in Harris (2000): Throughout the first decades of the 19th century, a large number of entrepreneurs began seeking incorporation rights for their businesses. Harris counts 624 companies being promoted in 1825. Most of these new companies sought incorporation from Parliament—438 bills for incorporation were put forward in 1825 and 286 were approved. The involvement of the MPs in these new enterprises was direct: Harris argues that an unprecedented number of MPs were offered roles as directors (board members) of these new companies. Numerous accusations towards MPs who promoted companies in which they had been offered free shares were levelled in and outside Parliament. The cabinet of Lord Liverpool rejected the procedure of parliamentary incorporation altogether and wanted to return to a royal chartering system which had declined after the Glorious Revolution. In 1825, the executive, through its Attorney General, Lord Eldon, proposed a bill that featured a mixed system: a Parliamentary bill was still needed for full incorporation, which included limited liability, but for the purposes of establishing a joint-stock company without limited liability, a royal charter (which by this time meant a decision by the executive) could be requested. This bill was adopted and

became known as the Repeal of the Bubble Act. The bill did contain somewhat the number of new incorporations. In 1834 this was further altered through a bill passed with near unanimity which stated that the executive could also grant limited liability privileges. Harris notes that those desiring a charter were encouraged to take the executive route. However, by 1844, it seems that any interest in limiting the formation of new business enterprises in this manner was lost: a Parliamentary committee chaired by the future prime-minister William Gladstone proposed the establishment of a system of free incorporation (without limited liability), and his bill was adopted without much debate or opposition. In 1855 and 1856 this principle was further extended by Parliament to allow limited liability to these companies, with the 1856 Joint Stock Companies Act, which formed a unified framework for free incorporation in the entire UK, passing the House of Commons easily (Hansard, 1856 [2012]).

The debates around free incorporation suggest a model where, until the 1820s, Parliament was able to limit access to this privilege to those who had the favor of a majority, and who had to provide benefits back to the majority. As majorities were tightly controlled by the executive, the system was efficient for political elites, who could derive significant rents from their ability to block access to economic activity. The ability of a stable majority to commit itself to not handing out the privilege of incorporation too easily broke down by the 1820s, and fluid majorities started awarding such privileges to an ever-increasing number of applicants, for an ever-decreasing payoff. The Repeal of the Bubble Act, far from being a liberalizing measure, instead attempted to take this power from the hands of Parliament, and did manage to contain the process of easily awarding the permits, which was desired by virtually all MPs. But the legislators could not directly benefit form the fact that the executive could now control incorporation, as the ability of the executive to transmit the profits from such control back to MPs was now gone. The system of executive incorporation was useless for MPs, and they removed it without much opposition in 1844 and 1855.

2. While many trading monopolies had been eliminated in the wake of the Glorious

Revolution, the East India Company (EIC) still had a monopoly on the lucrative trade with India and China. The EIC was deeply connected to the administration: government officials and company representatives acted together to administer affairs in India, and the company had immense political influence. In 1793 the company's monopoly was extended for another 20 years, but by 1813 demand for access to this trade by shipping interests in provincial towns was strong in Parliament. The provincial businessmen were successful in 1813 in convincing Parliament to remove the monopoly on the India trade, and again in 1833 in removing the monopoly on the China trade. The marine insurance monopoly was attacked beginning in 1810 with attempts by competitors such as the New Marine Insurance Company to gain access to this market, but a bill to allow this was defeated by one vote. By 1824, a new entrant, Alliance, was able to secure a charter in the Commons. In banking, so-called country banks began seeking access to the same kind of privileges as the Bank of England. By 1826 the Bank of England's monopoly had been broken up and new banks could gain access to incorporation, but only if operating outside of London. The Bank Charter Act of 1833 allowed such banks in London as well. Similarly to the case of incorporation in general, monopolies were broken up by a process in which new entrants seek to obtain privileges similar to those of existing firms from Parliament, and manage to do so relatively easily in the context of the fluid and un-disciplined majorities of the period.

3. The story of the liberalization of foreign trade is complex and has been presented in many other places (Irwin 1997, Schonhardt-Bailey, 2006). Harley (1994) is a summary of the developments: In the 1840s limitations on trade were eliminated, with the most notable change being the repeal of the Corn Laws in 1846. Small steps towards liberalization had been taken in the 1820, through the elimination of some import duties. After the Conservatives came to power in 1842, they gave in to the pressure of un-protected interests, represented through organizations such as the Anti-Corn Law League. While the repeal of the Corn Laws follows a complex story and certainly had a lot to do with the famines that the system occasionally produced, most other markets were liberalized at the same time for

reasons having less to do with an interest in general welfare, and more to do with the fact that industrial interests managed to obtain from Parliament an equal footing to the one of the landed interests which were generally protected by tariffs. (The fact that industrial interests benefited from liberalization follows from the fact that while Britain had enormous comparative advantage in industrial products, it had no such advantage in land-intensive products. The tarriff system made it hard for workers to obtain food, clothing, and other basic necessities, but did not help industrialists who had no need for such protection.)

These changes all share some similarities, beyond the fact that they all led to a liberalization of access to economic activity. All came about as a result of demands from outsiders to be granted the same privileges as insiders. While such demands were deflected for more than one hundred years by the stable and disciplined majorities of the 18th century, the elite's ability to limit access to economic activity seemed to vanish around 1820. The disciplined majorities which rejected demands for free access before this period are now replaced by a situation where new entrants become able to gain access to the privileged positions with minimal sacrifices towards the elite. This change in elite behavior leads to the need to study the breakdown in parliamentary discipline which allowed the elite's bargaining position to weaken so much.

This paper argues that the difference between the pre-reform period and later dates with respect to elite behavior has to do with the disappearance of a mechanism which induced majorities in Parliament to behave in ways which were efficient for them. The mechanism is the patronage system often called "Old Corruption" which characterized the British political system throughout the 18th century (Popa, 2012; Harling, 1996b; Rubinstein, 1983). Commentators of the 18th and early 19th centuries, while often decrying the negative effects of Old Corruption on society, were generally in agreement that the system worked as an effective mechanism for maintaining disciplined majorities, and through this benefited the elite not only in a direct fashion, but also through its role in achieving legislative coordination (Foord, 1947). Old Corruption was a system of sinecures, non-competitive public

contracting, privileged position for public employees, and electoral manipulation that made a significant part of the members of Parliament be dependend on the executive for their continued welfare. While Commons controlled taxation and ultimately controlled public policy in all its aspects, under Old Corruption, the administration of public funds was delegated to the executive and the monarch, who then returned some of them to MPs or their families in the form of patronage, or "influence" in contemporary parlance (Rubinstein, 1983; Harling, 1996b). David Hume summarizes the contemporary view on the utility of the system thus:

> "The crown has so many offices at its disposal that, when assisted by the honest and disinterested part of the House, it will always command the resolutions of the whole, so far, at least, as to preserve the ancient constitution from danger. We may therefore give to this influence what name we please; we may call it by the invidious appellations of corruption and dependence; but some degree and some kind of it are inseparable from the very nature of the constitution and necessary to the preservation of our mixed government." (Hume, 1748 [1985])

Many contemporaries and later authors are similarly in agreement that patronage served a useful role for the elite. Foord (1947) is one of the definitive accounts of the system and he summarizes it thus:

> "Without exception the ministries of the eighteenth century employed court favours to maintain themselves in office, and practical politicians saw no way to 'get the King's business done' in parliament without the use of influence."

But, through a dynamic separate from that discussed in this paper, the system of patronage had largely disappeared by 1820. The House of the 1820 was less constrained in its actions by dependence on the government, and this meant that its strategic incentives were also altered. Prime Minister Lord Liverpool noted in 1819 that he could no longer use patronage to reward allies, and Prime Minister Lord Wellington was "forcibly struck by the lack of patronage at his disposal" (Foord, 1947) in 1828. The government could not even ensure

that its supporters were re-elected by this time, and in 1830 Wellington became the first sitting prime minister to lose an election.

The most notable analysis of party strength throughout the 18th century is Cox (1987). Cox argues that the ability of party organizations to constrain members' votes by altering their electoral prospects became important only after the introduction of secret voting and elimination of electoral corruption in around 1883-1884. Before that, the individual MP behaved like an entrepreneur in elections, having to provide his own (sometimes enormous) sums of money for electoral bribery. "Patrons", that is local economic elites, sometimes financed the campaigns of candidates, but the central party organization, in as much as it can be called that, did not have the power to do so. Indirect evidence on the lack of control by parties of their MPs comes from the low proportion of party-line votes in the House: Using data from Lowell (1902), Cox shows that only after about 1870 do party-line votes begin to make up a large (over 70%) proportion of total votes in the House. Cox calls the twenty year period after the abolition of the Corn Laws (e.g. 1846-1866) the "golden age of the private MP", when members of the House proudly professed not being constrained by parties in their actions.

The formal model captures these intuitions in a rigorous framework, and shows that the equilibria of legislative bargaining processes between members of a legislature and outsiders are determined by the two incentive structures.

A model of legislative bargaining and policy reform

Consider a set of n_L legislators, where n_L is an odd number, indexed by l. The legislators make decisions through majority voting on binary agendas, so that an agenda is adopted if strictly more than $n_L/2$ vote for it. Economic agents that want to engage in various activities need a permit which is allocated by the legislators through a vote. Denote by $P_e = 1$ the case in which the permit has been allocated to agent e and by $P_e = 0$ the case in which

the permit has not been allocated. The utility of the economic agent is given by his or her income minus any expenditures that are incurred for securing that income. The income without a permit is normalized to zero and the income with the permit is some P. The costs for securing the permit are B_e for each agent. The economic agent's utility is therefore:

$$U_e(P_e, B_e) = \begin{cases} 0 - B_e & \text{if } P_e = 0 \\ P - B_e & \text{if } P_e = 1 \end{cases} \tag{25}$$

The economic agent gets the permit from the legislators. To secure a permit, strictly more than $n_L/2$ legislators have to agree to this, that is vote affirmative on a binary agenda between allocating and not allocating the permit. The interaction between the agent and the legislature is a bargaining process in which a bribe of total value B_e can be distributed among a certain number of members of the legislature. The legislators can accept the offer, that is take the bribe in exchange for votes, or reject the offer, which means that no deal is reached and the interaction advances to a new period. The utility of an individual legislator is the bribe that is paid to that legislator, which is a share of the total bribe B_e.

$$\begin{aligned} U_l(P_e, B_e) &= b_l \\ \text{s.t.} \quad \sum_{l=1}^{n_L} b_l &= B_e \end{aligned} \tag{26}$$

All agents use a discount rate $\delta \in (0, 1)$, so any payoffs that can be achieved in the next time period have to be discounted accordingly. The legislative bargaining process is a random-proposer model (McCarty and Meirowitz, 2007): at each new proposal stage, a legislator is drawn with equal probability to make a proposal for a policy vector that contains B_e and P_e. Each legislator therefore has a probability of $1/n_L$ of making a proposal in each stage. The economic agent, sitting outside of the legislature cannot make proposals. However, the nature of the bribe-paying process means the agent has an absolute veto on the policy being implemented: unless he or she agrees to pay the bribe, it cannot be paid to the

legislators regardless of what they vote. For the model to be complete, transactions between individual legislators and the citizen need to also be allowed. That is, side-payments from the citizen to legislators should not be assumed as impossible, given the factual details presented in section 2. Therefore the following aspect of the model is introduced by assumption:

Assumption 1: Side payments of the form $s \in [0, \infty)$ from the economic agent e to any one legislator l are available.

(Of course, for any side payment to happen, paying and accepting it should be equilibrium behavior.) The model analyses two modes of interaction between the potential buyer and the legislators who can "sell" the permit through their votes: first a situation in which only the legislators and the buyer are involved in the bargaining, and then a situation where a "leader" of the legislators, in the form of an executive or a party, can alter their incentives in the bargaining process. Results with $\delta \to 1$ are always given special consideration in the analysis, to model a situation where the bargaining takes the form of rapid offers and counter-offers from the players.

Uncoordinated bargaining

In this case, the timing of the game is as follows: at stage t a legislator l begins the bargaining process by proposing a total bribe $B_{e,t}$. The bribe payout can be written as a vector:

$$B_{e,t} = [b_1, ..., b_{n_\{L\}}], \ b_l \geq 0 \ \forall l \tag{27}$$

where each legislator gets a specific payoff b_l, which can be zero. It should be obvious that in any equilibrium the bribe B_e has to be lower than the value of the good, so $B_e \leq P$, otherwise transactions would not take place. It is useful to think of the legislators who get positive payoffs under the proposal $B_{e,t}$ as the "coalition" which is selected by the l player for that stage. Once the proposal has been made, each individual legislator votes "yes" or "no" on the motion of awarding the permit to e. In case strictly more than $n_L/2$ "yes" votes

are expressed and the citizen also agrees, the permit is allocated, and the payoff vector $B_{e,t}$ is implemented. In case less than $n_L/2$ "yes" votes are expressed, the permit is not allocated, the payoff vector $B_{e,t} = [0, ..., 0]$, $P_{e,t} = 0$ is implemented for that period, and the game advances to a new period, which is discounted by all players at rate δ. In the new period, $t + 1$, a new proposer is drawn and he or she proposes another payoff vector $B_{e,t+1}$. A vote is taken on this new proposal, and if both the citizen and a majority of legislators agree on the new payoff vector, it is implemented, and so on.

This is therefore a model of legislative bargaining with full veto power by the citizen. Each legislator has an equal chance of making a proposal in each period, as in the classic model by Baron and Ferejohn (1989). However, there is one player who, while having no proposal power, has full veto power on any allocation, similarly to the model in McCarty (2000). A discussion of the relevant equilibrium concept in this interaction is warranted at this point: Baron and Ferejohn first note that in such legislative bargaining games (without a veto player in their case), any allocation B_e can be sustained in a subgame perfect equilibrium provided the legislature is large enough and the discount rate is high enough. To avoid this profusion of equilibria, Baron and Ferejohn and a large proportion of the literature on legislative bargaining that followed their paper imposes the assumption of stationarity on the strategies that players are allowed to use in any subgame perfect equilibrium. This assumption essentially says that players cannot condition on the history of play until time t, their actions at time t. In particular, this means punishment strategies cannot be used. This rather strong assumption allows the equilibrium set to be collapsed to a much smaller one. Assuming away punishment strategies is not very problematic in the Baron-Ferejohn model and in similar extensions, as there is no particular "better" equilibrium that players might be interested in generating by the use of punishment strategies than the one that does emerge.

Assuming away the use of punishment strategies however, would not be appropriate in this model. This is because there is one particular kind of equilibrium that legislators might

be interested in generating by the use of punishment strategies: one in which all (or a large part) of the surplus in the game is distributed among them rather than being shared with the citizen. In particular, legislators would naturally be conjectured to find it in their advantage to use punishments against fellow legislators that make or vote for proposals that award to the citizen any payoff larger than what is absolutely necessary for the citizen to keep participating in the bargaining (which is an arbitrarily small quantity ε). So the analysis here will not limit attention to only stationary equilibria.

Allowing any subgame perfect equilibrium (SPE) as a solution of the model will again lead to any allocation B_e being sustained in some SPE. There is however something that is unconvincing about the SPEs that would generate such allocations (as well about the SPEs in the original Baron-Ferejohn model). These equilibria are predicated on the fact that the definition of subgame perfection is such that a SPE should only be immune to one-player deviations. That is, if in a particular equilibrium Σ^* the payoff vector for some two players l_1 and l_2 is $[u_1, u_2]$, but a joint, incentive compatible, and mutually agreed upon deviation by the two players would give them payoff $[u_1 + a, u_2 + a]$, $a > 0$, such a joint deviation will not take place. That is, the SPEs being allowed are not *coalition-proof* (Bernheim, Peleg, and Whinston, 1987), in the sense of not being required to be immune to joint, incentive-compatible, deviations.[10] This is an unnatural assumption to make in the context of a legislature: a basic function of a legislature is to allow players to discuss their strategies and to coordinate their voting. When there is noting to be gained by anyone by not voting in a mutually agreed upon way, it is erroneous to simply assume that such mutual agreements will not take place. That is, it should be the case that the SPEs that are considered in the analysis of legislative bargaining are coalition-proof subgame perfect equilibria (CPSPEs). The following is a straightforward extension of Bernheim, Peleg, and Whinston's definition of coalition-proofness to extensive-form games (See Fudenberg and Tirole (1991) for the

[10]Coalition-proofness is a weaker version of the requirement for a Nash equilibrium to be *strong* (Aumann, 1959). Strong Nash equilibria are those which are immune to any joint deviations, even if the joint deviations themselves are not self-enforceable. A connected concept from social choice theory is the *core*, which is the set of undominated outcomes given a preference aggregation rule. (Schofield, Grofman, and Feld, 1988)

definition of subgame perfection):

Definition: (Coalition-Proof Subgame Perfect Equilibrium). Consider the extensive-form game Γ. A *proper subgame* G of Γ is a node n_t and its successor nodes n_τ such that if $n'_\tau \in G$ and n''_τ belongs to the same history as n'_τ, that is $n''_\tau \in h(n'_\tau)$, then $n''_\tau \in G$. A strategy profile σ^* in the game Γ is a *coalition-proof subgame perfect equilibrium* if the restriction of σ^* to G is a *coalition proof Nash equilibrium* of G for every proper subgame G of Γ. A generic strategy profile σ^* is a coalition-proof Nash equilibrium if the following recursive definition holds (Bernheim, Peleg, and Whinston, 1987): Take the normal-form game $G^N = [\{u^i\}_{i=1}^n, \{\Sigma^i\}_{i=1}^n]$, where u^i is player i's utility function and Σ^i is player i's strategy set. Denote by J the proper subsets of $\{1, ..., n\}$ and denote an element of J by j, a "coalition" of players. Denote by Σ^j the strategy sets of all players in coalition j. and by Σ the strategy sets of all players 1 through n. Denote by $-j$ the complement of coalition j. For each $\sigma^0_{-j} \in \Sigma^{-j}$ denote by $G^N|s^0_{-j}$ the game induced on group j by the given actions s^0_{-j} for members of the group $-j$. Denote by $\tilde{u}^i : \Sigma^j \to R$ the utility given by $\tilde{u}^i(\sigma_j) \equiv u^i(\sigma_j, \sigma^0_{-j})$, that is the utility for a member of coalition j under strategy profile σ_j given fixed actions σ^0_{-j} by non-members of the coalition. The *coalition-proof Nash equilibrium* (CPNE) is defined recursively as follows: *(i)* If $n = 1$, σ^* is a CPNE iff s^* maximizes $u^1(\sigma)$. *(ii)* If $n > 1$ then *(a):* For any game G^N, $\sigma^* \in \Sigma$ is *self enforcing* if for all $j \in J$, σ^*_j is a CPNE in the game $G|\sigma^*_{-j}$, and *(b):* For any game G^N , $\sigma^* \in \Sigma$ is a CPNE if it is self enforcing and if there is no other self enforcing strategy profile $\sigma \in \Sigma$ such that $u^i(\sigma) > u^i(\sigma^*)$ for all $i = 1, ..., n$.

This definition simply requires that the CPSPE strategy profile be a coalition-proof Nash equilibrium in each proper subgame, that is that there are no profitable "coalitional" deviations from the equilibrium strategies. The definition of coalition-proof subgame perfect equilibria (CPSPE) implies that coalitional deviations from candidate equilibria are considered if they are welfare improving for all those who agree upon them, and moreover, no

profitable deviations from the agreed-upon deviation exist. The extension of the one-shot deviation principle to coalition-proof equilibria is straightforward: instead of looking for profitable one-player deviations, the definition allows to search for profitable, self-enforcing, coalitional deviations. Also note that since all CPNEs have to be Nash equilibria, all CPSPEs have to be subgame perfect equilibria.

Generic legislative bargaining games will not usually have any coalition-proof equilibria. The intuition for this is simple, and is connected to the inexistence of the core in generic multidimensional preference aggregation problems: fix an allocation $B_e = [b_1, ..., b_{n_L}]$ in a bargaining process in which a majority is needed for a decision and there are no vetoes by a citizen or any other agent. There will always exist an allocation $B_e^+ = [b_1 + a, ..., b_{n_m} + a, ..., b_{n_m+1} - c, ..., b_{n_L} - c]$, where $n_m > n_L/2$ such that all legislators 1 through n_m would jointly deviate from B_e to B_e^+in a way that is self-enforcing.[11] However, it is the case that in the model discussed in this paper, a CPSPEs exists and is "unique" in a loose sense, thus being the natural predicted outcome of the bargaining process. The fact that the bribe-paying citizen has a veto on any allocation of the bribe will lead to the existence of a small set of CPSPE outcomes, which compacts to a single point when $\delta \to 1$. The first set of results therefore are:

Proposition 1: Consider the legislative bargaining game presented above. Only the following allocations can be sustained as a coalition-proof subgame perfect equilibrium outcome: $B_e^* = [b_1, ..., b_{n_L}]$, $P = 1$ where $\sum_{l=1}^{n_L} b_l \leq (1 - \delta)P$. This leads immediately to:

Corollary 1: If $\delta \to 1$, the only allocation that can be sustained in a coalition-proof subgame perfect equilibrium is $B_e^* = [0, ..., 0]$, $P = 1$ (here the payoff 0 can be thought of as an arbitrarily small ε for at least one half of the legislators).

[11] The result that, abstaining from any game form, any given allocation in multidimensional choice problems is dominated by another allocation, has been stated numerous times with some of the most notable analyses being Plott (1967) and Shepsle and Weingast (1981).

That is, the most the legislators will get in a CPSPE is the share of profits $(1-\delta)P$, which collapses to zero in the natural case in which $\delta \to 1$.

Proof: The strategy for proving Proposition 1 is to show that any allocation B_e^* that fulfills the given condition can be sustained as a CPSPE and then, more importantly, to show that no other allocations can be sustained as CPSPEs. First consider any allocation $B_e^* = [b_1, ...b_{n_L}], P = 1$ with $\sum_{l=1}^{n_L} b_l \leq (1-\delta)P$ and the strategy profile:

i) Any legislator to be drawn as proposer proposes a B_e^*.

ii) All legislators vote "yes" for any B_e^* in any stage; also the citizen agrees to any B_e^* in any stage.

iii) In case any other allocation is proposed: (a) The legislators can vote whatever they want, and (b) The citizen will vote "no", so the game advances to the next stage.

This simple strategy profile is a CPSPE because there are no profitable joint, self-enforcing, one-shot deviations for any players at any point on or off the equilibrium path. Take first the histories that lie off the equilibrium path (that is when a proposal other than B_e^* has been made): In such a non-B_e^* proposal, the citizen would get less than δP as a payoff. Any payoff-modifying deviation from the prescribed equilibrium strategy behavior has to include a "yes" vote from the citizen. But a "yes" vote from the citizen would lead to a payoff less than δP , whereas the "no" vote prescribed by the equilibrium strategy generates more than δP. So a payoff-modifying profitable deviation by a coalition does not exist. Profitable deviations by individual players do not exist either: Any change of vote by a legislator does not change the outcome of the process keeping other players' votes constant, and an individual deviation by the citizen is not profitable by the argument above. (In this off-the-equilibrium-path case legislators can vote anything in the equilibrium strategy profile, so their deviations do not need to be analyzed.)

Consider now deviations from the equilibrium path: A coalitional deviation that includes a deviation by the citizen to voting "no" will not happen, as such a deviation is clearly not profitable, as it would lead to a payoff that is at most δP whereas on the equilibrium path the

citizen is receiving more than δP. A deviation by the legislators at the proposal stage is not profitable, as it leads to the rejection of the new policy by either the legislators themselves or the citizen, by the argument above. A payoff-modifying deviation by a coalition at the voting stage will not be profitable, as it will generate the payoff δB_e which is less than B_e. The fact that as $\delta \to 1$ the set of equilibria that can be sustained collapses to a single point follows immediately.

The coalition-proofness requirement becomes more important in showing that no other equilibrium outcome can be sustained in a CPSPE. Consider an allocation $B_e = [b_1, ..., b_{n_L}],\ P = 1$ where $\sum_{l=1}^{n_L} b_l > (1-\delta)P$. In such an allocation, the legislators must use an incentive structure such that they force the citizen to accept less than δP from the bargaining process. Assume an equilibrium path along which such an allocation is proposed and it is accepted, that is it receives "yes" votes from at least half the legislature and from the citizen. Now consider a history that lies off the equilibrium path in which the following alternative proposal which makes both the proposer, a majority of legislators, and the citizen better off, has been made:

$$\begin{aligned} B'_e \quad &= \quad [b_1 + a_1, ..., b_m + a_m, b_{m+1} - c_{m+1}, ...b_{n_L} - c_{n_L}],\ a_l > 0, \forall l, c_l \geq 0, \forall l \\ &\text{and} \quad \left(\sum_{l=1}^{n_L} (b_l + a_l) \text{ for } (b_l + a_l) \in B'_e\right) < \left(\sum_{l=1}^{n_L} b_l \text{ for } b_l \in B_e\right) \end{aligned} \tag{28}$$

It is easy to see that such a B'_e always exists, except in the case in which the proposer allocated herself the entire bribe in the candidate equilibrium, that is when $B_e = [P, 0, ..., 0]$. The alternative proposal is a modification of B_e where the proposer and at least half of the legislators receive more than in B_e, and the citizen also receives more than in B_e. In the context of a legislature, there is nothing to prevent the players benefiting from the new proposal B'_e , that is both the more than half of legislators who receive more under the new proposal, and the citizen who also receives more, from agreeing upon a joint deviation in which they vote "yes" on the new proposal. So consider the one-shot modification of the

strategy profile σ meant to enforce B_e, σ_{OSD}, in which after a proposal of the form B'_e in equation (4) has been put forward, a majority of legislators and the citizen deviate to voting "yes" for B'_e. It is clearly the case that the deviation is profitable:

$$\begin{aligned} V_{l,t}(\sigma_{OSD}) &> V_{l,t}(\sigma) \text{ for } l \text{ in } \overline{1,m} \\ V_{e,t}(\sigma_{OSD}) &> V_{e,t}(\sigma) \end{aligned} \tag{29}$$

But for σ_{OSD} to be a valid deviation, it remains to be proved that it is self-enforcing, that is that no player or group of players who take part in the deviation would find it worthwhile to "bail out" on the agreement and renounce to deviate. The self-enforcing requirement on the deviation means that changing their mind and voting "no" when the new proposal has been made should not be attractive for any player or any coalition. For such a change of mind to be attractive for the legislators, it would have to be that the equilibrium strategy profile can enforce from the next stage an outcome that is even better for the players who defect from voting "yes" on the deviation. That is, for a deviation from the allocation $B'_e = [b_1 + a_1, ...b_m + a_m, b_{m+1} - c_{m+1}, ...b_{n_L} - c_{n_L}]$ to be attractive for players 1 through d, $d \leq m$, it would have to be that those who vote "no" on the vector B'_e are guaranteed even more in the next stage, that is they will receive

$$B''_e|d = [(b_1 + a_1)\frac{1}{\delta} + \varepsilon, ...(b_d + a_d)\frac{1}{\delta} + \varepsilon] \ , \varepsilon > 0 \tag{30}$$

where $B''_e|d$ is the restriction of a payoff vector to players 1 through d. For this promise to be credible, it has to be that the payoff vector B''_e can be sustained in a CPSPE. But now for B''_e to be sustained in an equilibrium a necessary condition is that given some legislator l, the payoff

$$B'''_e|l = \left[((b_l(B''_e) + a'_1)\frac{1}{\delta} + \varepsilon\right] \tag{31}$$

where $B'''_e|l$ is the restriction of the payoff vector to l and $b_l(B''_e)$ is the payoff of player l

under B_e'' can be sustained in an equilibrium. This series of necessary conditions progresses an infinite number of times: for an allocation $B_e^{(k)}$ to be sustained in equilibrium it has to be that, given a modified allocation $B_e^{(k+1)}$ in which at least half of legislators get a better outcome cannot be sustained. But for $B_e^{(k+1)}$ to not be sustained, a necessary condition is that that an allocation $B_e^{(k+2)}$ in which one player l receives the payoff

$$b_l(B_e^{(k+1)}) = \left(b_l(B_e^{(k+1)}) + a_l\right)\frac{1}{\delta} + \varepsilon \tag{32}$$

can be sustained in a CPSPE. Clearly allocations in which

$$\left(b_l(B_e^{(k+1)}) + a_l\right)\frac{1}{\delta} + \varepsilon > P \tag{33}$$

cannot be sustained in equilibrium, so a corresponding allocation $B_e^{(k+1)}$ cannot be sustained, which leads to the fact that $B_e^{(k)}$ cannot be sustained, and so on. For any allocation to be sustained in an equilibrium, it has to be that at least one member of the legislature can be dissuaded from voting for a new proposal that gives her more by the promise of a "prize" in the future for rejecting the new better offer. But such ever-increasing payoffs will eventually hit the budget constraint that all payoffs must sum to P, as long as $\varepsilon > 0$ and $\delta < 1$, with δ fixed, and hence promises to increase the payoff of legislators who defect from the coordinated deviation are not credible.

The fact that the economic agent would also not "bail out" on the deviation follows from a similar reasoning and from Assumption 1. For e to renounce a deviation from B_e to B_e', where B_e' gives her a better payoff it has to be that an even better payoff, part of some B_e'' can be enforced in an equilibrium. This increasing series leads up to a payoff of P for the economic agent, which *can* be enforced in equilibrium, as has been shown above. So the economic agent would bail out on the proposed initial deviation at time t if she was guaranteed a payoff of P in the next stage, $t+1$, if doing so. Payoff P for e can be implemented in a CPSPE at time $t+1$. But the citizens using a "self-punishment" strategy

profile σ^*_{PUN} which switches to the "bad" equilibrium in which e receives P in case a proposal that is not B_e has been put forward is *not* subgame perfect at stage t. This is because by Assumption 1, the citizen could induce a non-B_e proposal to be put forward at time t, which would guarantee her payoff P at time $t+1$ under σ^*_{PUN}. For this to happen, the citizen can make a side payment s_t to the proposer at time t worth (slightly more than) what the proposer is getting under σ^*_{PUN}. Such a side payment will be made by the economic agent up to the level $\max(s_t) = \delta P$, which is the gain from making the payment and attracting the "bad" equilibrium (in which the economic agent gets P) in the following stage. So for σ^*_{PUN} to form an equilibrium, a necessary condition would be that the proposer at time t receives more than the maximal side-payment that could be made to him by the citizen:

$$b_l(\sigma^*_{PUN}) \geq \delta P \text{ for } l \text{ proposer} \tag{34}$$

However, such an allocation again cannot be sustained in a CPSPE if the citizen can made side payments, by the follwing argument: clearly for this allocation to be sustained it has to be that it is not rejected by half of the legislators. For this rejection to not occur, it has to be that in case a rejection by a coalition of half of the legislators has occurred, play switches to the punishment equilibrium σ^*_{PUN} in which the economic agent receives P and legislators receive zero. In case side payments were not available, the fact that σ^*_{PUN} states that play switches to the punishment equilibrium after a rejection of B_e would act as an effective disincentive for legislators to reject B_e. It has been established that for B_e to be sustained as an equilibrium with strategy profile σ^*_{PUN} it has to be that the non-proposing legislators should receive at most $(1-\delta)P$ in total. But the economic agent is willing to pay side-payments up to the level δP for a rejection to occur. Clearly then the economic agent would make side-payments to at least half of the legislators in order to trigger a rejection of the B_e proposal and a switch to the punishment equilibrium. This shows that equilibria in which play switches to an allocation in which the economic agent receives P at time

$t+1$ as a punishment for legislators' behavior at time t cannot be sustained in a CPSPE, as long as side-payments can be made. This then shows that the economic agent cannot be dissuaded from agreeing to deviations from a proposed allocation in which she is not receiving at least δP by the promise of getting the payoff P in case she does so, which shows that coalitional deviations from any B_e defined in equation (27) to B'_e defined in equation (28) are self-enforcing. This shows that B_e cannot be sustained in a CPSPE.

The remaining possibility is one in which the proposer proposes the allocation $B_e = [P, 0, ..., 0]$, from which there are no profitable changes such as the one presented above. But in this case the citizen is at least indifferent between accepting this proposal and postponing for another stage, so the citizen can delay agreement for another stage. Hence there are no CPSPEs that implement an allocation in which the citizen receives less than δP and the proof is complete.

Coordinated bargaining

The problem faced by legislators in the game in section 3.1 is essentially a collective action problem: they would all like to be able to prevent themselves from accepting new offers, as this leads to the lack of equilibria in which legislators capture more than $(1-\delta)P$ of the surplus. However, in any individual vote, one-half of legislators will always find it advantageous to deviate from any allocation, which leads to the breakdown of any equilibrium which is not the one in which they get the minimal payoff. The legislators can overcome this collective action problem by limiting their freedom through an institution that implements a mechanism in which the legislators are sanctioned in case their behavior deviates from a prescribed set of rules. Such an institution should be able to impose a cost on any individual legislator who behaves in ways which are suboptimal for the group (and ultimately for any legislator individually). Examples would be an executive or monarch who controls a stream of payments to the legislators, and who can alter these payments in response to the actions of the legislators in the bargaining game, or a party organization that can impose costs on

a member who misbehaves.

Consider then the following modification of the game in the previous section. There is in every period a tax income T which is collected from the economy. The legislators control the use of this tax through majority voting, but can delegate its use to an agent G. The agent then can return this payment to the legislators in the form of patronage. In between each period of the bargaining game described above, a (potential) vote on whether the role of agent G should continue is taken by the legislators. Such a circuitous way to distribute the tax income seems redundant at first sight: if the legislators can control the tax payment T, why not decide on its use themselves rather than delegating this to an outside agent? In the context of this model, such a delegation mechanism will help legislators prevent themselves from being pushed to an equilibrium where the citizen captures (almost) all of the surplus. In case agent G exists and he or she is free to exercise control over T, the game structure is as follows:

The bargaining process between the citizen and legislators is identical to the one in the previous section. Now after each stage in which a vote is taken, the coordinator G distributes a patronage vector $\Pi = [\pi_1, ..., \pi_{n_L}]$ such that $\sum_{l=1}^{n_L} \pi_l \leq T$. The behavior of the coordinator is only strategic in that she has to follow the rules of a mechanism M. The question is whether a majority of legislators can design a mechanism M to be implemented by the coordinator G that would help them achieve a better outcome in the bargaining process. In case such a rule can be designed, the majority will extend the contract with the coordinator for future periods.

Consider the following behavior rule M for the coordinator: select a coalition $C = \{1, 2, ..., n_C\}$, $n_C > n_L/2$. Members of this coalition receive the patronage vector $\Pi = [\pi_1, ..., \pi_{n_C}]$ where $\pi_l = T/n_C$ for all $l \in \overline{1, n_C}$. Denote by $B_e^* = [\frac{P}{n_C}, ..., \frac{P}{n_C}, 0, ..., 0]$ a payoff vector in which each member of the coalition receives an equal share of the bribe, and the total bribe is the entire profit P. This is an outcome of the bargaining process in which legislators capture all of the surplus, in spite of the fact that the citizen has a veto on any

allocation. (The citizen can be assumed to receive a small ε which makes him or her not indifferent between accepting the deal or not.) This allocation will be the unique CPSPE of the bargaining game in case an appropriate incentive structure is implemented. Moreover, at any point in time, the members of the coalition C would vote for the maintenance of the coordinator G in her position, so the mechanism works even if legislators do not give up their ultimate control on the tax payment.

When awarding the patronage, G should use the following criterion: In case a "yes" vote has been expressed by a member of C on a proposal other than B_e^* or in case a "no" vote has been expressed by a member of C on B_e^* , implement a patronage vector in which the coalition member which expressed the offending vote gets zero in patronage for that period. (Assume for simplicity that the tax income not spent is destroyed or returned to the tax base). Legislators that behave according to the rules set by G will receive the appropriate allocation $\frac{T}{n_C}$ for that period. For this mechanism to successfully dissuade coalition members from engaging in the cycle of defections that reduces their rents to close to zero, the parameter that needs to be adjusted is the size of the coalition, by the following reasoning:

In a legislature of size n_L, with a governing coalition of size n_C with $.5n_L < n_C \leq n_L$, any majority that implements a given policy needs to include at least $s_c = \text{floor}[n_C - .5n_L]$ members of C[12]. (The s_c notation suggests that they are the "supermajority" part of the coalition.) For these s_c members of the coalition to be dissuaded from voting for a proposal other than B_e^*, they need to be guaranteed a loss of patronage due to doing so that is greater than the gain in bribe payments that can be made to them. A sufficient condition for such a supermajority to not vote for the alternative proposal is that

$$\begin{aligned} P &\leq s_c \Pi_{s_c} \\ \text{where } \Pi_{s_c} &= \sum_{l=1}^{s_c} \pi_l \end{aligned} \tag{35}$$

[12]The floor function is $\text{floor}(x) = y$ where $y = \max(n)$ such that $n \in \mathbb{N}$ and $n \leq x$

Here Π_{s_c} is the total patronage that is paid to the supermajority members of C. This gives the coalition size that is needed for defections to be avoided: The optimal size is given by

$$P = (\text{floor}(n_C - .5n_L)) \left(\frac{T}{n_C}\right) \tag{36}$$

which leads to an optimal coalition size n_C of

$$n_C = \begin{cases} \frac{n_L T}{2(T-P)} & \text{if } \frac{n_L T}{2(T-P)} > .5n_L \\ .5n_L & \text{if } \frac{n_L T}{2(T-P)} \leq .5n_L \end{cases} \tag{37}$$

This explains why super-majoritarian coalitions might be needed, even if they lead to an over-dispersion of the patronage income.

Proposition 2: In a version of the legislative bargaining game in which the mechanism M is implemented, the only allocation that can be sustained in a CPSPE is $B_e^* = [\frac{P}{n_C}, ..., \frac{P}{n_C}, 0, ..., 0], P = 1$ where the number of $\frac{P}{n_C}$ terms is $n_C = ...\frac{n_L T}{2(T-P)}$ if $\frac{n_L T}{2(T-P)} > .5n_L$ or $n_C = .5n_L$ if $\frac{n_L T}{2(T-P)} < .5n_L$.

Proof: Again, first show that the given payoff profile can be sustained by a CPSPE and then show that no other payoff profile can be sustained in a CPSPE. B_e^* is sustained as a CPSPE by the following strategy profile: Any proposer selected at any stage proposes B_e^* as the policy vector and every member of the coalition and the citizen vote "yes" on this motion. In case another proposal has been made, every member of the coalition C votes "no" on this alternative proposal. (The citizen and non-C legislators can vote anything). There are no profitable joint or single one-shot deviations from this strategy profile: any single deviation by a member of the coalition to voting "no" for this proposal is not profitable, as it either does not change the outcome of the vote but it does remove his or her patronage income (in case they are pivotal), or if it does change the outcome , the gain is not enough to overcome the loss in patronage, given condition (35). Any joint deviation by members of C cannot be profitable: either the group that deviates is too small to change the outcome of

the vote (but its members lose the patronage), or if the group that deviates is large enough, the gain in bribes cannot be large enough to overcome the loss of patronage: as shown above, the largest per-capita gain from the bribe is given by distributing all of P to the s_c supermajority members of C (which in this case has to be discounted by δ as the soonest this payoff can arrive is the next stage), but by construction of the supermajority, this will not be enough to make a joint deviation profitable for them, as each lose more in patronage than they gain by this deviation (condition 35). The citizen cannot gain by voting "no" and advancing to the next stage, as in the next stage the same constraints will be in place for coalition members, and a postponement until then cannot generate an increase in payoffs for the citizen. (Assuming a small ε is gained by the citizen in the bargaining process - then he or she is not indifferent between voting "no" and voting "yes" on the proposal B_e^*, and will vote "yes"). Off the equilibrium path, again no proposal can be good enough to make it worthwhile for a large enough part of C to vote for it given the removal of patronage income this would lead to, as indicated by the sufficient condition (35). Deviations from the prescribed strategies off the equilibrium path by the citizen or by non-C legislators do not matter for the outcome of the game.

Now it needs to be shown that no other allocation than B_e^* can be sustained in a CPSPE: Assume that such an allocation can be sustained in a CPSPE. This would entail having at least s_c members of the C group vote "yes" for such an allocation. But it has been established that such a vote cannot occur in equilibrium, as the loss in patronage by the s_c legislators cannot be overcome by the gain in bribes if condition (35) holds, therefore no such allocation that is not B_e^* can be sustained in a CPSPE, which completes the proof.

A simple but important corollary of Propositions 1 and 2 is that given a binary choice between the coordinated bargaining system in section 3.2 and the uncoordinated bargaining system in section 3.1 , all members of the coalition C would vote in favor of the coordinated bargaining process whenever the coordinated system generates a higher payoff for each of them. This would always be the case for any reasonable parameter values: Taking the simple

case in which in the uncoordinated case legislators receive the maximal amount that could be sustained in a CPSPE, shared equally between a minimally winning majority, what is needed for the C legislators to prefer the coordinated system is that $P/n_C > (1-\delta)P/.5n_L$. The C legislators would also always prefer the coordinated system in the case in which $\delta \to 1$.

The exposition until now has assumed, for simplicity, that only one permit is awarded, and only one economic agent bids for it. A situation in which multiple economic agents are interested in obtaining such permits is more natural. This extension of the model, however, will not change the conclusions of the analysis: An uncoordinated bargaining process will again lead to the legislature giving away the permits for free, while a coordination mechanism will help the members of the legislature avoid this situation. The fact that the number of permits being awarded can affect the value of each such permit does not affect this conclusion. The analysis in this section is presented in a more abbreviated form, as it is largely analogous to the one in the single-bidder section. The situation in which $\delta \to 1$ is given priority, as it is the most natural setup, one in which rapid offers and counteroffers are made by all parties involved in the bargaining process.

To model a situation in which multiple bidders are looking for permits, consider first an extension of the model in which two such bidders are interacting with the legislature. (The argument immediately generalizes to more bidders). Now the timing of the bargaining game is similar to the situation before, except the proposals are on a vector of the type $B = \left[(b_1^1, b_1^2), (b_2^1, b_2^2), \ldots . (b_{n_L}^1, b_{n_L}^2)\right]$. The superscripts in each pair indicate the bribe received from economic agent 1 and 2, with the subscripts again indexing the members of the legislature. At the voting stage, each legislator is allowed to express a vector of votes, on whether the permit should be given to either of the two bidders, and both bidders can accept or reject the proposed allocation. In case one bidder has accepted the allocation and the other has not, the bargaining process advances to the next stage with only the bidder that is left.

The major difference between this process and the one with a single bidder is that the value of each permit might depend on the number of permits being awarded at the same

time: rationing the permits would create rents, so a higher number would reduce the value of each one individually. Express the value of a permit now at each moment in time as a function of the number of permits awarded: $P(n_P)$, where n_P is the number of permits awarded with P decreasing in n_P.

The basic intuition of why this modified game leads to the same kinds of conclusions as the single-bidder game is that, just as before, joint and self-reinforcing deviations from any proposed allocations in which legislators receive substantial bribes always exist. Similarly, attractive deviations from an equilibrium where the bidders capture most of the rents do not exist, as the bidders themselves need to be part of such deviations. To see that joint deviations from allocations with significant bribes being paid exist, note that for any allocation $B = [(b_1^1, b_1^2), ..., (b_{n_L}^1, b_{n_L}^2)]$, and for any $m \geq \frac{1}{2} n_L$there exists an alternative proposal:

$$\begin{aligned} B' \quad = \quad & \left[\left(b_1^1 + a_1^1, b_1^2 + a_1^2\right), ..., \left(b_m^1 + a_m^1, b_m^2 + a_m^2\right), \left(b_{m+1}^1 - c_{m+1}^1, b_{m+1}^2 - c_{m+1}^2\right), ..., \left(b_{n_L}^1 - c_{n_L}^1, b_{n_L}^2 - c_{n_L}^2\right)\right] \\ & a_l^i > 0 \forall i \forall l, c_l^i \geq 0, \forall i \forall l \text{ and } \left(\sum_{l=1}^{n_L} \sum_i b_{l,DEV}^i \text{ for } b_{l,DEV}^i \in B'\right) < \left(\sum_{l=1}^{n_L} \sum_i b_l^i \text{ for } b_l^i \in B\right) \qquad (38) \\ & \text{where } b_{l,DEV}^i \text{ are the individual bribes under } B' \end{aligned}$$

This alternative proposal can arise off the equilibrium path for any equilibrium that generates the allocation B. By an argument identical to the one in the single-bidder game, this proposal features increased bribes for at least half of the legislators and more rents for both bidders. Clearly a one-shot deviation by a coalition of players including the bidders to accepting this alternative proposal is profitable, and by an argument analogous to the single-bidder case such a deviation is self-reinforcing. Similarly, strategies that postulate a self-punishment in which legislators give up all rents to one or both of the bidders in case a deviation from the B allocation has been proposed and one/both bidders have rejected it are not subgame perfect as long as side payments are allowed, as bidders would then induce such proposals in order to capture all of the rents, by an argument identical to the one from the single-bidder case.

The difference that arises in the proof for the multiple-bidders case is that now there also may exists a profitable joint deviation from the allocation in which both bidders capture all

of the rents, that is one in which the bribe vector is $B = [(0,0),..(0,0)]$. As the value of one permit now depends on how many such permits are allocated, there exist deviations in which the following alternative proposals are utility-improving for both half the legislators and for one bidder (assume it is bidder 1, and assume legislators 1 through m are the ones whose utilities are improved):

$$B' = \left[\left(0 + a_1^1, 0\right), ..., \left(0 + a_m^1, 0\right), (0,0), ..., (0,0)\right] \tag{39}$$

In B' legislators 1 through m each receive a higher total bribe payment than under B. At the same time, the difference between the rents captured by bidder 1, $P(1)$, and the total bribe he/she has to pay, $\sum b_{l,DEV}^1$ for $b_{l,DEV}^1$, is higher than the equivalent difference in case the bribe vector B is implemented and both permits are allocated. In case this outcome were permanent, both half of the legislators and one bidder get a better deal, so they would appear to be tempted to deviate to the new allocation. However, this is not the case when looking at the entire time horizon: as the second bidder will reject an allocation in which he/she does not get the permit (in the sense that he/she will not pay any bribes), the bargaining process between the legislature and the second bidder advances to a new stage, in which it becomes identical to the process described in the single bidder case. The outcome of this bargaining process is characterized in Propositions 1 and 2. This means bidder number 1, who gains the sole permit in the proposed equilibrium will only reap the benefits of holding the permit by themselves for one period of the bargaining game: after this the second permit will be allocated as well and the value of the permit will drop to $P(2)$. As $\delta \to 1$, which is the most relevant case as explained above, this effectively means the additional benefit that bidder 1 derives form holding the permit by themselves converges to zero. This shows that the proposed beneficial joint deviations from the allocation in which both bidders get the permit do not exist, and this shows that indeed the strategic situation in the two-bidder case is analogous to the one in the one bidder case as $\delta \to 1$. The argument extends immediately

to a higher number of bidders: any situation in which the number of bidders who get permits is lower than the total number of bidders will be ephemeral, so the situation in which all bidders receive permits is the unique equilibrium of that situation as well.

The coordinated bargaining situation with multiple bidders is similar to the one with a single bidder as well: Under the leadership of a coordinator who controls the stream of tax payments, the legislators can now generate an equilibrium in which the quantity of permits is optimized to maximize the total amount of rents in the economy. Denote by n_O the optimal number of permits, which maximizes aggregate rents. A sufficient condition for n_O permits to be allocated and for each member of the governing coalition to receive $\frac{1}{n_C}P(n_O)$ is that the coordinator implements the same mechanism from the single-bidder section, where now the size of the coalition, s_C, is given by replacing P with $P(n_O)$ in expression (13). Therefore, the multiple-bidders case will be identical in its conclusions to the single-bidder case, even if each additional permit being awarded affects the value of other permits.

Empirical evidence

Historical evidence from 18th-19th century Britain is extremely supportive of the logic presented in this paper for why the British elite came to no longer restrict access to economic activity after about 1820. This section uses evidence regarding incorporation rights for commercial enterprises to prove this. Using information from Taylor (2006) and Freeman et al. (2012), this section shows that there is ample historical evidence in favor of the following points:

1. There is clear evidence that limitations on company incorporation, such as the Bubble Act, were designed to create rents for insiders and were effective in doing so.

2. Before the era of open access, it was crucial for companies seeking incorporation from Parliament to secure the suppport of influential individuals who might have exercised direct or indirect influence in Parliament. This was most commonly done by awarding such

individuals shares in the business organization, but also through other means.

3. After about 1820, the practice of securing support in Parliament by offering shares or other inducements to members of the House was maintained. However, there is evidence that the scale of such transfers dropped significantly, and being partners in such enterprises was no longer a very lucrative endeavor for members of the House.

4. Limitations on incorporation were abolished with little resistance or debate when it was becoming clear that they no longer served the purpose of preventing the access of new entrants to markets.

These points taken together support the logic of the model in this paper. In the following, each one is analyzed separately.

1. From its genesis, the Bubble Act, preventing the free formation of incorporated companies without Parliamentary approval, was meant to protect the returns of existing incorporated companies: "The legislation was not the result of a moral panic about joint-stock projects, but of a cabal of South Sea Company directors pushing Parliament—where many of the company's directors sat—into protecting the price bubble that they had taken great pains to inflate. The cabal aimed to deter further stock company promotion and maintain the flow of funds into South Sea shares" (Freeman et al. 2012, p 22; see also Scott, 1912, v1.). Freeman et al (2012) show that the main effect of the act was not so much to prevent the formation of speculative enterprises, as to direct entrepreneurs seeking to engage in significant economic activity to seek incorporation from Parliament (or to try to organize their business as an "unchartered shareholder partnership" of dubious legality.) At the beginning of the 19th century, as the opportunities for new company formation were increasing for entrepreneurs, together with their desire to do so, the enforcement of the Bubble Act began to be more strict that it had been in the 18th century, turning into a tool which insiders were trying to use to stop all new market entrants, not just those seeking the advantage of incorporation. In 1807 for example, an existing distillery in West Ham filed a complaint regarding a new entrant in the liquor market which was trying to set up an (unincorporated)

company with capital under the form of shares. While the complaint was ultimately unsuccessful, the fact that it made it to court, as well as the ambiguous court ruling regarding it, showed how easy it was for insiders to use such legal mechanisms to deter new entrants even when they did not formally violate existing legislation. (Freeman et al 2012, p 29).

2. Seeking incorporation from Parliament was no easy task before around 1820: ... In order to obtain a parliamentary act, "winning at least the support of the local landowners was essential. [...] Allocations of shares could win over skeptical landowners." (Freeman et al 2012, p 49). Freeman et al describe the problems faced by a canal company seeking incorporation in 1792: At the beginning of the project, the entrepeneurs "flatter[ed] themselves that the project will meet with Lord Rawdon's concurrence and patronage" (Ashby-de-la Zouch Canal Company Minute Book, 1792, cit in Freeman et al 2012, p 48.) This was not enough as other influential landowners from the regions through which the canal was going to pass through were not yet on board: "As a result of these problems, when the shares were issued, the committee of management decided to reserve 500 of the company's 1,500 shares for landowners, and withheld a further 250 to be distributed during the progress of the company's bill through Parliament." (Freeman et al. p 49). Therefore more than half of the shares (and future profits) of the company were captured by influential power-brokers and politicians. Another approach was to appoint influential individuals as executives in the companies seeking incorporation. Freeman et al again list the example of another canal company which had four of its seven directors appointed by local landowners. Critics of the system were stating the obvious: Joseph Hume, MP, was "strongly impressed with the impropriety" of the system "of canvass and influence" of the incorporation process (Hansard 11:910, 1824, cited in Freeman et al.). Similarly, Henry Brougham thought that "the system also encouraged "jobbing" in votes, that is, MPs selling their votes on the committee to the highest bidder." (Hansard 12:635-6, 1825, cited in Freeman et al).

3. The system of remuneration in exchange for votes between entrepreneurs and politicians did not end in the second decade of the 19th century, quite the contrary. The years

after 1820 saw an even greater number of such transactions taking place, corresponding to an increase in the number of incorporated companies. However, the historical evidence shows that the nature of these bargains had changed: On the one hand the scale of the inducements that entrepreneurs had to provide politicians with went down a lot. Freeman et al. note a few examples of such efforts from the 1830s and 40s. In 1844 a railway company had spent £11,409 on incorporation expenses in Parliament, which was 3% of its capital, and according to the company's minutes, double what it would have been had incorporation not been opposed by local landowners. Similarly, a railway company established in 1826 spent some £160 (plus £300 on solicitors' fees) on expenses related to passing its incorporation bill in the Commons. This is again about two percentage points of its capital. Perhaps more convincingly, this period sees a huge increase in the percentage of new companies that make a provision in their "constitution" to seek incorporation. Using a sample of British companies from that period, Freeman et al show that this percentage goes from 0% before 1800, to 13% in 1810-19, to 53% in 1820-24, and up to 71% in 1830-34. This is all happening in a period where incorporation still had to be obtained with an act of Parliament. It should be obvious from these numbers that securing such an act became significantly cheaper for entrepreneurs in the period after 1820, in accordance with the logic of the model.

4. Given the significance of barriers to incorporation in the political economy of Britain in the 18th and early 19th centuries, the abolition of these barriers came with little debate or conflict. In fact, there has never been a floor vote taken on the two major legislative changes that eliminated these barriers: the Companies Act of 1844, which established automatic incorporation in case a few basic qualifications were met, and the Limited Liability Act of 1855, which granted limited liability on such companies. The act of 1844 had actually been preceded by laws specific to certain sectors to allow free registration: Shipping companies, savings banks, building societies, and joint-stock banks had all received access to registration in the decades before 1844. The act of 1844 was written by a commission lead by the young William Gladstone, and passed Commons easily according to Taylor (2006), and Harris

(2000). Similarly, the act of 1855 granting limited liability to all registered companies passed Commons without much debate. There is no record in the Hansard of roll-call votes on these acts, and Taylor (2006) states that their passage was seen as a "minor adjustment at the time". Taken together, these points show that the logic of the model is in accordance with the basic historical facts, and thus the model can serve as an explanation for the behavior of the British elite in this period.

Conclusions

This paper has explained a set favorable institutional changes in the British economy of the 19th century by emphasizing the unique political framework of this country in that period: Britain at the time was led by a legislature, but this legislature neither had at its disposal the traditional patronage system, neither had yet developed a modern party system. This unique feature led to an equilibrium where the bargaining power of the elites in the legislature in relation to members of society was unusually weak. The mechanism of reform presented here can be seen as an answer to the problem presented in Acemoglu (2003): there, reforms that could improve total productivity in an economy are not adopted if those who hold political power stand to lose from these refoms, and the fact that promises of future redistribution towards those who now allow reforms are not credible makes the existence of a "political Coase theorem" impossible. Under the mechanism presented in this paper, no political Coase theorem is needed for reform to be achieved: While the political elite would block reforms if it behaved as a unitary actor, operating under a majority rule the elite faces a formidable collective action problem which leads it to not being able to block reforms. To solve this collective action problem the elite designs mechanisms that constrain the behavior of individual members, such as political parties or a patronage system. However, when such mechanisms are not available, as was the case in Britain, reforms are an equilibrium outcome

Chapter 3

The Distributive Effects of Corruption

This paper analyzes the distributive effects of corrupt interactions between government officials and citizens. Corruption is modeled as a solution to an allocation problem for a generic government good G. The defining features of this solution are the existence of a market for G when it is not supposed to exist, and the fact that in that market contracts cannot be enforced by an outside agent and transactions are usually secret. The interaction between government officials and citizens takes place in a large-population game in which they are randomly matched for one period. Beyond a transfer from citizens to the government, corruption redistributes welfare towards "insiders" who share some natural connection to the government and to other insiders. Corruption also redistributes welfare towards those who are skilled in imposing negative externalities, and encourages the imposition of such negative externalities.

Introduction and informal presentation of the model

The formal literature on the social effects of corruption often starts by modeling this phenomenon as an allocation problem for a generic government good G. The nature of the allocation that emerges in equilibrium is then analyzed for its implications for the corrupt society. This paper will argue that existing models do not capture some of the most relevant features of corrupt transactions, and will show that incorporating those features in models of corruption produces interesting results with respect to the distributive effects of corruption. The most important argument of the paper can be summarized by saying that the very special nature of corrupt transactions means they have important distributive effects,

when compared to a non-corrupt situation, that go beyond just a transfer from citizens to the government.

Shleifer and Vishny (1993) are a classic starting point for the literature on the formal analysis of the effects of corruption: they consider the provision of government goods G_j in market transactions by officials, when there are complementarities between the various G_j goods, under different coordination structures by the officials. Banerjee (1997) and Banerjee, Hanna, and Mullainathan (2012) model corruption as a more general allocation problem for the government good, and analyze the principal-agent relation between a welfare maximizing government and a bureaucrat. A survey of the issues relating to the formal modeling of corruption is Aidt (2003). This paper continues the tradition of modeling corruption as an allocation problem for a government good, and contributes to the literature by explicitly considering the special nature of corrupt transactions, as well as by concentrating on their distributive effects *among* citizens.

The core of the interaction between citizens and the government official in the paper is the problem of allocating a generic government good G. In a non-corrupt system, the good G will be allocated based on social utility. In the utilitarian framework adopted here, social utility will take into account both the private utility of the a citizen receiving the good G as well as the possible effects on others (externalities) from G being awarded to that citizen. In the non-corrupt system, the allocation itself could be made through an administrative decision, through a market (in case the market is better suited for revealing private preferences), or through some other mechanism. Notwithstanding the mechanism of allocation, what is important is that allocation in the non-corrupt system is based on social utility rather than private willingness to pay. In case the social utility of allocating good G to anyone is computed to be negative, the good would not be allocated at all. In the corrupt system, G is allocated in such a way as to maximize the government official's income, rather than social utility. In practice this means the good is allocated through a market mechanism: this is Shleifer and Vishny's classic definition of corruption as the sale

of government goods. The market allocation of G will differ from the allocation based on social utility in the non-corrupt case in many ways, but one immediate implication is that goods which should not be available at all in the non-corrupt case are available for purchase in the corrupt case: the obvious example is that of a get-out-of-jail card for a criminal. In the non-corrupt case the exchange of bribes for letting a criminal go does not happen, as this does not maximize an appropriately defined social utility. In the corrupt case, such goods are available, as they maximize the government's income. A similar example is a "ticket" to let one agent capture rents from other agents in society: A ticket for participating in government contracting at super-competitive prices, and hence capturing rents from the rest of society is a very typical product that is subject to corrupt transactions. The only case in which a market for G would also exist in the non-corrupt system is one in which this is the socially optimal way to distribute G: an example is government auctions for various products such as telecommunications bandwidth. Even in this case, there will be significant differences between the market for G in the non-corrupt and corrupt systems.

Beyond the fact that it often should not exist, the market for G under the corrupt regime is very special. Two characteristics separate it from usual competitive or monopolistic markets, and the difference might be so great as to even make it inappropriate to call the corrupt interaction a "market". The first characteristic is the lack of any outside enforcer of corrupt contracts. Simply put, promises made under corrupt conditions are not at all credible, as no higher authority would intervene to enforce them, since they are illegal. This would seem to suggest that corrupt interactions should be limited to spot transactions. However, there are few if any true spot transactions in the world: what is normally called a spot transaction is still an exchange of money now for goods that will have to reveal their true usefulness over time, even if that time is very short and very near. If the goods are proved ex-post to not have the promised qualities, the seller will be sanctioned by the government, which would not be the case if that transaction was a corrupt one. This leads to modeling the corrupt interaction as a dynamic game: first the customer pays the bribe,

then the government delivers, or not, the promised good. As long as there is the slightest cost to delivering the good, the unique equilibrium behavior of the government should be to not deliver it, and corrupt transactions and their associated bribing would therefore never happen.

Cooperative equilibria in which the corrupt transactions do happen should therefore emerge only under some form of repeated interaction. Some corrupt interactions are appropriately modeled as infinitely repeated games between one citizen and one government official, and this case is briefly discussed in the paper. However, many relevant types of interactions between the official and citizens are those in which they interact once (or over a finite time horizon, or over a short time horizon). Favorable judicial decisions, business and building permits, government contracts and their associated rents, are all examples of "one-shot" interactions, where normally the commitment power of the government next to a potential customer is non-existent. Therefore, the paper argues that the most relevant model of interaction between citizens and the government is one in which customers are randomly drawn from a continuum of citizens, and are matched with the government for such a one-on-one, one-shot transaction. The government is a long run player, and the customers are short run players (Fudenberg and Tirole 1991). Cooperative equilibria in such large-population random matching games have been studied extensively in game theory. The natural way to obtain a cooperative equilibrium in such cases is to rely on community enforcement: new players who are drawn to be matched with the government condition their behavior on the previous behavior of the government and citizens. In case deviations from the cooperative equilibrium by either citizens or the government happen, play switches to a punishment equilibrium, in which players revert to the one-shot non-cooperative outcome. These kinds of "trigger" community-enforcement strategies can generate cooperative equilibria in much the same way they generate cooperative equilibria in regular repeated games.

The main question in the paper is what are the properties of such cooperative equilibria in terms of distributive effects in society, when compared to a baseline in which the government

good is distributed according to social utility. To determine the properties of cooperative equilibria, the second feature of corrupt transactions must be taken into account : the fact that that corrupt transactions are not usually public. Their outcomes will not normally be observed by all agents, which leads to the need to model carefully the information structure of games that model such transactions. One major determinant of the nature of the cooperative equilibria is therefore the information structure of the game: players can punish bad behavior by previous players only if they observe such bad behavior. But corrupt transactions are generally meant to be secret, as they are illegal. Having access to knowledge about previous interactions is in this case a valuable asset, and those citizens who for whatever reason know about what the government and other fellow citizens have done in the past, or to whom such information can be revealed without danger, will be the only ones who can participate in a cooperative equilibrium. A group of "insiders" who has access to information on previous matches between the government and citizens will therefore be the only one which can participate in such corrupt transactions. In practice, the insiders would be citizens who are family, friends, or are otherwise connected to the official, which explains why corruption most often goes hand in hand with cliquish behavior based on "connections" rather than with the open process by which the highest bidder among all possible customers engages in the corrupt transaction. One immediate implication of this is that corrupt transactions will often be very inefficient: the only ones who engage in them are those who are closely connected to the official (and there is no reason to believe they are also the ones with the highest valuation of the corrupt good) rather than the most efficient agents in the entire population, even if the most efficient agents would be able to pay much higher bribes.

An extension of the model allows more than one citizen to be matched with the government at any given time. In this case, there is more than one cooperative equilibrium, as the selection of any of the matched citizens as partner for the corrupt transaction is compatible with the criteria for selecting cooperative equilibria presented in the body of the paper. However, it is argued that an equilibrium in which the government selects the insider citizen

who has the highest valuation for the good and the highest willingness to pay for it has special attractive properties, and it forms the basis of the analysis, along with discussion of other possible equilibria.

For completeness, the analysis of spot transactions and regular repeated interaction is also presented. Spot transactions lead to the selection of the citizen with the highest willingness to pay (in case more than one is matched), and the distinction between outsiders and insiders no longer matters. Repeated interaction with a single player has simple distributive properties: a corrupt transfer is made to the government, externalities might be imposed on the other citizens, and the discount rate matters for the existence of this equilibrium. In case many citizens are matched with the government over long time horizons, there are many possible equilibria and no strong predictions about which one is selected.

The private usefulness of the G good can itself be seen as endogenous. For example, the utility of a get-out-of-jail card depends on whether the citizen has committed the crime with which it is associated. The knowledge that such products are available for purchase will determine citizens to maximize the usefulness of holding them. A large part of the utility of holding the G good might come in the form of an externality: the usefulness of the freedom card is maximized in case the crime associated with it has been committed. The usefulness of a ticket to participate in government contracting is maximized if the highest amount of rents can be captured by the holder of the ticket from the other citizens, and so on. In equilibrium, agents who gain G will always maximize their private utility for the good, which means maximizing the externality that the good alllows, which means that those who are able to impose the highest externalities have an advantage to other players in winning the G good.

The distributive effects of the corrupt system compared to a non-corrupt system follow from the properties of the described equilibria. The comparison is mainly made in the case of the random matching interaction described above. In the non-corrupt system, a social welfare function which maximizes private utility as long as externalities are not imposed is

assumed to be in place. This social welfare function combines the basic utilitarian principle with the Pareto optimality principle that the increase in someone's utility should not come from capturing utility from someone else. Compared to this baseline, the corrupt system generally redistributes towards insiders, as they are the only ones who are able to engage in corrupt transactions. The corrupt system also generally redistributes towards those citizens who have a high ability to impose externalities on others, e.g. criminals or persons who are especially skilled in capturing utility from others. This is because the ones with such high ability to impose externalities will have a higher private utility for the G good, and therefore will be the ones who acquire it. The corrupt system also obviously redistributes towards the government official, who is free to use his or her ability to provide the G good to extract bribes. The effect of corruption on total utility in the society is generally negative: even if externalities and rents are counted as transfers, and therefore have no effect on total utility, the selection of partners for corrupt transactions only from the insider group will have large negative effects on total utility for realistic models of private utility for G. As the most reasonable distribution of the parameter indicating private utility for the government good in society is skewed towards zero and has a very long tail, limiting the number of draws from the distribution to the insider group will leave out some very high-utility citizens. The properties of the social loss from corruption are explored through a simulation exercise, and it is shown that a small insider group and high variability in the private utility for the G good increase social losses. The last section of the paper discusses some more subtle implications of the model and its connections with existing theoretical and empirical puzzles.

A model of corrupt interactions

The basic building block of the model is an allocation problem: There exists a government good G which needs to be allocated (or not) to citizens who each have a certain level of utility for the good. Under a *corrupt* ($CORR$) system, a citizen j desiring such a product

can engage in an interaction with a government official who can provide the given G good. There are three connected features of what are normally referred to as corrupt interactions that separate them from the regular non corrupt activity of the government, and these three features need to be part of the model:

1. Corrupt transactions often take place in markets that are not supposed to exist. In the reformed (REF) system the G good would most often be provided through non-market mechanisms. If market mechanisms were used in the non-corrupt system (e.g. a public auction), they would have different characteristics. Moreover, the corrupt markets themselves have two very distinctive features:

2. The usual enforcement mechanisms for contracts are not available. In the case in this paper, the government is both the seller of the good and the enforcer of any rules, so it cannot commit to acting against its own interests. (An equivalent justification would be that a higher-level government official is a welfare-maximizing social planner, and has no interest in enforcing illegal transactions.)

3. Corrupt transactions are often secret and cannot be made public.[13] Only a part of the population might have access to information about them. The extent of secrecy needs to be parameterized through features of the information structure of the game.

One citizen per period

The most simple type of interaction between citizens and the government is a two-player game that takes place at some time t: a citizen j and a government official g are matched for an interaction. The citizen has an endowment w and can spend it on two goods: a private

[13]This feature is introduced in the model because it characterizes an overwhelming majority or real-life corrupt interactions. Reasons why corrupt transactions are kept secret can include: *i)* Fear that a higher-level official would punish corruption (either because he or she is a social utility maximizer, or because they face constraints that induce them to so so). *ii)* Fear that political or personal enemies would use this information against the official. *iii)* Electoral constraints. *iv)* Fear from the citizens who participate in these transactions about points *i)-iii)*, etc.

good P, which has a price normalized to 1 per unit, and provides utility normalized to 1 per unit, and a government good G. In the follwing, only one market for G goods is considered at a time, so the subscript g on each G good is omitted.

The utility function of the citizen for the private and government good is linear and additive: endowment is transformed into utility at rate 1 for the private good, so w enters into the utility function without a coefficient before it. The government good enters the utility function at rate α_j, and it is constrained by assumption to be binary: $G_j \in \{0, 1\}$. For the problem to be at all interesting, α_j has to be greater than 1, so that the government good is desirable for the citizen. Any R_j "rent" (bribe, tax) payments to the government are subtracted from the utility function, as they reduce the private good consumption of the citizen. The utility function is therefore:

$$U_j = w + \alpha_j G_j - R_j \tag{40}$$

The government official's utility is also linear in money (which in the corrupt system comes in the form of a "rent" or bribe, hence the R notation):

$$U_g = R_g \tag{41}$$

One-shot interaction

The "match" of the two players takes the form of a two-stage game: in the first stage, the citizen hands out a payment to the official, of size R_j. Assume no credit constraints for the citizen, so R_j can be as great as needed to secure G. In the second stage, the official keeps this payment and can choose to provide the good G back to the citizen. Denote this event, the provision of the good to player j, by $G_j = 1$, and the non-provision by $G_j = 0$. (The assumption that the provision is a binary event is made here). Providing the good carries a cost $c \in (0, \infty)$, so denote by $c_g = c$ the event "official g incurs the cost c". This cost

encapsulates the private cost for the government official: the personal effort by the official of producing g, the risk involved by the provision of an illegal good, or simply the opportunity cost of giving up a good which is generally desirable (this would happen in case the G good was rival). It does not contain the costs of producing the good that are borne by the public budget, as these should not affect the official's utility in any way. Therefore, the cost c might well be very small.

The unique subgame perfect equilibrium outcome of the one-shot game is easy to see: in the second stage, the government official solves:

$$\begin{aligned} \arg\max_{G_j} \;\; & R_j - c_g \\ \text{s. t.} \;\; & G_j \in \{0, G\};\; c_g = c \text{ if } G_j = G;\; c_g = 0 \text{ if } G_j = 0 \\ \Rightarrow \;\; & G_j^* = 0 \end{aligned} \tag{42}$$

It should be intuitive that as long as providing G has the slightest cost, the official is better off keeping the bribe payment but not providing G. Backing off one stage, in the first stage, the citizen solves:

$$\begin{aligned} \arg\max_{R_j} \;\; & w + \alpha_j G_j - R_j \\ \text{s.t.} \;\; & G_j = G_j^* \\ \Rightarrow \;\; & R_j^* = 0, P_j^* = w, U_j = w \end{aligned} \tag{43}$$

So without a more complex form of interaction, a transaction in which the good g is delivered in exchange for a bribe will not happen as long as providing that good has the slightest cost for the government official. Such a commitment problem would not be important in case of a spot transaction, where the payment and the delivery of the good are absolutely simultaneous. This case will be discussed in Section 2.3.1.

Multiple interactions, different citizens: equilibrium properties

The commitment problem looks different however, in case multiple, repeated, interactions are considered. Repeated games will have multiple equilibria, as suggested by the various folk theorem results (e.g. Friedman 1971). The folk theorem for repeated games in which the stage game is a dynamic game is given in Wen (2002). The result in Wen (2002) is similar to the one in the folk theorems for repeated simultaneous games, with the exception of the replacement of the minmax value for repeated simultaneous games with a more general notion of "effective minmax". The effective minmax is roughly speaking the lowest utility that can be imposed on a player in one period without other players also minmaxing themselves. In the present case, this value is easy to determine as zero for the government and w for citizens: For each citizen, he or she can choose to not make any rent payments and thus consume only private goods, thus receiving a utility of w. For the government, it can choose to not provide any G and therefore not incur any costs, and get utility zero. The feasibility condition in the folk theorem is that the sum of payoffs cannot be greater than the maximum amount of utility available in the game each period, which in this case is $w + \alpha_{t,j}^{MAX} - c$. Here $\alpha_{t,j}^{MAX}$ is the highest value of α at time t. Therefore the folk theorem of Wen (2002) states that any payoff vector that generates utilities per period higher than 0 for the government, and higher than w for the citizens, but that sums up to less than $w + \alpha_{j}^{MAX} - c$ in each period can be sustained in a subgame perfect equilibrium for a high enough discount rate.

Among these multiple equilibria, this analysis concentrates on those which, loosely speaking, are cooperative, in the sense of having some notion of Pareto optimality associated to them. More formally, the analysis will assume that players only consider equilibria Γ^* which have the following properties:

i) Γ^* is Pareto efficient in expectation. This means that Γ^* is not weakly Pareto dominated in expectation. Denote by EV_{EQ}^k the expected payoff of player k in equilibrium EQ. An equilibrium $\Gamma^{*\prime}$ will not be considered if there exists another Γ^* such that $EV_{\Gamma^{*\prime}}^k \leq EV_{\Gamma^*}^k \quad \forall k \in \{N, g\}$, with strict inequality at least once, where N is a continuum from which the citizens

are selected. So if some equilibrium Γ^* offers a better expected payoff for at least some citizens and the government than an equilibrium $\Gamma^{*\prime}$, and not a worse outcome for anyone, then eliminate equilibrium $\Gamma^{*\prime}$ from the analysis, as it is assumed that players do not consider it.

A separate requirement from the cooperative one would be that the community enforcement process only selects equilibria in which the citizens are not over-paying for the good, that is the rent level is not higher than what is absolutely necessary for the government to provide the good to whatever citizen it provides to in equilibrium. This requirement helps remove multiple equilibria in which all that is different is the size of the rent (which is just a transfer from citizens to the government), and thus allows the analysis to concentrate on other dimensions of redistribution. Formally:

ii) Γ^* is such that $V^g_{t,\Gamma^*} = V^g_{t,OSD}, \forall t$. This requires that the government's participation (incentive compatibility) condition in the equilibrium always holds with equality: the utility of the government under the equilibrium has to be equal to the utility of the government under the best one-stage deviation from the given equilibrium at every moment.

The form of interaction considered in section 2.4 will generate many equilibria which fail both of these criteria, so in that case the predictions of the model will be weaker.

Multiple interactions, different citizens: equilibrium derivation

Consider a game in which the basic two-stage game presented above is repeated numerous times between the official and a different potential customer each period. In such an infinitely repeated game, all players discount the future with rate $\delta \in (0, 1)$. In this section consider the simplest matching structure between the official and possible "customers": each period the official is matched to play the game described above with a single customer. The customers are drawn from a continuum of size N, so the same customer will only be drawn once. The crucial parameters influencing what sorts of equilibria can arise in this random matching game are the information sets of the players: the information set $\Lambda_{t,j}$ of player j at time t is

determined by which of the interactions that have taken place until time $t-1$ are known to j, in terms of their actions/outcomes. A player who knows about (some of) the actions taken until time $t-1$ at time t can condition his or her actions on this knowledge. A player who does not know cannot condition his or her action on this knowledge, so will be effectively playing the one-period game described above. This leads to modeling a simple information structure among the citizens: the citizens are split in two groups: I for *insiders*, whose information sets include at least the last meetings between the government official and a members of I (the more realistic situation in which they include all previous interactions between insiders and the official is identical in terms of equilibrium outcomes), and O for *outsiders*, whose information sets include only their own participation to the game.

Formally, given the set of histories H_t, up to time t, the information set of player j at time t is $\Lambda_{t,j}$. Denote by $A_{t,i}$ the set of available actions for player j at time t, by $a_{t,j} \in A_{t,j}$ the action chosen by player j at time t, and by $a_{(t-1)I,j}$ or $a_{(t-1)O,j}$ the action of j at time the previous time period in which an I player has been matched, and the corresponding notion for O players respectively. If the history h is such that $h \in \Lambda_{t,j}$, then player j does not know whether they are at history h or some other $h' \in \Lambda_{t,j}$. The information sets of the two kinds of players therefore are:

$$\begin{aligned}\Lambda_{t,i} &= \{h_t | a_{(t-1)I,i} \in h_t, A_{\tau,o} \in h_t, a_{(t-1)I,g} \in h_t, A_{(\tau)O,g} \in h_t, \\ &\quad \forall \tau \in \overline{0,t},\ \forall i \in I,\ \forall o \in O\} \qquad (44)\\ \Lambda_{t,o} &= \{h_t | A_{\tau,i} \in h_t, A_{\tau,o} \in h_t, A_{\tau,g} \in h_t, \forall \tau \in \overline{0,t}, \forall i \in I, \forall o \in O\} \qquad (45)\end{aligned}$$

That is, insider players at time t know the actions taken by other insider players and the government up to time in the latest period where they met, and outsider players do not know what actions have been taken by anyone up to time t. Moreover, assume that these information structures are common knowledge among all players.

The matching process is given by random draws from the mass of citizens, and the

distribution of α parameters in the mass of citizens is given by a continuous random variable with cumulative distribution function F:

$$\alpha \sim F_\alpha(\alpha) \tag{46}$$

As shown above, the unique subgame perfect equilibrium of the one-period game is that no corrupt transactions take place because there is no commitment power from the government to actually provide the goods that are the object of a potential transaction. The repeated nature of the game opens up the possibility of cooperation sustained by community enforcement.[14] In the following, an equilibrium that fulfills condition *i)* will be derived, and shown to be the only one that satisfies it while also satisfying condition *ii)*. The basic intuition of community enforcement of "cooperative" equilibria is that the players that are matched after a certain interaction has taken place use punishment strategies against players who have deviated from the prescribed equilibrium behavior in that interaction. The matching of I or O players is stochastic, with the simple law that the probability of an i match in every stage is p and the probability of an o match is $1-p$. The parameter p is a measure of the extent of secrecy that exists in society with respect to corrupt transactions: a higher p means less secrecy, as more people are in the group of insiders. In the extreme case in which $p = 1$, everyone has full information about corruption, meaning that the constraints on revealing corrupt transactions are non-existent.

Some notation is useful: Denote by $M_{t,i}$ the event "an insider player has been matched with the government official at stage t", and by $M_{t,o}$ the event "an outsider player has been matched with the government official at stage t". Also denote by $i\prime$ all I players that are not i. Given this set-up, the following statement can be shown to be true:

Proposition 1: Assume $\alpha_i \geq \frac{c(1-\delta(1-p))}{\delta p}$, $\forall i$. The follwing strategies generate a coop-

[14]For discussion and models of community enforcement in repeated, random matching games, see Ellison (1994), Greif (1993), Kandori (1992), Milgrom, North, and Weingast (1990), Dixit, (2003), Ghosh and Ray (1996), Karlan et al. (2009), Takahashi (2010). The basic idea in this literature is that cooperative equilibria can be sustained even when players meet only once, if players condition their actions at time t on their and other players' behavior at times before t.

erative subgame perfect equilibrium of the repeated game, in periods when the government official is matched with players from I:

$\forall \tau < t$:

$$\sigma_{t,i} = \begin{cases} R_{t,i} = & c\frac{1-\delta(1-p)}{\delta p} \text{ if } \left(R_{(t-1)I,i\prime} \geq c\frac{1-\delta(1-p)}{\delta p} \text{ and } G_{(t-1)I,i\prime} = 1\right) \\ R_{t,i} = & 0 \text{ if } \left(R_{(t-1)I,i\prime} < c\frac{1-\delta(1-p)}{\delta p} \text{ or } G_{(t-1)I,i\prime} \neq G\right) \end{cases} \tag{47}$$

$\forall \tau < t$:

$$\sigma_{t,g} = \begin{cases} G_{t,i} & = 1 \text{ if } \left(M_{t,i} \text{ and } \left(R_{(t-1)I,i\prime} \geq c\frac{1-\delta(1-p)}{\delta p} \text{ and } R_{t,i} \geq c\frac{1-\delta(1-p)}{\delta p} \text{ and } G_{(t-1)I,i\prime} = 1\right)\right) \\ G_{t,i} & = 0 \text{ if } \left(M_{t,i} \text{ and } \left(R_{(t-1)I,i\prime} < c\frac{1-\delta(1-p)}{\delta p} \text{ or } R_{t,i} < c\frac{1-\delta(1-p)}{\delta p} \text{ or } G_{(t-1)I,i\prime} \neq 1\right)\right) \\ G_{t,o} & = 0 \text{ if } M_{t,o} \end{cases} \tag{48}$$

$$\forall \tau < t \;\; \sigma_{t,o} = (R_{t,o} = 0) \tag{49}$$

Proof: Write the value functions of the government in recursive form (the Bellman equations) for the equilibrium path of the cooperative situation described by the strategies above, as well as for the best one-stage deviation (OSD) by the government:

$$V^g_{COOP}(M_{t,i}) = R_{t,i} - c + \delta\left[(1-p)E\left[V^g_{COOP}(M_{t+1,o})\right] + pE\left[V^g_{COOP}(M_{t+1,i\prime})\right]\right] \tag{50}$$

$$V^g_{OSD}(M_{t,i}) = R_{t,i} + \delta\left[(1-p)E\left[V^g_{PUN}(M_{t+1,o})\right] + pE\left[V^g_{PUN}(M_{t+1,i\prime})\right]\right] \tag{51}$$

Here $V^g_{COOP}(M_{t,i})$ is the value function of the government on the equilibrium path in the cooperative equilibrium described by the strategies above, in stages where the government is matched with an insider player, $V^g(M_{t,o})$ is the value function of the government when matched with an outsider player, $V^g_{OSD}(M_{t,i})$ is the value of the best one-stage deviation by the government, and $V^g_{PUN}(M_{t,i})$ is the value function of the government when play has switched to the punishment prescribed by the strategies described above. The reason future

instances of the value function are written in expectation is because these values might depend on the α parameters drawn in future stages, and those parameters are random. The subgame perfect equilibrium condition is that no profitable one shot deviations exist for the government:

$$\forall t, \forall i \quad V^g_{COOP}(M_{t,i}) \geq V^g_{OSD}(M_{t,i}) \tag{52}$$

This condition will have to hold with equality, as there is no need for citizens to pay more than enough rents to the government according to condition *ii)* (the remaining income is incorporated in citizens' utilities as the private good). To see what values of the rent parameter lead to the condition holding, compute V^g_{COOP} : First, take the expected value of both Bellman equations in (50-51). Doing this will lead to equilibrium conditions involving the expected value of the rent payment, $E[R_{i,t}]$, so individual behavior by the citizens will have to correspond to a probability law that leads to a certain expected value for the rent, If it is further assumed that citizens use symmetric strategies, it is also possible to denote all i players by a single subscript, rather than using i and $i\prime$. Using the fact that $E[E[X]] = E[X]$ and the linear property of the expected value, the Bellman equations now become:

$$\begin{aligned} E\left[V^g_{COOP}(M_{t,i})\right] &= E\left[R_{t,i}\right] - c + \delta\left[(1-p)E\left[V^G_{COOP}(M_{t+1,o})\right] + pE\left[V^G_{COOP}(M_{t+1,i})\right]\right] \\ E\left[V^G_{OSD}(M_{t,i})\right] &= E\left[R_{t,i}\right] + \delta\left[(1-p)E\left[V^G_{PUNISH}(M_{t+1,o})\right] + pE\left[V^G_{PUNISH}(M_{t+1,i})\right]\right] \end{aligned}$$

Then from the first equation:

$$E\left[V^g_{COOP}(M_{t,i})\right](1-\delta p) = E\left[R_{t,i}\right] - c + \delta(1-p)E\left[V^G_{COOP}(M_{t+1,o})\right] \tag{53}$$

The value function when being paired with an outsider player in the cooperative equilibrium can be derived from its own set of two Bellman equations, again written in expectation, and

again assuming symmetric strategies by O players:

$$\begin{aligned} E\left[V^g_{COOP}(M_{t+1,o})\right] &= E\left[R_{t+1,o}\right] - c + \\ &\quad +\delta\left[(1-p)E\left[V^g_{COOP}(M_{t+2,o})\right] + pE\left[V^g_{COOP}(M_{t+2,i})\right]\right] \qquad (54) \\ E\left[V^g_{OSD}(M_{t+1,o})\right] &= E\left[R_{t+1,o}\right] + \\ &\quad +\delta\left[(1-p)E\left[V^g(M_{t+2,o})\right] + pE\left[V^g(M_{t+2,i})\right]\right] \qquad (55) \end{aligned}$$

The value functions following a deviation by the government here do not carry any subscript regarding the strategy used by players who are matched in those periods, because once stage $t+2$ has been reached following a defection by the government, for the citizens this event lies in the same information set as reaching stage $t+2$ following cooperative behavior by the government. Therefore, the citizens have to behave identically in the two histories, as they do not know which one they are in. The government will have unique best responses to whatever behaviors the citizens engage in, so it always has to be that $E\left[V^g_{COOP}(M_{t+2,o})\right] = E\left[V^g(M_{t+2,o})\right]$ and $E\left[V^g_{COOP}(M_{t+2,i})\right] = E\left[V^g(M_{t+2,i})\right]$.

So the condition that $V^g_{COOP}(M_{t+1,o}) \geq V^g_{OSD}(M_{t+1,o})$ leads to $E\left[V^g_{COOP}(M_{t+1,o})\right] \geq E\left[V^g_{OSD}(M_{t+1,o})\right]$, which then leads to:

$$E\left[R_{t+1,o}\right] - c \geq E\left[R_{t+1,o}\right] \qquad (56)$$

which is never true as long as $c > 0$. Therefore cooperation cannot be sustained in stages where the government meets outside players, so the value function of the government when matched with an outside player is:

$$E\left[V^g_{COOP}(M_{t+1,o})\right] = \frac{\delta p}{1-\delta p} E\left[V^g_{COOP}(M_{t+2,i})\right] \qquad (57)$$

Putting this back in the value function for cooperating with an insider:

$$E[V^g_{COOP}(M_{t,i})] = \frac{1-\delta(1-p)}{1-\delta}\left(E\left[R_{t,i}\right]-c\right) \tag{58}$$

The value function for the best one stage deviation is given by capturing the entire rent payment now, which triggers the punishment future matches with insider players. Therefore a stream of zero payments follows defection by the government, and

$$E\left[V^g_{OSD}(M_{t,i})\right] = E\left[R_{t,i}\right] \tag{59}$$

The no-deviation condition has to hold: $E\left[V^g_{COOP}(M_{t,i})\right] = E\left[V^g_{OSD}(M_{t,i})\right]$, so it follows that:

$$\begin{aligned} E\left[R_{t,i}\right] &= \frac{1-\delta(1-p)}{1-\delta}\left(E\left[R_{t,i}\right]-c\right) && (60)\\ \implies E[R_{t,i}] &= \frac{c(1-\delta(1-p))}{\delta p} && (61)\end{aligned}$$

Using symmetric strategies for all players, it follows that a constant rent payment by any insider player keeps the government in the cooperative equilibrium, and that payment is:

$$R_{t,i} = \frac{c(1-\delta(1-p))}{\delta p} \tag{62}$$

For citizens, the value functions in the cooperative equilibrium are simpler:

$$\begin{aligned} V^i_{COOP}(M_{t,i}) &= \alpha_i G_i - R_{t,i} + w + \delta V^i(\neg(M_{t+1,i})) && (63)\\ V^i_{OSD}(M_{t,i}) &= w + \delta V^i(\neg(M_{t+1,i})) && (64)\end{aligned}$$

Future periods, in which i is not matched, have the value function $V_i(\neg(M_{t+1,i}))$. So the

cooperation condition $V^i_{COOP} \geq V^i_{OSD}$ reduces to:

$$\alpha_i \geq \frac{c(1-\delta(1-p))}{\delta p} \tag{65}$$

This condition states that the government good is worth enough that sacrificing some income to secure it is worth it for player i. The condition is mild, stating that the utility of the citizen for the good is large enough when compared to the cost for the government so that the citizen is willing to pay the price of the good. If this condition holds for any α_i, the cooperative equilibrium always exists and features the provision of the G good in every matching with an insider player, the payment of a bribe R_i and the provision of no G and the payment of no bribes when interacting with outsiders. The assumption of no credit constraints means that α_i and therefore the rent paid can be greater than w if needed (or alternatively that $\alpha_i \leq w, \forall i$). Note that an equivalent equilibrium is generated in case insider players observe all previous matches with insider players: similar to the equilibrium presented above, they would condition on observing one defection from cooperative behavior the start of the punishment phase.

The equilibrium derived above is Pareto optimal, as the maximal level of utility is generated each stage: The utilities in each period are $w + \alpha_j - R_j$ for the citizen, and $R_j - c$ for the government, so total utility is $w + \alpha_j - c$, which is the maximal amount of utility available in the game, as long as $c < \alpha_j$. Obviously, giving more of this utility to one player means taking utility from another player, so the equilibrium is Pareto optimal. Among the allocations that are Pareto optimal, the one generated by the equilibrium is the only one that is also subgame perfect: the citizens would not give up more income each stage for the government, as this would not be subgame perfect for them, and the government would similarly not give up any of its utility, as this would violate subgame perfection.

Multiple citizens per period

The model above omits an important feature of real-life corrupt transactions: the fact that the G good might be rival at any given time t: that is, that more than one person would derive utility from getting it from the official. This situation will generate multiple equilibria, so the question that arises is how to select among the multiple equilibria which are possible. Applying condition *i)* will restrict the possible equilibria to a class of equilibria that share most of the properties of the one for single matches, and further requirements will suggest a natural candidate for a focal point among this class of equilibria.

Multiple interactions, different citizens: equilibrium derivation

Consider a modified version of the selection process for customers for G at time t: now instead of drawing one citizen, insider or outsider, from the distribution $F_\alpha(\alpha)$, draw n_i insiders, and n_o outsiders from $F_\alpha(\alpha)$. The parameters n_i and n_o are themselves random:

$$\begin{aligned} n_i &\sim F_{N_i}(n_i) \\ n_o &\sim F_{N_o}(n_o) \end{aligned} \tag{66}$$

The random variable F_n is generic, but it is useful to impose the limitation that $n_i > 0$ or $n_o > 0$ for simplicity of computation. That is, stages in which no customer is matched are ignored, and in each stage, at least one potential customer exists. Also maintained is the assumption that the customers are drawn from a continuum. So the government now faces a "demand function" in each period made up of $n_i + n_o$ potential customers, ranked by α, their valuation of the government good, and can distribute G to only one of them. It is useful to denote by $\alpha_{t,i}^{(r)}, r = 1, 2, ...$ the ranking of the α parameters of the insiders drawn at time t, with $\alpha_{t,i}^{(1)}$ being the highest, and so on. It is also useful to denote by q the probability that the draws from the two distributions generate a match with at least one inside player: $q = \Pr(n_i > 0)$. Further, denote by $C_{t,j}$ the event "player j has been

chosen by the government as partner at stage t", and by $\mathfrak{M}_t$ the set of all citizens that have been matched at time t. Also denote by $M_{t,i}$ the event "at least one insider player has been matched at time t" (which has probability q) and by $M_{t,o}$ the event "only outsider players have been matched at time t" (probability 1-q).

Condition *i)* eliminates all equilibria in which the good G is not allocated to someone who is part of the demand at each time t. Therefore, only consider equilibria in which someone always is the recipient of the good, from among those who have been matched at time t. The surviving equilibria are all similar to the one in section 2.1, in that the government selects an insider citizen from among those forming the demand, offers the G good in exchange for a rent, and deviations from that behavior lead to a trigger punishment strategy for all players. However, any choice of a partner to cooperate with from among the I players matched each period fulfills condition *i)*, so it cannot help restrict the set of equilibria further. One equilibrium however has a number of attractive properties which suggest it is the most natural focal point: An equilibrium in which the government asks for bids from the insider citizens who have been matched each period, and selects the one with the highest ability to pay the rent, has four attractive properties: First, it is the most attractive for the government among those that satisfy all the other conditions, as it generates the highest level of the bribe. In as much as the government's announced strategy can be a focal point, this will be the outcome of the game. Second, it is strictly better in expectation than the non-cooperative equilibrium, for every citizen, as every citizen has a positive probability of being selected as partner, as everyone has a positive probability of ending up in a single match with the government (though it is not the only equilibrium that has this property). Third, it maximizes total welfare in the group made up of g and I, as the citizen who wins the good is the one with the highest valuation for it. Fourth, it satisfies condition *ii)*, which requires that citizens do not overpay for G. The formal description of this equilibrium follows here:

Proposition 2: Assume $\alpha_{t,i}^{(2)} \geq \frac{c(1-\delta(1-q))}{\delta q} \ \forall t, \forall i$. The follwing strategies generate a

cooperative subgame perfect equilibrium whenever the government official is matched with players from I:

$\forall \tau < t$:

$$\sigma_{t,i} = \begin{cases} R_{t,i} = & \frac{c(1-\delta(1-q))}{\delta q} \text{ if } \left(R_{(t-1)I,i\prime} \geq \frac{c(1-\delta(1-q))}{\delta q} \text{ and } G_{(t-1)I,i\prime} = G \text{ and } C_{t,i} \text{ and } n_{t,i} = 1\right) \\ R_{t,i} = & \alpha_{t,i}^{(2)} \text{ if } \left(R_{(t-1)I,i\prime} \geq \frac{c(1-\delta(1-q))}{\delta q} \text{ and } G_{(t-1)I,i\prime} = G \text{ and } C_{t,i} \text{ and } n_{t,i} > 1\right) \\ R_{t,i} = & 0 \text{ if } \left(R_{(t-1)I,i\prime} < \frac{c(1-\delta(1-q))}{\delta q} \text{ or } G_{(t-1)I,i\prime} \neq G \text{ or } \neg C_{t,i}\right) \end{cases} \tag{67}$$

$\forall \tau < t$

$$\sigma_{t,g} = \begin{cases} j \text{ s.t. } C_{t,j} & = \arg\max_j V_{COOP}^g(C_{t,j}), \text{ s.t. } j \in \mathfrak{M}_t \\ G_{t,i} & = G \text{ if } n_{t,i} > 0 \text{ and } R_{(t-1)I,i\prime} \geq \frac{c(1-\delta(1-q))}{\delta q} \\ & \text{ and } R_{t,i} \geq \frac{c(1-\delta(1-q))}{\delta q} \text{ and } G_{(t-1)I,i\prime} = G \\ G_{t,i} & = 0 \text{ if } n_{t,i} > 0 \\ & \text{ and } \left(R_{(t-1)I,i} < \frac{c(1-\delta(1-q))}{\delta q} \text{ or } R_{t,i} < \frac{c(1-\delta(1-q))}{\delta q} \text{ or } G_{(t-1)I,i\prime} \neq G\right) \\ G_{t,o} & = 0 \end{cases} \tag{68}$$

$$\forall \tau < t \;\; \sigma_{t,o} = (R_{t,o} = 0) \tag{69}$$

Proof: Write the value functions of the government on the equilibrium path and the best one stage deviation for the government:

$$V_{COOP}^g(M_{t,i}) = R_{i,t} - c + \delta\left[(1-q)E\left[V_{COOP}^G(M_{t+1,o})\right] + qE\left[V_{COOP}^G(M_{t+1,i})\right]\right] \tag{70}$$

$$V_{OSD}^G(M_{t,i}) = R_{i,t} + \delta\left[(1-q)E\left[V_{PUN}^G(M_{t+1,o})\right] + qpE\left[V_{PUN}^G(M_{t+1,i})\right]\right] \tag{71}$$

The government's conditions for maximizing income while being in this cooperative equi-

librium are

$$(t,i) = \left(t, \arg\max_j V^g_{COOP}(C_{t,j}),\ \text{s.t. } j \in \mathfrak{M}_t\right) \tag{72}$$

$$V^g_{COOP}(M_{t,i}) \geq V^g_{OSD}(M_{t,i}) \tag{73}$$

(The maximization problem is set up here only with respect to i players, as in equilibrium an o player is never chosen, by the same logic as in the previous section.) The optimization condition for the government is similar to that in case 1 but with the addition of the problem of choosing among the citizens which have been matched, that is of choosing at each t the one i (or o) for which the value function conditions have to hold. Since the forms of the two relevant value functions are identical to those in case 1, except for replacing p with q, the same derivation leads to the following cooperative equilibrium condition for the government:

$$E\left[R_{t,i}\right] \geq \frac{c(1-\delta(1-q))}{\delta q} \tag{74}$$

The condition is not yet reduced to equality, because there might be more than one insider player willing to pay a bribe. To see which i player is chosen, write the value functions for the citizens:

$$V^i_{COOP}(C_{t,i}) = \alpha_i G_i - R_{t,i} + w + \delta V^i(\neg(M_{t+1,i})) \tag{75}$$

$$V^i_{OSD}(C_{t,i}) = w + \delta V^i(\neg(M_{t+1,i})) \tag{76}$$

$$V^i(\neg C_{t,i}) = V^i_{OSD}(C_{t,i}) \tag{77}$$

The set of relevant value functions now includes the last one, for the situation in which player i is not chosen at time t. Then the cooperation condition for citizens (which is the same as the condition for being willing to participate in a cooperative equilibrium altogether by

being chosen as partner by the government) is:

$$\alpha_i \geq R_i \tag{78}$$

In case more than one citizen is matched, it is clear that the one with the highest α_i level will become the partner of the government official, and will offer a rent payment (just slightly above) the maximum rent payment of the second-ranked drawn citizen.

With the given strategies, the government's problem of choosing the player to cooperate with in each period to maximize its value function for cooperation is reduced to choosing the player who can pay the highest rent each period, as there is nothing to be gained by choosing a player who can pay less.

The citizens in I then solve:

$$\begin{aligned} & \arg\max_{R_i} \alpha_i - R_i \\ \text{subject to} \quad & \alpha_i \geq R_i \text{ and } R_i \geq R_j \ \ \forall j \in \mathfrak{M}_t \end{aligned} \tag{79}$$

This leads for the player who has $\alpha^{(1)}$ at time t to set:

$$R_{t,i} = \alpha^{(2)} \tag{80}$$

This means that the player with the highest valuation for the G good at time t wins the contest for G by paying (slightly more than) the maximum that the second player is willing to pay. The assumption that this rent payment is enough to keep the government in the cooperative equilibrium is similar to the one in section 2.1: $\alpha^{(2)} \geq \frac{c(1-\delta(1-q))}{\delta q}$. The major difference between the equilibrium here and the one described in the previous case is that the distribution of gains between the government and citizens is different in the case of multiple matches. The presence of competition between bribe payers leads to the government capturing most of the rents from such interactions.

The other equilibria which are allowed by condition *i)* are similar with the exception of the criterion for choosing cooperative partners, and hence of the bribe that must be paid. Virtually any rule for choosing among $\mathfrak{M}_{t,i}$, either deterministically or probabilistically can generate a subgame perfect equilibrium with a given rent associated with it. Compared with the equilibrium described above, these other equilibria have the following properties: First, total utility will be lower, as the citizen receiving the good will not generally be the one with the highest valuation. Second, the insider-outsider distinction is maintained, as punishment strategies are still only effective in the community of insiders. Third, the distributive effects of variation in players' ability to impose externalities will not be as clear cut as they are in the equilibrium presented above, as will be explained in section 2.3.2.

Spot transactions

One type of interaction not covered by the model above is that of a spot transaction, in which there are no commitment problems on the part of the government. As has been argued, these kinds of transactions are not likely to characterize corrupt interaction in most cases, but they are included here for completeness. In the spot transaction case, the insider-outsider effect disappears, and the government awards the good to the citizen who pays the highest price each stage: That is, the government's problem is:

$$\begin{aligned} \arg\max_{G_{t,j}} \quad & R_j - c \\ \text{s. t.} \quad & G_{t,j} \in \{0,1\} \\ & c_g = c \text{ if } G_{t,j} = 1,\ c_G = 0 \text{ if } G_{t,j} = 0 \\ & R_{t,j} = R_{t,j} \text{ if } G_{t,j} = 1, C_{t,j};,\ R_{t,j} = 0 \text{ if } G_{t,j} = 0, C_{t,j} \\ \Rightarrow \quad & G^*_{t,j} = 1 \text{ if } R_{t,j} > c \text{ and } C_j \end{aligned} \tag{81}$$

together with

$$j = \arg\max_{j} R_j \tag{82}$$

And the citizen solves:

$$\begin{aligned} \arg\max_{R} \;& w + \alpha_j G_j - R_j \\ \text{s.t.} \;& R_{t,j} \geq c, \;\; (G = G^* \text{ if } C_{t,j}) \text{ and } (G = 0 \text{ if } \neg C_{t,j}) \\ \Rightarrow \;& R^*_{t,j} = \alpha^{(2)}_{t,j} \text{ if } n_{t,i} > 1, R^*_{t,j} = c \text{ if } n_{t,i} = 1 \end{aligned} \tag{83}$$

Therefore, the insider or outsider who has the highest α gets the G good, and pays a rent worth the maximal rent that the player with the second highest α would be willing to pay. So the spot transaction case retains the result that the citizen with the highest private utility wins the good, but does not retain the distinction between insiders and outsiders. However, these kinds of transactions are likely to be rare, or altogether non-existent in practice.

Repeated interaction with the same player or same group

Another type of interaction that is omitted from the model above is one in which the same players are matched with the government for multiple periods—a repeated game where the government can meet the same player for many stages in a row. When there is only one such player being matched with the government in each stage, the properties of this interaction are the same as those of the spot transaction, in case the discount rate is high enough to sustain a cooperative equilibrium, so the case is not further discussed. More relevant are cases in which the good is desired by all (many) players in each stage: this is the case of a generic good that genrates returns for the holders in each period, and so is potentially desired by a large number of citizens over a long time horizon. Just as in the previous cases, the repeated nature of the game leads to the existence of large numbers of possible subgame perfect equilibria, by the logic of the folk theorems. Unlike in the previous cases,

thought, there is no natural cooperative equilibrium that is to be sought by the players using condition *i)*. The strongest statements that can be made about this type of interaction are those deriving from the results of the relevant folk theorem (Wen 2002). In addition, the nature of a few possible equilibria can be discussed, as follows:

As stated before, the folk theorem of Wen (2002) states that any payoff vector that generates utilities per period weakly higher than 0 for the government, and weakly higher than w for the citizens, but that sums up to less than $w + \alpha_j^{MAX} - c$ in each period can be sustained in a subgame perfect equilibrium for high enough δ. More precisely, any rule for choosing the partner for cooperation at time t from among insiders can be sustained in equilibrium. Condition *i)* does not restrict the set of equilibria beyond eliminating the partially non-cooperative equilibria in which the good is sometimes not allocated. Condition *ii)* does restrict the set of equilibria somewhat, for example by requiring that the highest-α player is not paying a rent higher than the maximal rent that the government could extract from other players, but the usefulness of this requirement is limited.

Therefore, there are many equilibria which can be produced by this interaction. An obvious example is the analog of the equilibrium favored in section 2.2, which where would be one in which the government solicits a bribe worth $\alpha_j^{(2)}$ from the citizen with the highest α value in exchange for G, and any defection from this leads to all players switching to the non-cooperative equilibrium with payoffs w for all citizens and 0 for the government forever. For high enough values of δ these grim-trigger strategies will be subgame perfect. (The distinction between I and O players does not matter anymore, as defections from the cooperative strategy can be observed by all through the fact that a new match with the government has become available.) However, here this equilibrium no longer fulfills the conditions which recommended it as a favorite in section 2.2: while it is the best equilibrium for the government, and generates the most social utility, it violates requirement two, that it be strictly better than the non-cooperative equilibrium for everyone: in this case, for every citizen who is not the highest ranked citizen, the utility generated in this equilibrium is w,

just like in the non-cooperative equilibrium, so one of the main reasons why this kind of equilibrium was favored in section 2.2 is not present here.

There are many other possible equilibria, and no natural criterion by which to favor one of them over the others. For example, an equilibrium where the government selects a random citizen each stage, who offers a rent payment worth $\frac{c}{\delta}$ (the minimal rent payment that keeps the government offering the good), is also sustained for high enough δ using grim trigger strategies, and there is no reason to believe that either of the two proposed equilibria is more natural than the other, as there is no Pareto optimality ordering between them. The reason it is impossible to find an equilibrium which fulfills all four properties of the equilibrium from section 2.2 is because now condition two, that of outcomes which are strictly better than the non-cooperative equilibrium for everyone, is in direct contradiction with requirement one, that the equilibrium be the best for the government, and with requirement three, that total social welfare be maximized. Idiosyncratic (cultural) features of the society in which players exist will determine which one of the many equilibria is a focal point (Myerson 2004), so the analysis here cannot say more about the distributive effects of interactions in which all players participate in a typical repeated-game setup.

Equilibrium determination of α

So far the α indicating how useful the government good is for each of the citizens has been kept exogenous. But there are many cases where agents react to knowing that the buying of G is available by modifying their behavior in ways that maximize the usefulness of this fact. An obvious example is that of a "get out of jail" card. The knowledge that this product can be bought on the open market will make an agent commit the crime that is associated with the get out of jail card, knowing that they can avoid the negative consequences of that by buying the card. Assuming the equilibrium presented in 2.2.1, in case more than one customer is matched with the government, the one with the highest ability to maximize α will have an advantage to the others.

To analyze the nature of this maximization, and the effects it creates for utility distribution, consider the maximization problem in case the good G is not available for sale. Time subscripts are not included, as they would be redundant here. In this non-corrupt case, considering the same matching structure as above, the good G is distributed according to social utility. There are various ways in which the social utility can differ from the private utility, depending on the precise social welfare function used. However, the major reason why utilitarian social and private utility would differ is the existence of externalities: citizen j maximizing his or her utility might induce an externality e on other citizens. So the identity that connects social and private utilities is assumed to be:

$$\alpha_j = \alpha_j^B + e_j \tag{84}$$

The parameters α_j^B and e_j arise in equilibrium, once player j knows that he or she will be the one to receive the good G. The externality e_j is assumed to always be positive for the citizen whose utility function it enters directly, and negative for all other citizens (e.g. it is a negative externality). The parameter α^B indicates the "baseline" utility of distributing good G for citizen j, that is j's private utility net of any externalities. For many of the goods that are subject to corrupt transactions, this baseline utility is zero: there is no benefit to someone having a get-out-of-jail card, or a pass to extract rents from citizens, that is not also a cost for someone else. In these cases, all of the gains for j are captured by the externality term.

Whether citizen j is the one receiving the good is determined by the nature of the regime: non-corrupt or corrupt. In the non-corrupt system the good is distributed to the citizen with the highest baseline utility for the good, as long as he or she does not impose externalities. That is, the j^* who gets the good G is determined by:

$$\forall j \text{ s.t. } (e_j = 0 \text{ and } \alpha_j^B > 0) \quad j^* = \arg\max_j \alpha_j^B \tag{85}$$

Implicit in this definition is that if the baseline utility of anyone receiving the good is not strictly positive, then the good is not distributed at all, $j^* = \emptyset$. This simple social welfare function combines the two basic principles of utilitarian individual utility maximization and Pareto optimality.

The citizen's problem is therefore to set the optimal level of (potential) α_j^B and e_j, knowing that they could be selected by the government for the allocation of G based on the results of this optimization. The maximization problem of the citizen in the non corrupt system is:

$$\begin{aligned} &\max_{\alpha_j, e_j} \alpha_j^B + e_j \\ &\text{s.t. } e = 0 \end{aligned} \tag{86}$$

which yields the obvious solution $\left(\max \alpha^B\right)_j$, $e_j = 0$, where $\left(\max \alpha^B\right)_j$ stands for the highest α^B that citizen j can achieve. The externality e_j is already set to 0 in the maximization problem, since it is a given that any other level of e_j will not maximize the citizen's utility, as he or she will not receive the G good.

In the corrupt system the G good is always distributed to the citizen with the highest α_j, that is the highest private utility for the good, by the arguments in the previous sections. The citizen that gets the good is therefore:

$$i^* = \arg\max_i \alpha_i^B + e_i \tag{87}$$

So the players who manage to make e_i higher have an advantage to those who do not do so. Also, if α_i^B is zero, that is, there is no private utility for the good that is not also an externality, all that matters is the citizen's ability to impose externalities: the citizens who are most skilled in this get the government good.

Distributive effects

This section proves formally what should intuitively emerge from the sections above: the presence of corruption, when compared to the non-corrupt system in which goods are not allocated based on willingness to pay and private utility, distributes income towards insiders, towards those with high capability to impose externalities, and towards the government, while reducing total output. The analysis concentrates on the cases in sections 2.1 and 2.2 (single matches and multiple matches in one stage), as the spot transaction and repeated game situations in section 2.3 either are not very relevant (the former), or do not make strong predictions (the latter). The equilibrium assumed for the case of multiple matches is the one described in section 2.2.1.

Denote by $\Delta_j(\cdot) = U_j^{CORR}(\cdot) - U_j^{REF}(\cdot)$, the net gain from corruption when compared to reform (REF). The relevant gains and losses are: $\Delta_i(\alpha_i, e_i)$, the gain for insiders given fixed α and e; $\Delta_o(\alpha_o, e_o)$, the gain for outsiders; $\Delta_j(e)$, the gain as a function of an agent's e; Δ_g, the gain for the government, and $\Delta\left(\sum_{I,O,g} U\right)$, the total gain in utility for the society. It is useful to denote by $\bar{e}$ the per capita level of the externality for players who are not the ones imposing it. This term will enter their utilities with a negative sign.

The change in utility for outsiders from the corrupt system is given by:

$$\Delta_o(\alpha_0, e_o) = \begin{cases} -\bar{e} - \alpha_o^B & \text{if } C_o^{REF} \\ -\bar{e} - 0 & \text{if } \neg C_o^{REF} \end{cases} \tag{88}$$

In the corrupt system, outsider players are never chosen to receive the G good, but have to suffer the expected value of the externality imposed by the winner. In the reformed system, the outsiders can either be allocated the government good, which gives them the baseline utility α_o^B or not win it, while not having an externality be imposed upon them either, and get 0. So whatever the case, outsider players lose from the corrupt system.

Denote by R_{MIN} either $\frac{c(1-\delta(1-p))}{\delta p}$ or $\frac{c(1-\delta(1-q))}{\delta q}$, depending on whether the analysis is

performed on the model with single matches, or on the model with multiple matches. R_{MIN} is the minimal payment made to the government each stage when matched alone. The change in utility for insider players is given by:

$$\Delta_i(\alpha_i, e_i) = \begin{cases} \begin{cases} \alpha_i - \alpha_i^{(2)} & \text{if } n_{i,t} > 1 \\ \alpha_i - R_{MIN} & \text{if } n_{i,t} = 1 \end{cases} & \text{and if } (C_i^{CORR} \text{ and } \neg C_i^{REF}) \\ \begin{cases} \alpha_i - \alpha_i^{(2)} - \alpha_i^B & \text{if } n_{i,t} > 1 \\ \alpha_i - R_{MIN} - \alpha_i^B & \text{if } n_{i,t} = 1 \end{cases} & \text{and if } (C_i^{CORR} \text{ and } C^{REF}) \\ -\bar{e}_i - \alpha_i^B & \text{if } (\neg C_i^{CORR} \text{ and } C_i^{REF}) \\ -\bar{e}_i - 0 & \text{if } (\neg C_i^{CORR} \text{ and } \neg C_i^{REF}) \end{cases} \tag{89}$$

The cases in which $n_{i,t} > 1$ are obviously only relevant if allowing multiple matches. Insider players gain from the corrupt system if they are chosen as recipients of G in this system but not in the reformed system (first case). In case they are chosen in both systems, the effect is ambiguous: On the one hand, they have to pay the bribe $\alpha_i^{(2)}$ or R_{MIN} for getting the good in the corrupt system, and no bribe in the reformed system. On the other hand, the utility from the good in the corrupt system, α_i, can be greater than the utility in the reformed system α_i^B because the former might include the externality e_i. So the insider player gains from the corrupt system in this subcase if:

$$\begin{cases} \alpha_i - \alpha_i^{(2)} - \alpha_i^B > 0 \iff e_i > \alpha_i^{(2)} & \text{if } n_{i,t} > 1 \\ \alpha_i - R_{MIN} - \alpha_i^B > 0 \iff e_i > R_{MIN} & \text{if } n_{i,t} = 1 \end{cases} \tag{90}$$

That is, an insider player who is very skilled at imposing externalities can benefit from the corrupt system, even if he or she would have been awarded G in the bribe-free reformed system, if the externality he or she can impose on other players is higher than the effective value of the bribe.

The third subcase, when the insider player is not awarded G in the corrupt system, but would be awarded G in the reformed system can arise when the insider player has a high baseline utility for the good, but less of an ability to impose externalities than other I players. In this case, this player loses from the corrupt system. In case the insider player would not be awarded G in either the reformed or the corrupt system, he or she loses from the corrupt system, because of the externality that is imposed in such a system.

The conclusion of the first two analyses of changes in utilities is that outsider players always lose from the corrupt system, while insider players can often gain from it. In any given stage, the insider player who wins the G good under corruption either clearly gains from the corrupt system (if they would have not received G in the reformed system), or gains conditional on having a large e_i (or low R_{MIN} or low $\alpha_i^{(2)}$). As different I players will be drawn in different stages, all of them have some chance at getting the benefits from corruption at some point. Also notable would be a realistic case where the externalities $\bar{e}$ are imposed on a large mass of citizens who are either outside the I group, or outside the I and O group altogether. In this case the $\bar{e}$ terms would be very small for an individual I player, so over time their negative effect in stages where that I player is not chosen to receive G would be small, while in the stages where he or she is chosen to receive G, the gains would be large. In the case of an equilibrium where the citizen who gets G pays something else than $\alpha^{(2)}$ (in the multiple-matches case), then the intuition of the results, is not changed: insider players can often benefit from corruption, while outsider players never benefit.

The effect of corruption given e_j is that those with high capacity to impose externalities have to gain from corruption if they are also insiders, as they are both more likely to win the G good and to benefit from it once they have gained it. (In the case of multiple matches, this assumes the equilibrium presented in section 2.2). The change in utility from corruption is given in the following expression, where the underset notation indicates whether e has a

positive (+), negative (-) or neutral (0) effect on the given quantity:

$$\Delta_i(e) = \underset{(+/0)}{E[C_i^{CORR}|e_i]}\underset{(+)}{U^{CORR}(e_i)} - \underset{(0)}{E[C_i^{REF}]}\underset{(0)}{U^{REF}(e)} - \underset{(-/0)}{E[\neg C_i^{CORR}|e_i]}\underset{(0)}{(\bar{e}_i)} \tag{91}$$

This quantity is affected by e_i in the follwing way: The second term is not affected by e at all. In the first term, the expectation of winning the G good is increased by e (when competing against other I players), as well as the utility of winning it (always). In the third term, the loss from externalities from others is not affected by i's own e_i, but the probability of not being chosen is negatively affected by e_i. So overall, e_i has a positive effect on an insider player's utility from corruption, that is the corrupt system favors those with higher ability to generate externalities. For an outsider player, e_o has no effect on their gain or loss form corruption, as they either do not the good (in corruption), or get it in an environment where e_o does not matter (in the reformed system). In case the rule for choosing partners in the case of multiple matches is different, then, while $U^{(CORR)}(e_i)$ is still positively affected by e, it may be that $E[C_i^{CORR}|e_i]$ has no natural connection with e_i in case the rule for choosing partners is not based on choosing the one with the highest α.

For the government, the effect of corruption is either neutral or positive in each period:

$$\Delta_g = \begin{cases} R_{MIN} - c - 0 & \text{if } n_i = 1 \\ \alpha_i^{(2)} - c - 0 & \text{if } n_i > 1 \\ 0 - 0 & \text{if } n_i = 0 \end{cases} \tag{92}$$

In the first two cases, the effect is positive, as $R_{MIN} > c$ from its formula, and $\alpha_i^{(2)} \geq R_{MIN} \implies \alpha_i^{(2)} \geq c$ by assumption. So the overall effect of the corrupt system on the government is positive. The effect is positive even if the rent that emerges in the case of multiple matches is not $\alpha_i^{(2)}$, as the rent paid has to always be large enough to cover the cost c for the government.

To compute the overall effect on total utility among the three kinds of agents, first note

that externalities and rent payments can be eliminated from the calculation, as they are just transfers from one group to another. Also notable is the fact that in the corrupt system, many transactions do not happen at all: in cases in which the only match is one or more outsider players, the good G is not allocated at all, and it does not generate utility for anyone even if it would have positive social utility if it were allocated. Another reason why corruption reduces total utility is that in corruption, even when G is allocated, it is less likely to be allocated to the individual with the highest baseline utility for it: In the corrupt system, each stage, a citizen with baseline utility α_i^{B*} gets the good. In the reformed system, each stage a citizen with baseline utility α_j^{B*} gets the good. There are two reasons why α_i^{B*} might be lower than α_j^{B*}, and no case in which it is higher. First as j can be either i or o, the pool from which the highest-α^B j player is drawn is larger than the pool from which the highest-α i player is drawn. Second, as distribution in the corrupt system is based on α_i, not α_i^B, so in general, the insider player with the highest α_i^B will not be chosen. That is, under corruption, there are social losses because the government goods are awarded only to insider players and are awarded based on private utility, not social utility:

$$\Delta_{i,o,g} = \begin{cases} -\alpha_{j*}^B & \text{if } M_{t,o} \\ \alpha_{i*}^B - c - \alpha_{j*}^B & \text{if } M_{t,i} \end{cases} \tag{93}$$

$$\begin{aligned} \text{where} \qquad & i* = \{i | \alpha_i \geq \alpha_{i\prime} \forall i\prime \in I \setminus \{i\}\} \\ & j* = \{j | \alpha_j^B \geq \alpha_j^B \forall j\prime \in (I+O) \setminus \{i\}\} \end{aligned} \tag{94}$$

In periods when only an outsider player is matched, the net social effect is negative or zero: no transaction takes place under corruption, whereas G would be allocated to the citizen with the highest baseline valuation in the non-corrupt system. In case some insider players have been matched, the net effect is given by the difference between the baseline utility of the citizen receiving the good under corruption (minus the cost of providing the

good), and the baseline utility of the person receiving the good under the non-corrupt system. For reasonable parameter values, this will be highly negative in the case of goods that have any social utility in the first place: The major component of the difference is $\alpha^B_{i*} - \alpha^B_{j*}$ and α^B_{i*} will generally be smaller than α^B_{j*}. In case the winner of the good in the multiple matches case is not the one with the highest α, then the effect can only be more negative, as the utility of whoever gets the good can only be lower.

A corollary to expression (93) is that the amount of secrecy regarding corruption (which is given by the size of the I group, parameterized as the probability p) affects total social welfare: Keeping everything else constant, societies in which secrecy is greater suffer a greater loss, as more agents are part of the outside group with which transactions cannot be made.

The magnitude of the net social effect under reasonable parameter values, and in case there is some social utility associated to the good is worth exploring: The nature of the distribution F_α primarily determines it, and a realistic model for α will lead to high social losses from corruption. F_α is the distribution of baseline utilities for the G good in the population. G goods that generate any kind of social utility, such as permits to engage in regular economic activity, will generally require very specific complementarities between the good and the consumer, for the good to provide the optimal utility. For example, there are very few agents in a given country (maybe even in the world) who are really competent at building roads, at operating retail operations, at providing military equipment, and so on. That is, the distribution F_α is likely to be severely skewed towards zero, and very long-tailed. The first source of inefficiency is that limiting draws from this distribution to only insider players is likely to miss the few high-α^B players. Moreover, even after taking the draws only from the insider group, the one insider who gets chosen is not the one with the highest baseline utility, but the one with the highest value of the sum of baseline value and externality. Since imposing externalities is itself a skill, it can also be modeled as being distributed as a long-tailed distribution, which is either independent, or positively correlated with the baseline α^B distribution. A Monte-Carlo simulation is useful for illustrating this

Table 2: The net social effect of corruption—simulations

	μ_{α^B}	$\sigma^2_{\alpha^B}$	μ_e	$\sigma^2_{\alpha^e}$	n_i	n_o	$\overline{\Delta i, o, g}$
Default	2	.5	1	.125	5	5	-7.71
Small I group	2	.5	1	.125	5	15	-10.50
Low externalities	2	.5	.5	.125	5	5	-7.68
High var. in skill	2	1	1	.125	5	5	-16.46

logic. Take the case in which there are multiple matches of insider players and model the distribution of α^B and e as log-Normal:

$$\begin{aligned} \alpha^B &\sim \ln N(\mu_{\alpha^B}, \sigma^2_{\alpha^B}) \\ e &\sim \ln N(\mu_e, \sigma^2_e) \end{aligned} \tag{95}$$

Set n_i and n_o to be the expected value of their distributions, which are generic:

$$\begin{aligned} n_i &\equiv Ef_{n_i} \\ n_o &\equiv Ef_{n_o} \end{aligned} \tag{96}$$

Also set $c = 5$. For the simulation, take $N = 100,000$ repeated draws from the distribution above, at different values of the relevant parameters, and compute the expected value of the social loss $E\left[\alpha^B_{i*} - c - \alpha^B_{j*}\right]$. Results are presented in table 2. The social gain is always negative. A small I group relative to the O group, indicating greater secrecy, means a larger loss. The size of the externalities here does not matter, as they are not correlated with α^B. High variation in the skill α^B induces a larger loss, because getting the difference between the right agent for the job and the one chosen through the government's optimization problem will increase as the differences in skill in the population increase.

Discussion

There are a few non-obvious points that emerge from the models above. The first point is that, while corruption is good for the government official, as she is able to maximize her income, the nature of corrupt transactions means that the official is not able to fully use her power and get the best deals from citizens. The primary reason is the inability to engage outsider players in the random matching models. This might be why real life corrupt interactions, such as the awarding of a business permit, seem to often take the form of inefficient transactions between the government official and their proverbial "cousin", rather than of transactions with the most efficient agent, which in the case of the business permit would be the most efficient international corporation in that field. While the official would like to be able to extract a much higher bribe from the corporation, their lack of commitment power in that transaction means it will not take place.

An immediate corollary of this is that the value of corrupt transactions will often be "unnaturally" low. The fact that bribes paid to officials are often shown to be very low is emphasized in Buchannan (1980) as one of the major puzzles of empirical studies of corruption. One reason for this might be that the "demand" for the corrupt good is artificially lowered by the inability of the official to include in it all the potential customers from the outsider group.

The insider-outsider distinction suggests why corrupt societies are often best understood through the lens of cliques, connections, patronage, and family relations, rather than as extreme examples of free markets, where "everything is for sale". Everything might be for sale, but the customers who are willing to engage in the transactions might very well be only a very small subset of society, thus greatly departing from the ideal of the free market. The most relevant distinction between corrupt and non-corrupt interactions is that corrupt markets are often markets which are not supposed to exist, not simply versions of legitimate markets in which the government official is free to optimize how she provides the good in order to maximize income.

Another interesting conclusion is that corruption also facilitates the existence of crime in general. If goods such as get-out-of-jail cards are available for sale under corruption, but not under the non-corrupt system, then the equilibrium response of citizens in the corrupt system will be to maximize the usefulness of this fact by committing the crime associated with the card.

The fact that corrupt interactions cannot be made public implicitly assumes that there is some cost for the government in making them public: either the cost of being sanctioned by a higher-level official, or electoral costs. An interesting variation of the model removes this requirement, by making $p = 1$. This would mean that there is no reason for the transaction to be kept secret, as there is no higher-level official to punish, and/or electoral constraints are not binding. In this case, corruption would be more efficient, and the government would gain more, by making it able for outsider players to engage in transactions. An example of such a situation might be the case of some oil-rich absolute monarchies in the contemporary world, where transactions with the royal family are quite public, and seem to be engaged in by all agents who desire so, including high-efficiency international corporations. However, it also seems that these types of interactions should be called something else than corruption, as the phenomenon is quite different. The word "feudalism" might be more appropriate in this case.

The most interesting conclusion of the analysis, though, is that the complex distributive effects of corruption mean that a large number of *citizens* are in favor of corruption. The usual view of corruption, as a transfer from citizens to the government, must be amended with the fact that this system also has important distributive effects among citizens. Citizens who are part of some official's connections, as well as citizens who are very skilled in imposing externalities will benefit from corruption, and will vote for the continuation of the system if given the opportunity. This might be why electoral mechanisms often seem unable to eliminate corruption even in the case of vigorous political competition.

Appendix A - List of Divisions

For each of the thirty divisions, the date on which it occurred, and the code in Ginter is given. The "votes for" and "against" entries are the official totals recorded from the division. The "recorded for" and "against" are the number of expressed votes which are left in the surviving lists. When the voting intention of an MP was known, but he could not express it, Ginter notes this as "absent yes/no" or "implicit yes/no". These kinds of votes are counted in the "nonvote" category, along with "absent" votes, and they are also counted as regular yes/no votes, as they too reflect the MP's preferences. The "balanced" entry indicates whether the division is a part of the sample for the models are denoted "balanced sample" in the text. The government vote entry is listed by Ginter as how the most important ministers voted in the division. For the bills in which an anti-corruption preference is given by a "no" vote, this fact is noted.

Whenever possible, information on the motion that the division was taken on, and its context from the Hansard is given, as this is the most accurate source for information on the debates. When this is not possible, or for additional details, the Journals of the House of Commons (JC) are another source of information. The Journals describe the business of the House in more detail but do not record the speeches given by the MPs. The description of the division from the History of Parliament is also given when available, and for one division, the description comes from the Gentlemen's Magazine—a monthly magazine from that era.

12 Feb 1779 - Contractors Bill (779010)

Votes for: 160. Votes against: 145.

"Nonvote" for: 81. "Nonvote" against: 173.

Recorded for: 160. Recorded against: 142.

Balanced: Yes.

Government vote: No.

Description: "Division on the bill to prohibit Government contractors from sitting in the

House." (HP). The bill stated that any government contractor should not be allowed to be a member of the House of Commons, unless the contract has been awarded through competitive bidding. The mover, P.J. Clerke criticized the the government's influence in the house given by the awarding of such contracts, and also criticized a fraudulent contract offered by the Treasury in connection to the American war effort. Lord North argued that the contract given as example had actually been awarded fairly. (Hansard)

21 Feb 1780 - Pensions Granted by the Crown (780010 1)

"No" vote is pro-reforms.

Votes for: 190. Votes against: 188.

"Nonvote" for: 35. "Nonvote" against: 29.

Recorded for: 191. Recorded against: 189.

Balanced: Yes.

Government vote: Yes.

Description: A bill was moved by George Savile on Feb 15 for an account of all pensions granted by the crown, so that the Commons could judge their usefulness. The motion was argued against by Lord North and others, who said such an account would embarrass many individuals, such as widows of aristocrats, who were paid such pensions because they had no other sources of income in spite of their high social standings. On Feb 21, Lord North moved an amendment on that bill so that it would only refer to pensions paid by the Exchequer, that is not to those paid by the Crown directly. Opponents argued this makes the bill ineffective, because its main object are the pensions that are paid secretly by the crown. A very long debate followed and the house divided on North's amendment. (Hansard)

2 Mar 1780 - Civil Establishment Bill (780101 2)

Votes for: 197. Votes against: 232.

"Nonvote" for: 12. "Nonvote" against: 0.

Recorded for: 32. Recorded against: 53.

Balanced: Yes.

Government vote: No.

Description: A bill moved by Edmund Burke for "the better Regulation of his Majesty's Civil Establishments and of certain public offices for the limitation of pensions and the suppression of sundry useless expensive and inconvenient places and for applying the monies saved thereby to the public service." Speakers in favor argued that the increase in government business during the American War has increased the opportunities for corruption. Speakers against argued the bill is too general and there needs to be more time before it goes to a committee. The vote was on whether to send the bill to a committee the next day or to delay it. (Hansard)

8 Mar 1780 - Civil Establishment Bill (Third Secretary of State) (780020)

Votes for: 202. Votes against: 209.

Recorded for: 203. Recorded against: 209.

Balanced: Yes.

Government vote: No.

Description: "Division in the committee on Burke's economical reform bill on the clause to abolish the office of secretary of state for the colonies." (HP) This was the first clause of the Establishment Bill mentioned above. A speaker against argued that the bill both limits the executive's constitutional right to spend money on salaries as it sees fit, as well as referring to a post which is not useless. The debate on these matters went on until 3 a.m., and then a vote was taken. (Hansard)

13 Mar 1780 - Civil Establishment Bill (Board of Trade) (780030)

Votes for: 208. Votes against: 200.

Recorded for: 210. Recorded against: 206.

Balanced: Yes.

Government vote: No.

Description: "Division in the committee on Burke's economical reform bill on the clause to abolish the Board of Trade." (HP) Another part of Burke's bill. Debates similar to those presented above on abolishing this particular governmental institution. (Hansard)

28 Mar 1794 - Private Benevolances to Government (794090)

Votes for: 36. Votes against: 206.

Recorded for: 36. Recorded against: 2.

Balanced: No.

Government vote: No.

Description: A motion stating "that it is a dangerous and unconstitutional measure for the executive government to solicit money from the people as a private aid, loan, benevolence or subscription, for public purposes, without the consent of Parliament" (JC)

8 April 1794 - Reduction of Sinecures and Pensions (794100)

Votes for: 50. Votes against: 119.

"Nonvote" for: 0. "Nonvote" against: 2.

Recorded for: 51. Recorded against: 2.

Balanced: No.

Government vote: No.

Description: "a Bill for the purpose of appropriating a certain part of the emoluments arising from certain pensions and sinecure places, for the service of the public, during the continuance of the war, at the disposal of Parliament; and also for the purpose of appropriating a part of the emoluments arising from certain efficient places, amounting to more than a specified sum, to be applied to the same purpose." (JC)

13 Mar 1797 - Reduction of Sinecures (797060)

Votes for: 79. Votes against: 171.

"Nonvote" for: 2. "Nonvote" against: 2.

Recorded for: 19. Recorded against: 4.

Balanced: No.

Government vote: No.

Description: "the extent of supplies voted to Government since the commencement of the present war, having caused so heavy an increase in taxes, it is the duty of this House to enquire whether some relief to the burdens of the people, or provision for future experience, may not be obtained by the reduction of useless places, sinecure offices, exorbitant fees in offices, and other modes of retrenchment in the expenditure of the public money." (JC) The mover argued that in the face of increasing public debt, waste on sinecures must be curbed. William Pitt argues against the motion on the grounds that it does not make it clear how such reductions in expenditures would be achieved, and that it is all to easy to criticize the system from outside. (Hansard)

8 Apr 1805 - Censure of Lord Melville (805080)

Votes for: 219. Votes against: 218.

"Nonvote" for: 1. "Nonvote" against: 0.

Recorded for: 219. Recorded against: 216.

Balanced: Yes.

Government vote: No.

Description: Corruption charges against former War Secretary, Lord Melville: "Violation of the act of Parliament; connivance at the private profits illegally made by Mr. Trotter out of the public money; and participation in those profits" (JC). Lord Melville, (Henry Dundas), was a key member of Pitt's cabinet and a friend of the prime minister. He was acquitted in the end, in the impeachment trial in the House of Lords, but did not return to

public office. (Hansard)

15 Mar 1809 - Conduct of Duke of York (809020)

Votes for: 125. Votes against: 366.

"Nonvote" for: 3. "Nonvote" against: 1.

Recorded for: 129. Recorded against: 3.

Balanced: No.

Government vote: No.

Description: The Duke of York was the commander in chief of the British Army at the time. He was forced to step down as a result of suspicions that he allowed his mistress to sell army commissions, which they profited from. (Harling, 1996a) This division is for or against the original address put forward by Gwyllym Wardle in which he reveals the corruption accusations. (Hansard)

17 Mar 1809 - Conduct of Duke of York (Perceval Motion) (809040)

"No" vote is pro-reforms.

Votes for: 280. Votes against: 198.

"Nonvote" for: 2. "Nonvote" against: 6.

Recorded for: 3. Recorded against: 201.

Balanced: No.

Government vote: Yes.

Description: The motion is an amendment to relieve the Duke of York of personal responsibility for the corrupt transactions: that the House "finds it expedient to pronounce a distinct opinion upon the truth or falsehood of these imputations; and is therefore of opinion that there is no foundation for imputing personal corruption or criminal connivance to his royal highness." (Hansard)

17 Mar 1809 - Conduct of Duke of York (Turton Motion) (809030)

"No" vote is pro-reforms.

Votes for: 336. Votes against: 137.

"Nonvote" for: 2. "Nonvote" against: 6.

Recorded for: 2. Recorded against: 139.

Balanced: No.

Government vote: Yes.

Description: Similar to the Perceval motion above, but wants to relieve the Duke of any "knowledge" of corruption, rather than "connivance". (Hansard)

17 Apr 1809 - Conduct of Duke of York (Committee on Abuses) (809050)

Votes for: 32. Votes against: 180.

Recorded for: 35. Recorded against: 8.

Balanced: No.

Government vote: No.

Description: This is a wide-ranging proposal to appoint a committee to inquire into all possible abuses relating to the sale of military offices: the motion is "That a Committee be appointed to enquire into the existence of any corrupt practices with regard to the disposal of Offices in any department of the state, or any agreement, negotiation, or bargain, direct or indirect, for the sale thereof; and of any corrupt practices relative to the purchase and sale of Commissions in the Army; and also, to examine into the terms on which Letters of Service have been granted for raising men for the Army by way of Levies, and the manner in which the said Levies have been conducted; and to report the same, as it shall appear to them, to the house, together with their observations thereupon; and that the said Committee have power to report the Minutes of Evidence taken before them, and their proceedings, from time to time, to the house." The prime minister replied that the Duke of York's alleged corruption is no reason to have such a wide-ranging inquiry into the military. (Hansard)

25 Apr 1809 - Conduct of Castlereagh (809060)

Votes for: 169. Votes against: 218.

"Nonvote" for: 0. "Nonvote" against: 1.

Recorded for: 169. Recorded against: 4.

Balanced: No.

Government vote: No.

Description: A scandal involving Robert Stewart, Viscount Castlereagh, who was accused of awarding some offices in the East India Company for electoral gain as a member of the board of control. The resolution was "That it appears to this house, from the Evidence on the table, that lord viscount Castlereagh in the year 1805, he having just quitted the office of President of the Board of Controul, and being then a Privy Counsellor and Secretary of State, did place at the disposal of lord Clancarty, a member of the said Board, the nomination of a Writership to India, for the purpose of thereby procuring the said lord Clancarty a Seat in this honourable house. 2nd. That it was owing to a disagreement among other subordinate parties to the transaction, that this corrupt negotiation did not take effect.—3rd. That lord viscount Castlereagh has been by the said conduct guilty of a violation of his duty, of an abuse of his influence and authority as President of the Board of Controul, and also of an attack upon the purity and constitution of this house." (Hansard)

1 May 1809 - Dutch Commissioners (809070)

Votes for: 79. Votes against: 104.

"Nonvote" for: 0. "Nonvote" against: 1.

Recorded for: 79. Recorded against: 2.

Balanced: No.

Government vote: No.

Description: This is an inquiry into the behavior of public officials that were supposed,

in 1795, to dispose of the captured Dutch ships and goods by selling them. Corruption by these officials was alleged. The motion being voted on was: "1.That it appears to this house, that to commit pecuniary trusts to any persons whatsoever, without providing any check on their proceedings, without calling for any regular or periodical accounts, and without settling, during a long course of years, the mode or amount of their remuneration, is a neglect which must inevitably lead to the most prejudicial consequences, and is a violation of the obvious duty of government. 2. That such neglect and deviation have been proved to exist, and might have been attended with material loss to the public. 3. That the Commissioners upon Dutch Property have been guilty of gross misconduct, in violating the act under which they were appointed, and appropriating to their own use without authority, sums for which they ought to have accounted to the public. 4. That the Accounts of the Commissioners be referred to the Auditors of Public Accounts to be examined. 5. That all consideration of the remuneration to be allowed to the Commissioners ought to be deferred till their accounts are finally settled." (Hansard)

11 May 1809 - Conduct of Perceval and Castlereagh (809090)

Votes for: 87. Votes against: 312.

"Nonvote" for: 0. "Nonvote" against: 1.

Recorded for: 87. Recorded against: 4.

Balanced: No.

Government vote: No.

Description: A motion put forward by William Maddocks that that House inquire into the conduct of Prime Minister Perceval and the Viscount Castlereagh for alleged electoral corruption. (Hansard)

17 May 1810 - Abolition and Regulation of Sinecures (810110)

Votes for: 94. Votes against: 100.

"Nonvote" for: 1. "Nonvote" against: 1.

Recorded for: 96. Recorded against: 95.

Balanced: Yes.

Government vote: No.

Description: A motion by Henry Bankes to abolish sinecure offices and replace them with a fund for the rewarding of those who served in public office for a long time. (Gentlemen's Magazine)

7 Feb 1812 - Offices in Reversion Bill (812060)

Votes for: 56. Votes against: 58.

"Nonvote" for: 0. "Nonvote" against: 1.

Recorded for: 56. Recorded against: 57.

Balanced: Yes.

Government vote: No.

Description: Henry Bankes proposed a bill that stated "that no office, place, employment or salary, ought hereafter to be granted in reversion." (JC) The prime minister argued that no economy would arise from such a bill, and that "the objects to be attained by it were of so little importance, that more injury might be expected to result from a discordance in the legislature, than from its adoption." (Hansard)

4 May 1812 - Sinecure Offices Bill (812230)

Votes for: 136. Votes against: 125.

"Nonvote" for: 10. "Nonvote" against: 2.

Recorded for: 139. Recorded against: 123.

Balanced: Yes.

Government vote: No.

Description: "To take into further consideration the report on the sinecure offices bill."

(JC) Opponents of the bill argued that it was unconstitutional in Scotland. (Hansard)

29 Mar 1813 - Sinecure Offices Bill (813050)

Votes for: 96 Votes against: 86.

Recorded for: 96. Recorded against: 2.

Balanced: No.

Government vote: Neutral.

Description: Whether to further consider the Sinecure Offices Bill. (JC)

27 May 1813 - Committee on Civil List (813100)

Votes for: 31. Votes against: 110.

Recorded for: 31. Recorded against: 2.

Balanced: No.

Government vote: No.

Description: A motion that a House Committee to inquire into the Civil List expenditures and "that the committee have power to send for persons and records" (Hansard)

14 Apr 1815 - Committee on Civil List (815140)

Votes for: 96. Votes against: 129.

"Nonvote" for: 1. "Nonvote" against: 1.

Recorded for: 97. Recorded against: 123.

Balanced: Yes.

Government vote: No.

Description: George Tierney sought to establish a committee for "inquiry into the causes of the excesses of the Civil List". A long debate on the merits of such a committee followed. (Hansard)

8 May 1815 - Select Committee on Civil List (815230)

Votes for: 121. Votes against: 177.

"Nonvote" for: 12. "Nonvote" against: 1.

Recorded for: 121. Recorded against: 175.

Balanced: Yes.

Government vote: No.

Description: George Tierney, who had put forward other motions on the civil list, complained that all committees that had been set up do not have sufficient power to achieve anything meaningful. Now he proposes that the committee "have power to send for Mr. T. B. Mash, of the Lord Chamberlain's office." (Hansard)

6 May 1816 - Select Committee on Civil List (816200)

Votes for: 124. Votes against: 215.

Recorded for: 124. Recorded against: 215.

Balanced: Yes.

Government vote: No.

Description: Again a motion that a Select Committee on the Civil list have power to send for persons, papers, and records. (JC)

24 May 1816 - Civil List Bill (816280)

Votes for: 118. Votes against: 232.

Recorded for: 119. Recorded against: 227.

Balanced: Yes.

Government vote: No.

Description: A vote on the progress of a bill to regulate the Civil List. (JC)

14 Jun 1816 - Public Revenues Consolidation Bill (816360)

"No" vote is pro-reforms.

Votes for: 109. Votes against: 67.

"Nonvote" for: 2. "Nonvote" against: 2.

Recorded for: 108. Recorded against: 68.

Balanced: Yes.

Government vote: Yes.

Description: As a part of the Public Revenues Consolidation Bill, this is a vote on whether to allow a Vice-Treasurer position in Ireland to be created, which opponents argued was a sinecure worth £3,500 per year, as well as a deputy for that position, worth £1,000 a year. The prime minister said the position was necessary, and the only concern was the remuneration. Opponents insisted this was a sinecure, and a long debate followed. (Hansard)

17 Jun 1816 - Public Revenues Consolidation Bill (816370)

"No" vote is pro-reforms.

Votes for: 100. Votes against: 102.

"Nonvote" for: 14. "Nonvote" against: 18.

Recorded for: 101. Recorded against: 102.

Balanced: Yes.

Government vote: Yes.

Description: This is a vote specifically on the salary of the office in Ireland to be created. The vote is on whether the salary to be £3,500 a year, which opponents argued was excessive. (Hansard)

20 Jun 1816 - Public Revenues Consolidation Bill (816380)

Votes for: 113. Votes against: 151.

"Nonvote" for: 16. "Nonvote" against: 15.

Recorded for: 103. Recorded against: 150.

Balanced: Yes.

Government vote: No.

Description: This is an amendment proposed by Henry Bankes, to make the deputy of the newly-created Vice-Treasurer of Ireland not receive money directly from the budged, but rather that his salary be deducted from the salary of the Vice-Treasurer. (Hansard)

17 Feb 1817 - Salaries of Secretaries of Admiralty (817040)

Votes for: 116. Votes against: 171.

Recorded for: 116. Recorded against: 172.

Balanced: Yes.

Government vote: No.

Description: Charles Wentworth-Fitzwilliam, Lord Milton, proposed a motion "That the issue of the war salaries to the secretaries to the admiralty, and certain other persons connected with the navy and dock-yards, in consideration of the expedition to Algiers, which terminated in hostilities with that government, is uncalled for by the order in council of January 15th, 1800, and therefore an improper application of the public money." The issue was that the secretaries of the Admiralty had a higher salary in time of war, and they had claimed that higher salary during a Navy expedition to Algiers in a manner which opponents said was not legal. (Hansard)

25 Feb 1817 - Reduction in the Number of Lords of the Admiralty (817070)

Votes for: 154. Votes against: 210.

“Nonvote” for: 1. “Nonvote” against: 0.

Recorded for: 152. Recorded against: 207.

Balanced: Yes.

Government vote: No.

Description: Matthew Ridley puts forward a motion that the number of officials in the

Board of Admiralty be reduced from its current six. He argued this number was too high for a time of peace. (Hansard)

19 May 1817 - Civil Services Compensation Bill (817220)

Votes for: 107. Votes against: 47.

Recorded for: 2. Recorded against: 47.

Balanced: No.

Government vote: Yes.

Description: A vote on the progress of the Civil Services Compensation Bill, which instituted pensions for public officials, as a substitute for the practice of granting sinecures for elderly government workers. Reformers such as Henry Bankes spoke in favor of the bill. (Hansard)

10 Jun 1817 - Civil Services Compensation Bill (817260)

Votes for: 29. Votes against: 66.

Recorded for: 29. Recorded against: 2.

Balanced: No.

Government vote: No.

Description: A vote on a clause in the Civil Services Compensation Bill that anyone receiving a pension under the provisions of the law cannot be a member of Parliament at the same time. (Hansard)

10 Jun 1817 - Civil Services Compensation Bill (817270)

Votes for: 77. Votes against: 22.

Recorded for: 2. Recorded against: 22.

Balanced: No.

Government vote: Yes.

Description: A vote on whether to continue taking into consideration the Civil Services Compensation Bill. (Hansard)

18 Mar 1819 - Reduction of Admiralty Board (Two Lay Lords) (819080)

Votes for: 166. Votes against: 247.

"Nonvote" for: 2. "Nonvote" against: 1.

Recorded for: 167. Recorded against: 3.

Balanced: No.

Government vote: No.

Description: Matthew Ridley proposes a reduction in the number of the Lords of the Admiralty as he had done in 1817. (Hansard)

29 Mar 1819 - Electoral Bribery by Windham Quinn (819100 1)

Votes for: 75. Votes against: 164.

Recorded for: 75. Recorded against: 158.

Balanced: Yes.

Government vote: Neutral.

Description: An MP, Windham Quinn, was accused of bribing an influential individual in his constituency, by offering him the position of justice of the peace. The vote is on whether to take the matter into further consideration. (Hansard)

17 May 1819 - Barnstaple Bribery Bill (819220)

Votes for: 112. Votes against: 14.

Recorded for: 2. Recorded against: 14.

Balanced: No.

Government vote: Neutral.

Description: Sir Manassah Lopez was imprisoned for his open bribery at Barnstaple, and

this bill was on whether to change to franchise in that constituency so that it would not be concentrated among a few venal electors, but rather be extended to 800 freemen. The bill was defeated in the Lords in the end, in spite of strong support in the Commons. (Hansard)

22 Jun 1819 - Penryn Bribery Bill (819360)

Votes for: 46. Votes against: 26.

Recorded for: 46. Recorded against: 25.

Balanced: Yes.

Government vote: Neutral.

Description: A vote to proceed considering the Penryin Bribery Bill, which aimed to remove the franchise from the venal borough of Penryn, where corruption had been proven. (Hansard)

Appendix B - Data

Data collection

The sources for the independent variables are the History of Parliament and Judd (1972). Each MP for whom there is a vote recorded in the 30 bills which are analyzed is assigned a unique code in Ginter (1995). This code is also used by Judd. Lists from Judd were also used for the variables *merchant*, *India* (where the categories "East India interest" and "Nabobs" from Judd are conflated), *banker* (split into those associated with the Bank of England and others), *manufacturer*, and *physician*.

For the other independent variables, the source is the History of Parliament. We processed a digital version of the relevant volumes (1754-1790 and 1790-1820) from the HP to allow the extraction of the relevant information using the Python programming language. The text was put in ASCII format, therefore stripping much of the formatting. From each volume only the parts which contained biographies of MPs are kept, removing the introductory chapters and the parts where the individual constituencies are presented.

We then used the Natural Language Toolkit (NLTK) (Loper and Bird, 2002) package in Python to spilt the raw string into "tokens", that is units of analysis for the algorithms to be applied on the text. The first relevant level of tokenization for this analysis is the word. We used the function `word_tokenizer` from NLTK to split the text at this first level. This function applies the Treebank Word Tokenizer algorithm to the text (Marcus et al., 1993), which ensures that words are defined in a natural manner.

The second level of aggregation of the data is the MP level. To establish the beginning of the entry for an MP, we search for the word patterns which are characteristic of this: one or more last names written in all capital letters (possibly with apostrophes, as for "A'Court"), of length at least three characters, and followed shortly by a comma (to separate them from the first name). We removed the few words which might have produced this pattern but were not last names, such as "USA", by inspecting every last name produced by this criterion.

The entry for an MP, as can be seen in the example in the second part of this appendix, is split in two: a "header" which gives the basic biographical information in a pre-set order, and a body which presents less structured information.

A very large number of MPs were known by more than one name throughout their lives. Changes of last name were common, when one acceded to an aristocratic title, or when one individual inherited a fortune from someone other than his father. In the latter case, the last name of the person whose wealth was being inherited was often added to the last name of the heir. Other sources of multiple names are different spellings of Huguenot names, and multiple spellings of regular English names. When this is the case, the HP uses the official name of the MP when he first got elected, and for the other names it has entries of the form "New Name, see Old Name". Such entries have been removed from the text, as they add no information.

Also removed are any "c." (*circa*) or "bef." (before) words before years to leave year entries as simply four (or two) figures.

Some MPs have more than one entry because they had a significant political role both in the 1754-1790 and in the 1790-1820 periods. When this is the case, the two texts are joined, based on the criterion of identical names and dates of birth and death.

Each entry for an MP is tagged with the code used by Ginter and Judd. When a name matched exactly and uniquely the one in Judd's book, we assigned that code to the entry for that MP. When there was no perfect match, or multiple matches, we assigned the code manually, going by the dates of birth and death as a criterion for identifying which MP should be matched with what code.

Once this basic processing of the text had taken place, we used simple algorithms for extracting information from each MP's entry. The variables used in the paper, which are not code from Judd, have been extracted as follows:

Lawyer. The criterion for extracting the list of lawyers is that the MP should be either "called to the Bar" or mentioned in the text as a a solicitor or advocate (for a small number

of cases) and that he should not be established by Ginter as exercising another profession. We settled on this criterion because the number of lawyers obtained in this case (about 11% of the House) matches the estimates made by the authors of the HP. Using just legal education produces too many positive results, as a degree in law was very usual for those with university education. Looking at just those mentioned in the body as lawyers produces too few positive results, when compared to the HP.

The pattern (regular expression) we looked for in the header of the text (using "1780" as a placeholder for any year) was of the form "called 1780" or "called to the English Bar 1780", or "called [I] 1780" (for Ireland), or "Solicitor in", or "adv.", or "articled". All these expressions allow for different capitalization. From the list of MPs obtained using this criterion, we eliminated those identified explicitly by Judd as ending up in other professions, as an early career in law was often a natural stepping stone towards business and trade.

Military. As explained, we try to only capture career military men rather than everyone who did some military service in their youth. Those who ended up as Colonels or Rear-Admirals or higher, can safely be considered career military men. We search for the patterns indicating such positions for every MP ("col.", "gen.", "r-adm.", "f.m.", etc.).

Government official. To get at official positions for an MP, we first removed the part of the text which referred to his parents. This is because entries often contain in their header information of the form "s. of John Doe, Secretary of the Navy 1750-1755", sometimes with other pieces of information about the parents. Also included is sometimes information about the MP's wife's parents ("m. to Jane Doe, da. of John Smith, Master of the Mint 1740-1750", etc.) We removed the parts of the text that begin with "s. of" and until a pattern that indicates the MP's own children, of the form ("x s., y d." or "s.p." for *sine prole*). This ensures that whatever information is extracted refers to the MP, not to his parents or to his wife's parents. The HP presents a list of all official positions held by the MP, along with their date of beginning and end, as the last entry of the header. We used a combination of automated extraction and manual checking to get at the "government official"

variable. We first recorded any pattern that indicates a date range in the last portion of the header, along with the text right before it, which should be the name of the position. Then we manually checked the resulting entries, to ensure they really refer to positions the MP has held. While in general the HP lists only political/administrative positions, sometimes private-sector or non-profit positions are also listed. We eliminate any such position, for example those relating to various clubs for agricultural improvement, or other non-profits. We also eliminate local-level positions, often symbolic, such as sheriff, because these often came about as a natural consequence of the influence of the MP in the community. We do however keep the position of governor or lord-lieutenant of an administrative division, as these individuals were the monarch's representatives in that division. We then check whether in the 14 years in which votes occur any such position is recorded for each MP.

Public School. Judd lists the public schools that MPs could attend: Charterhouse, Eton, Harrow, Rugby, Shrewsbury, Westminster, and Winchester. We record whether these names occur after the "educ." marker.

University. Similarly, we record whether the words Oxf., Camb., Aberdeen, Edinburgh, Glasgow, Andrews, Dublin, Leyden or simply Univ. occur after the "educ." marker. Overwhelmingly, the MPs who went to university did so at Oxford and Cambridge.

Grand Tour. We record whether "Grand Tour" is encountered in the header for the MP.

First son. We search for patterns like "1st s. of" or "o.s. of" or "1st surv. s. of" in the header of the entry.

Aristocrat. We search for "Duke", "Mq.", "Marquess", "Earl", "Visct.", "Viscount", "Baron", "Bt." or "suc. fa. as" (for "succeeded father as"), or "cr." for "created" in the header of the text.

Whig Club / Brooks' Club. We search for a mention of the names of the clubs in the entire text of the entry. Members that did join one of these clubs always have an entry of the form "He joined the Whig Club in...".

For the constituency-level data, we first needed to extract the name of the constituency

that the MP served in in each one of the 14 years in which votes occurred. We did this by searching for the specific patterns that identify the constituency names in the header of the entry for each MP. The constituencies are written in capital letters and followed immediately by the years between which the MP served there. For each MP we recorded the name of the constituency and the years associated with it. Then we recorded the name of the constituency for each of the relevant years (e.g. 1779, 1780, etc).

The information for each constituency in these years is taken from the parts of the HP which deal with the districts. Both the 1754-1790 and the 1790-1820 volumes present tables of the constituencies, with their size (small, medium or large), franchise type, and whether there were contested elections in official election years, or in by-elections. We matched these pieces of information to each constituency-year. The size and franchise type do not change over the years. The contested election variable is coded as yes if a contested election is recorded at the last general election or the last by-election before or during the year the vote is recorded.

The dependent variable is coded from the records provided by Ginter. The votes in which the MP is listed as "absent yes" or "implicit yes", and "no" respectively, are coded as "yes" or "no", as they too reveal the MPs' preference. These votes are matched with the records for the independent variables using the unique code which characterizes each entry. At the end of this process, each expressed vote has been matched with an entry from the HP and Judd, and therefore with the needed independent variables.

Sample entry from the History of Parliament (first paragraphs only)

ABERCROMBY, Hon. James (1776-1858), of Spring Gardens, Westminster.

MIDHURST	1807-1812
CALNE	1812-1830
EDINBURGH	1832-May 1839

b. 7 Nov. 1776, 3rd s. of Gen. Sir Ralph Abercromby, and bro. of Hons. Alexander Abercromby, George Abercromby and Sir John Abercromby. *educ.* Edinburgh h.s. 1788-91; Christ Church, Oxf. 1794; L. Inn 1794, called 1800. *m.* 14 June 1802, Mary Anne, da. of Egerton Leigh of High Leigh, Cheshire, 1s. *cr.* Baron Dunfermline 7 June 1839.

Commr. of bankrupts 1801-27; PC 23 May 1827; judge adv.-gen. 1827-8; chief baron of Exchequer [S] 1830-2; master of Mint (with seat in cabinet) July-Dec. 1834.

ol. London and Westminster light horse 1798-1800.

Speaker of House of Commons 1835-9.

Abercromby wrote of himself in 1820: 'As to my own fortune it is that of a younger brother and consists mainly in the fruits of my own industry'. He had the asset of being 'singularly intelligent'. A contemporary of Francis Horner and Henry Brougham at Edinburgh high school, he completed his education in England. Soon after his call to the bar he was admired for 'his spirit and independence' at a legal club at the *Crown and Anchor* tavern in London. He practised in Chancery, becoming, through his father's friendship with Lord Loughborough, a commissioner of bankrupts. He was probably the 'Mr Abercromby' suggested to Lord Grenville by Lord Henry Petty in May 1806 as fit to be a commissioner of accounts. He broke with his family's politics by joining the Whig Club on 5 May 1807 and four days later was returned to Parliament, by his sister-in-law's brother-in-law Lord Carrington, for Midhurst. He went on to join Brooks's Club on 26 Apr. 1808. Thus in his first Parliament he was a committed member of the Whig opposition. Sir Samuel Romilly wrote of him, 15 June 1808:

> I have the highest opinion of Abercromby and I think him likely to render most essential service to the country. He has a very enlightened mind, an excellent understanding, very just principles of political economy, an independent spirit and a warm love of liberty and he has the more merit, because all his connexions are Tories. If I do not mistake, his brother married a daughter of Lord Melville.1

Abercromby first spoke against the Irish insurrection bill, 24 July 1807. On 15 Feb. 1808 his motion for particulars of the negotiation with Portugal in 1806 was objected to in part by Canning, who carried his point by 142 votes to 82. Abercromby voted for Whitbread's peace resolution, 29 Feb., and deplored the Copenhagen expedition, 21 Mar. He invariably supported Irish Catholic relief. He opposed the Scottish judges' pensions, 4 May, particularly their award to barons of the Exchequer, 2 June 1808, and objected to the copyright bill, 17, 22 June. The first subject that appealed to him, however, was the problem of penal reform; in this he was a coadjutor of Romilly. On 15 June 1808 he expressed his hostility to transportation to Botany Bay for limited periods and promised to move for inquiry next session: in fact he postponed it again, 26 May 1809, on the understanding that ministers were reviewing the situation. On 18 Jan. 1809 he was one of the Whigs meeting to endorse Ponsonby's leadership. He was an interrogator in the Duke of York's case and voted against Perceval on 17 Mar. In the debate on the Bankruptcy Laws he suggested from his own experience that the bankruptcy commissioners should be given sufficient remuneration to spare them from other legal pursuits, 29 Mar. On 27 Apr. he failed in a bid to secure

information for the purpose of clearing the name of Sir John Moore, by 62 to 37. He voted for Hamilton's motion on ministerial corruption on 25 Apr., but not for Madocks's on 11 May; he explained this, 12 June, by reference to his hopes of the House 'purging itself' through Curwen's reform bill. He opposed that bill as amended, but did not vote for Burdett's reform motion on 15 June. He took an interest in the Scottish judicature bill and complained of the delay in implementing it, 13 June. Later that year Creevey, a more rebellious Whig who found him unwilling to talk politics with him, reported Abercromby as prophesying that 'the present reign will end quietly from the popularity of the King, but that when it ends the profligacy and unpopularity of all the Princes, with the situation of the country as to financial difficulties, and the rapidly and widely extended growth of Methodism will produce a storm'.2

Abercromby was commended by Lord Henry Petty to Lord Holland, 4 Oct. 1809, as being 'admirably fitted for any of the secondary departments, and to be relied upon in every sense', if opposition took office. He assisted Lord Grenville in his canvass to become chancellor of Oxford University. He was one of the young Whigs eager for a coalition with Canning, whose conduct he did not wish to see indicted in the *Edinburgh Review*. Despite reports to the contrary, he favoured a continuation of Ponsonby's leadership.3 In December Tierney ('Old

Summary statistics

	Full sample			Balanced sample		
Variable	Obs.	Mean	S.d.	Obs.	Mean	S.d.
Dependent var.						
Yes Vote	7141	0.536	0.499	5776	0.449	0.497
Occupational cat.						
Merchant	7141	0.058	0.233	5776	0.051	0.220
Physician	7141	0.004	0.067	5776	0.003	0.059
Manufacturer	7141	0.008	0.091	5776	0.009	0.094
Military	7141	0.321	0.467	5776	0.321	0.467
Government Official	7141	0.222	0.415	5776	0.249	0.433
Bank of England	7141	0.006	0.078	5776	0.006	0.078
Banker	7141	0.051	0.220	5776	0.047	0.212
India Bourgeoisie	7141	0.071	0.258	5776	0.071	0.257
W. Indies Bourgeoisie	7141	0.043	0.204	5776	0.046	0.209
Landowner-only	7141	0.314	0.464	5776	0.311	0.463
Lawyer	7141	0.071	0.256	5776	0.067	0.250
Group A	7141	0.456	0.498	5776	0.471	0.499
Group B	7141	0.110	0.313	5776	0.112	0.315
Group C	7141	0.550	0.498	5776	0.534	0.499
Bourgeoisie	7141	0.330	0.470	5776	0.321	0.467
Personal char.						
Public School	7141	0.448	0.497	5776	0.442	0.497
University	7141	0.565	0.496	5776	0.566	0.496
Grand Tour	7141	0.045	0.207	5776	0.046	0.209
First Son	6977	0.490	0.500	5640	0.486	0.500
Aristocrat	7141	0.343	0.475	5776	0.348	0.476
Whig Club	7141	0.120	0.325	5776	0.094	0.292
Brooks' Club	7141	0.215	0.411	5776	0.170	0.376
Constituency size						
Large const.	7141	0.338	0.473	5776	0.324	0.468
Medium const.	7141	0.115	0.319	5776	0.110	0.313
Small const.	7141	0.517	0.500	5776	0.533	0.499
Unknown size const.	7141	0.030	0.172	5776	0.032	0.176
Franchise type						

County	7141	0.240	0.427	5776	0.241	0.428
Burgage Franchise	7141	0.096	0.294	5776	0.101	0.301
Scottish Borough	7141	0.018	0.133	5776	0.019	0.137
Corporation Borough	7141	0.091	0.288	5776	0.092	0.289
Freeholder Franchise	7141	0.027	0.162	5776	0.027	0.163
Freeman Borough	7141	0.356	0.479	5776	0.350	0.477
Householder Franchise	7141	0.045	0.208	5776	0.044	0.206
Other (Univ.) Franchise	7141	0.012	0.110	5776	0.013	0.112
Scot-and-Lot Franchise	7141	0.114	0.317	5776	0.113	0.316
Election						
Contested Election	7141	0.299	0.546	5776	0.290	0.453

Appendix C - Additional results

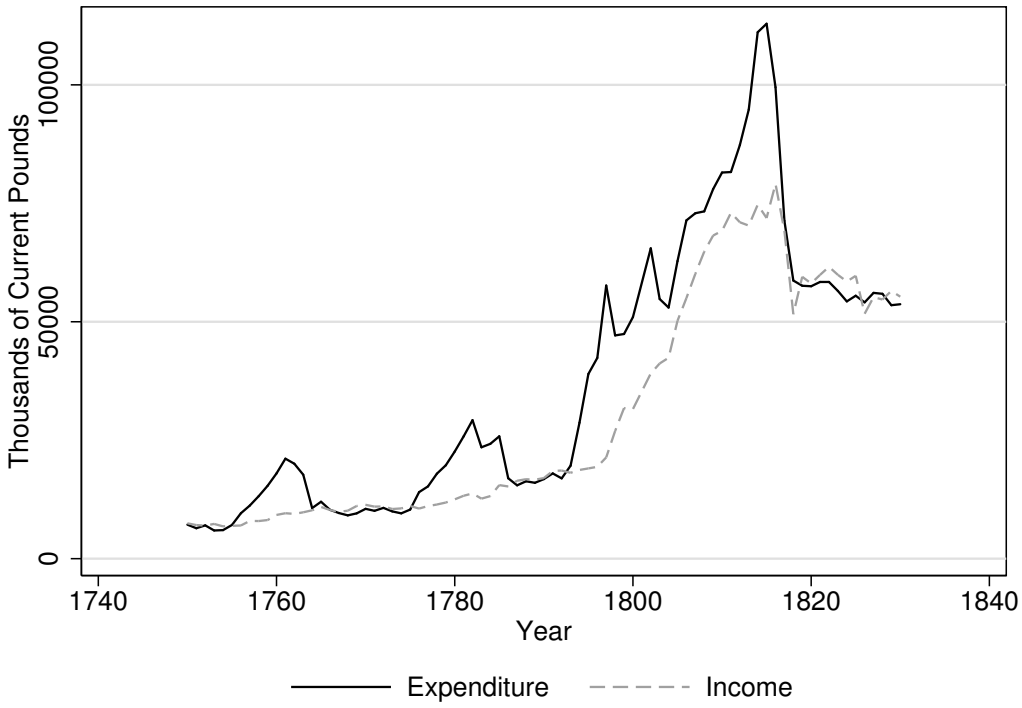


Figure 11: Government income and expenditure, nominal pounds. Data from Mitchell (1988).

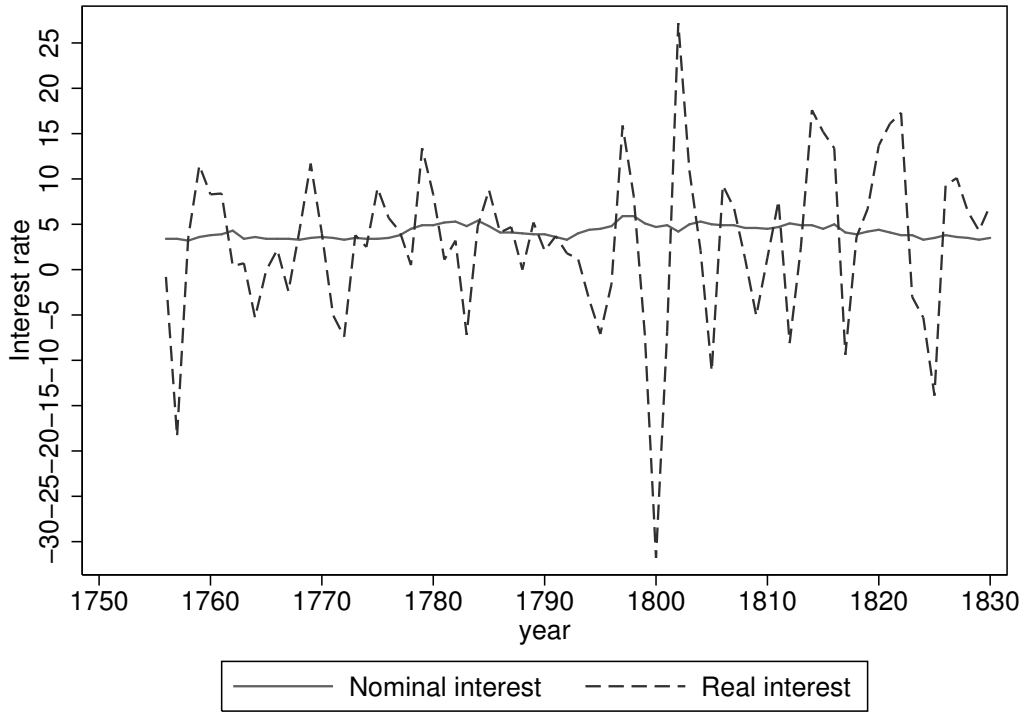


Figure 12: Real interest rate computed as nominal interest rate on long-term debt minus rate of inflation. Data from Mitchell (1988) and Officer (2001)

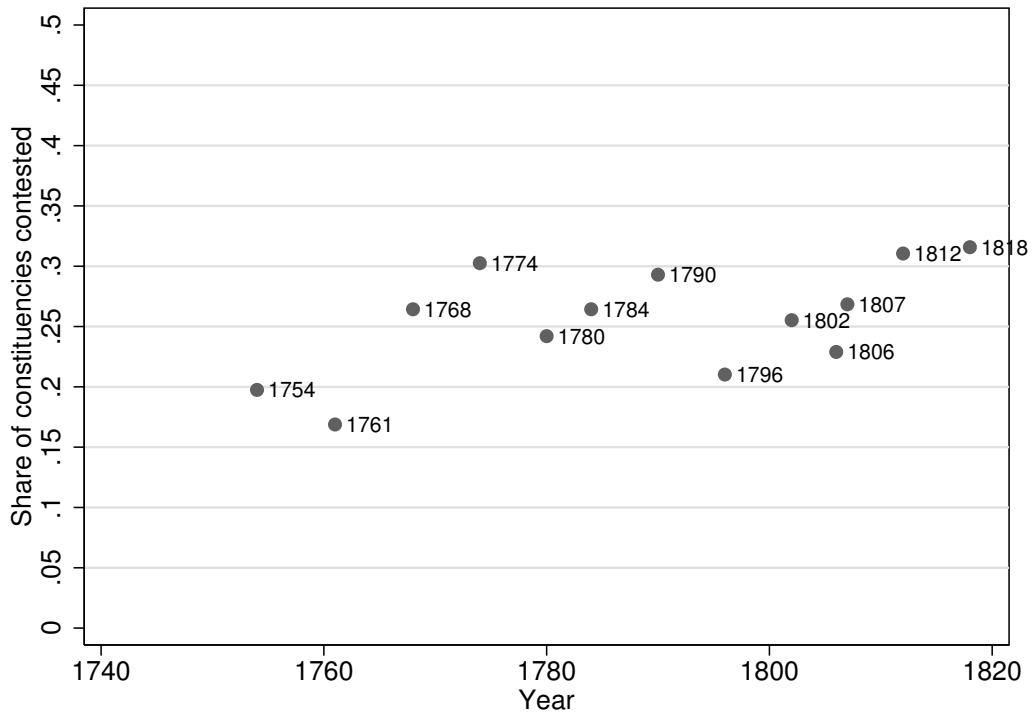
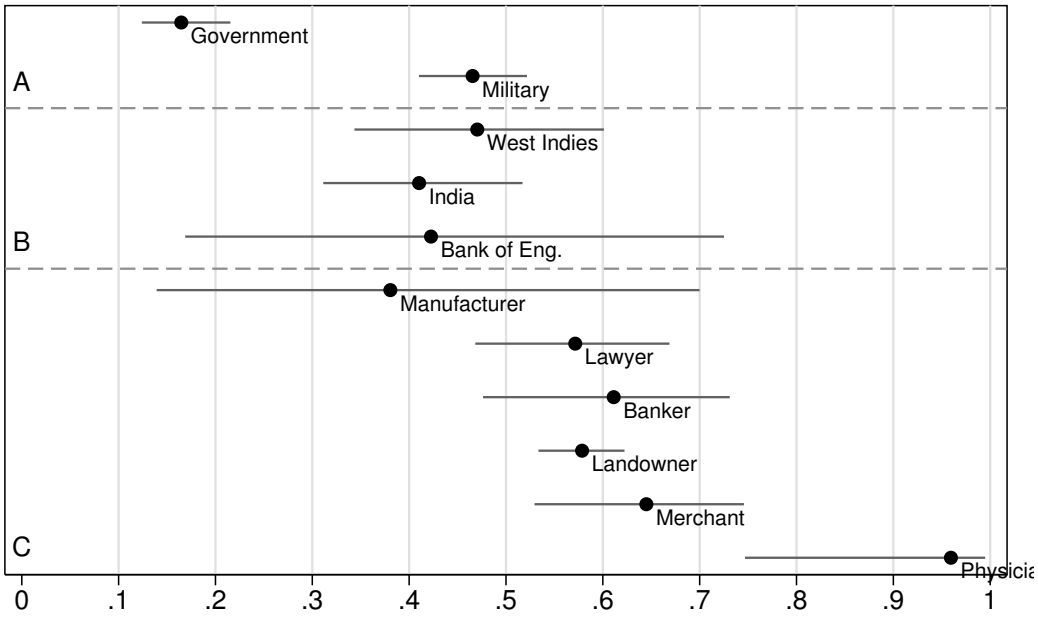
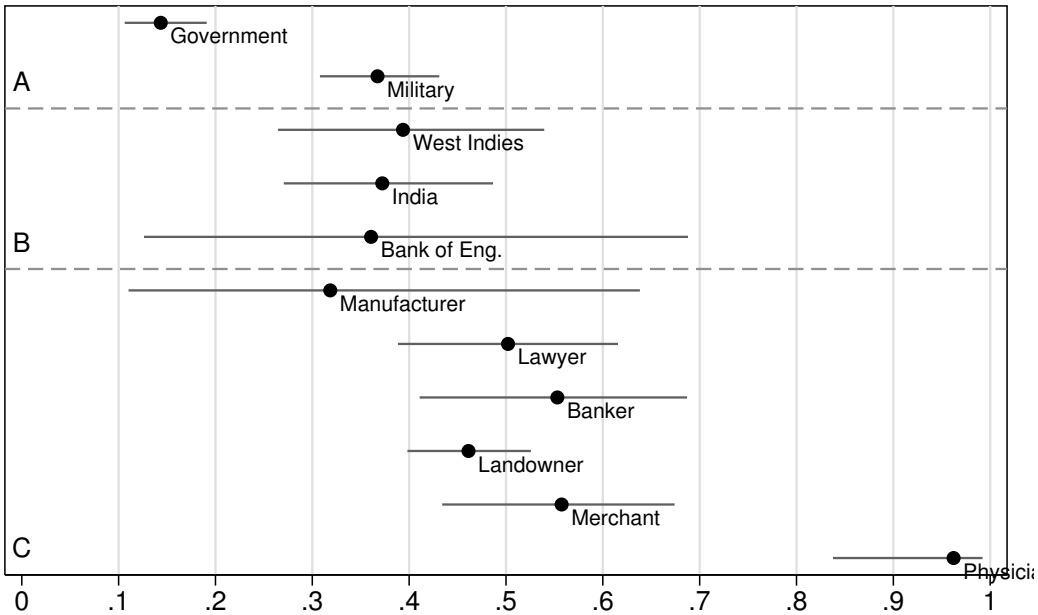


Figure 13: Share of electoral districts contested at each election. Data from the History of Parliament.



Controls: none.
Logit model, standard errors clustered by MP.
X axis indicates probability of pro−reform vote with 95% conf. intervals.
Balanced sample. N = 5776.

Figure 14: Voting behavior by occupational group, no controls.



Controls: electoral characteristics. Controls set at modal value.
Logit model, standard errors clustered by MP.
X axis indicates probability of pro−reform vote with 95% conf. intervals.
Balanced sample. N = 5776.

Figure 15: Voting behavior by occupational group, controls for electoral characteristics.

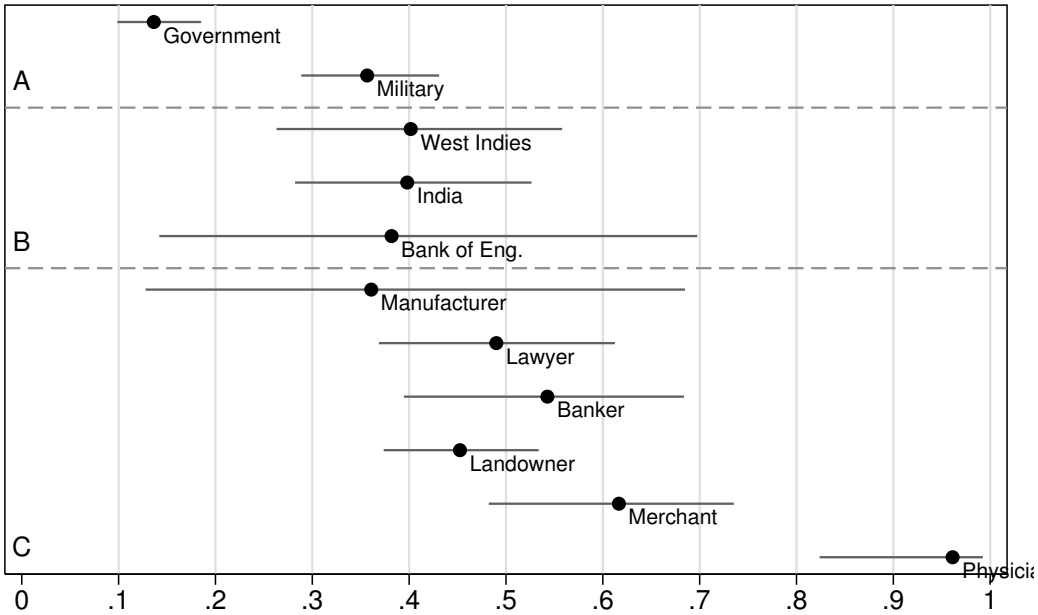
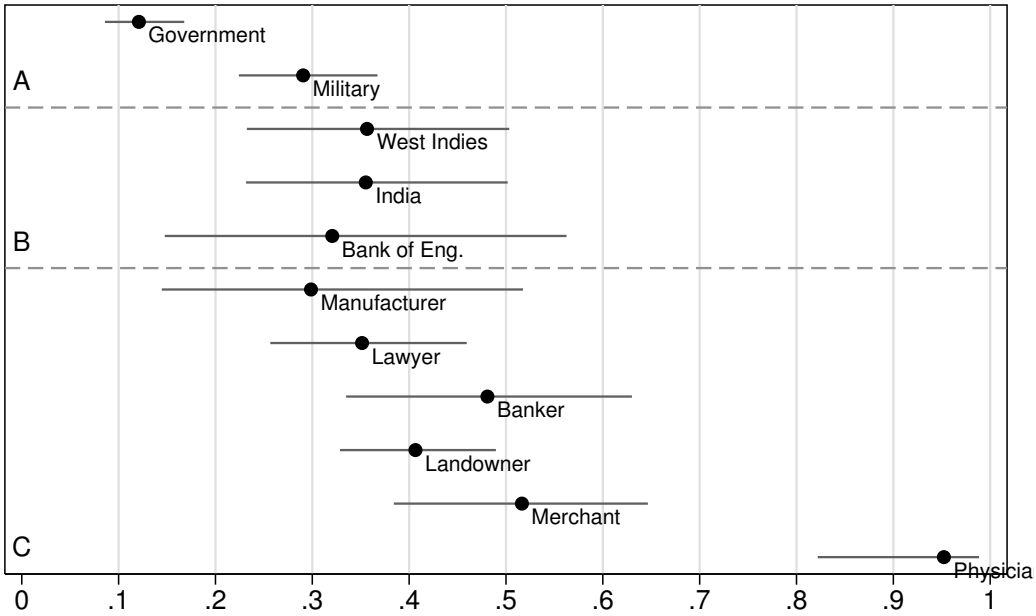
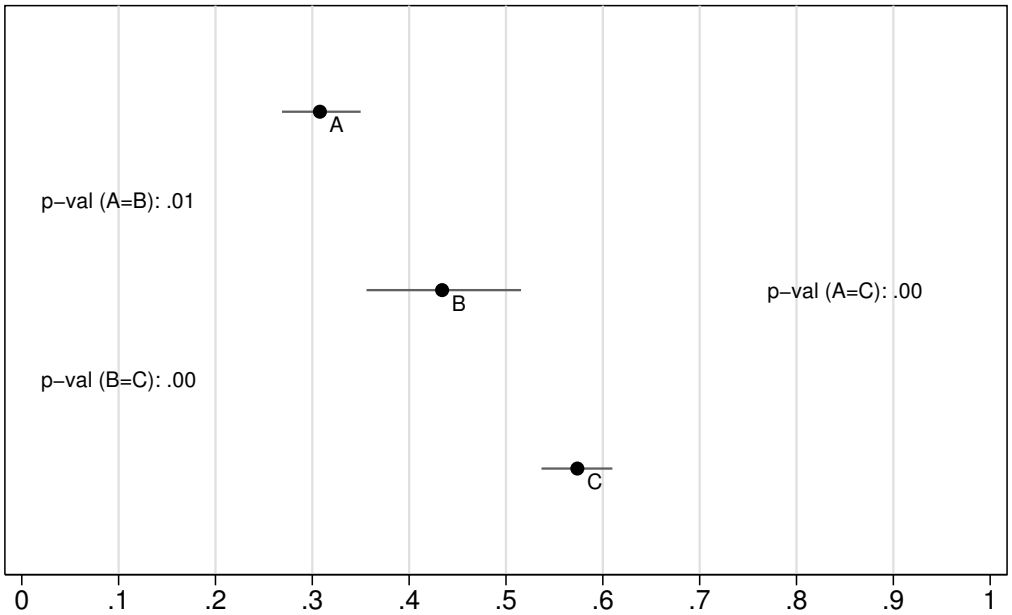


Figure 16: Voting behavior by occupational group, controls for electoral and personal characteristics.



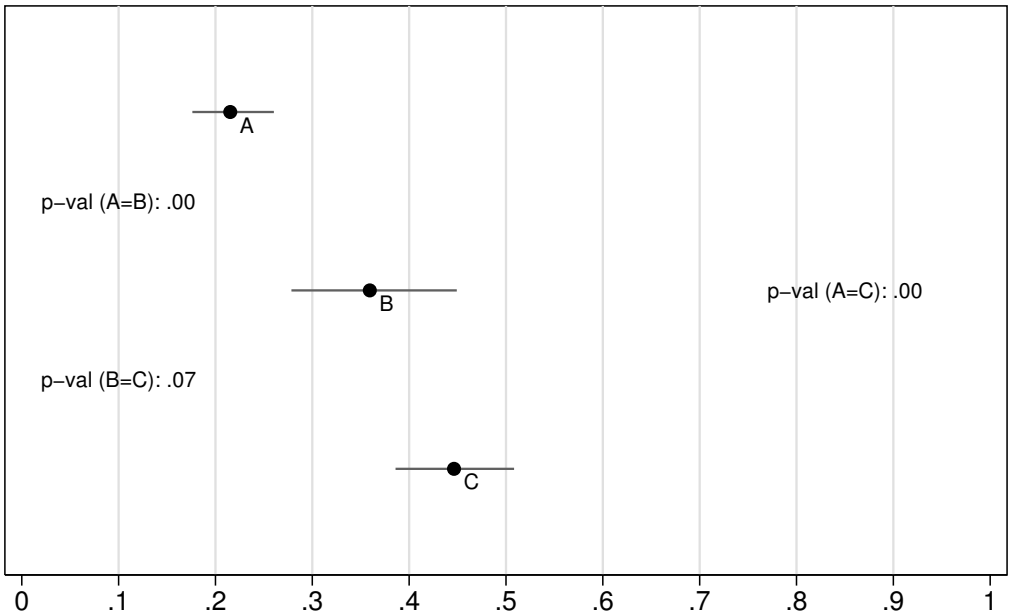
Controls: electoral characteristics, personal characteristics, Whig affiliation. Controls set at modal value.
Logit model, standard errors clustered by MP.
X axis indicates probability of pro−reform vote with 95% conf. intervals.
Balanced sample. N = 5640.

Figure 17: Voting behavior by occupational group, controls for electoral characteristics, personal characteristics, and Whig affiliation.



Controls: none.
Logit model, standard errors clustered by MP.
X axis indicates probability of pro−reform vote with 95% conf. intervals.
Balanced sample. N = 5776.

Figure 18: Voting behavior of groups A, B, and C, no controls.



Controls: electoral characteristics. Controls set at modal value.
Logit model, standard errors clustered by MP.
X axis indicates probability of pro−reform vote with 95% conf. intervals.
Balanced sample. N = 5776.

Figure 19: Voting behavior of groups A, B, and C, controls for electoral characteristics.

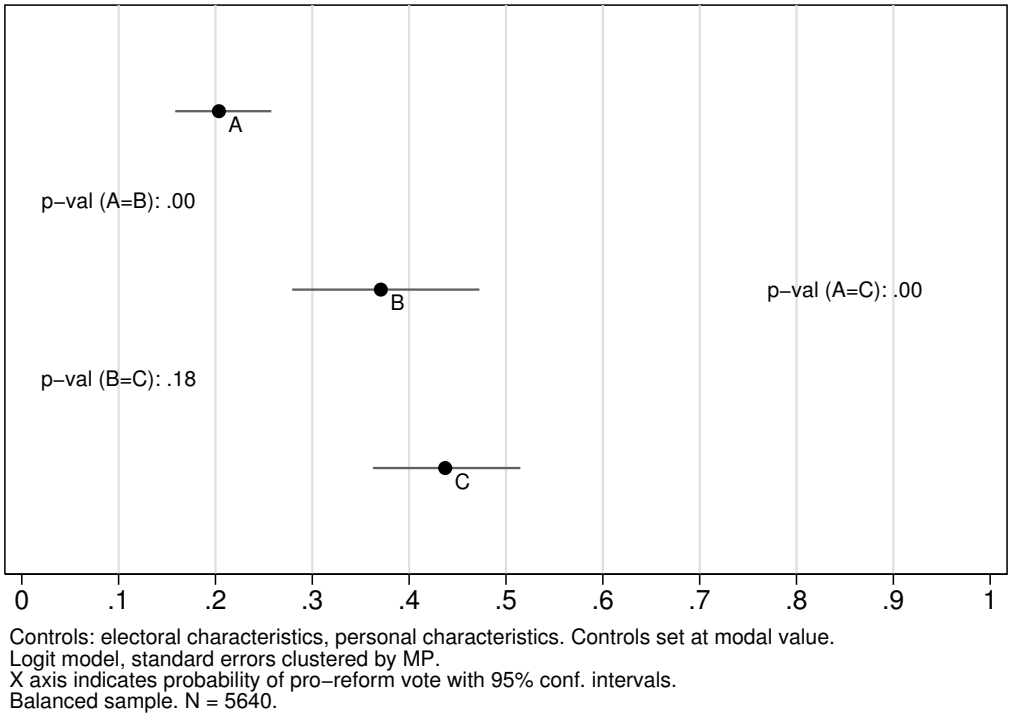


Figure 20: Voting behavior of groups A, B, and C, controls for electoral and personal characteristics.

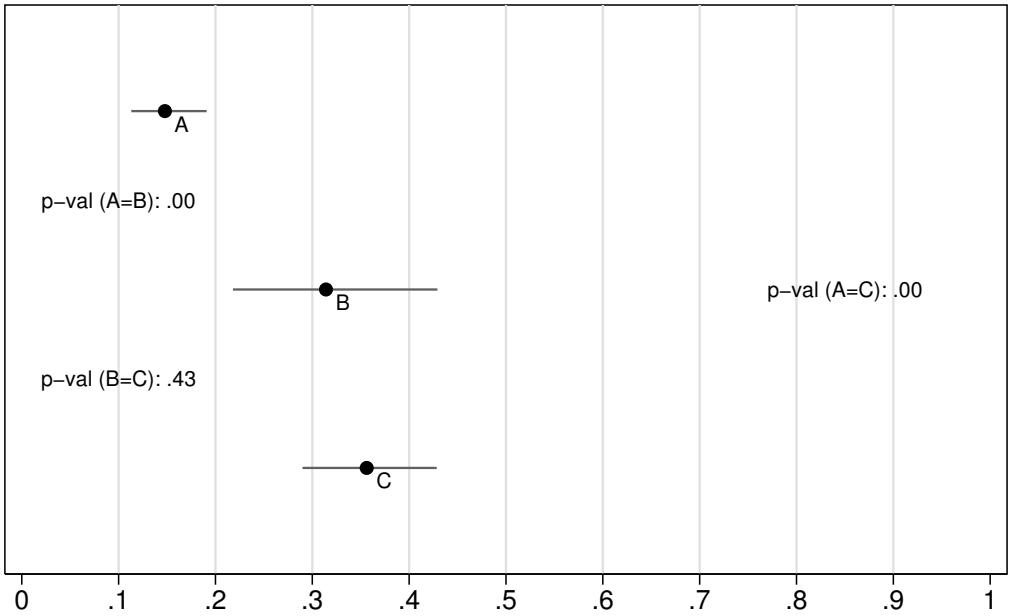


Figure 21: Voting behavior of groups A, B, and C, controls for electoral characteristics, personal characteristics, and Whig affiliation.

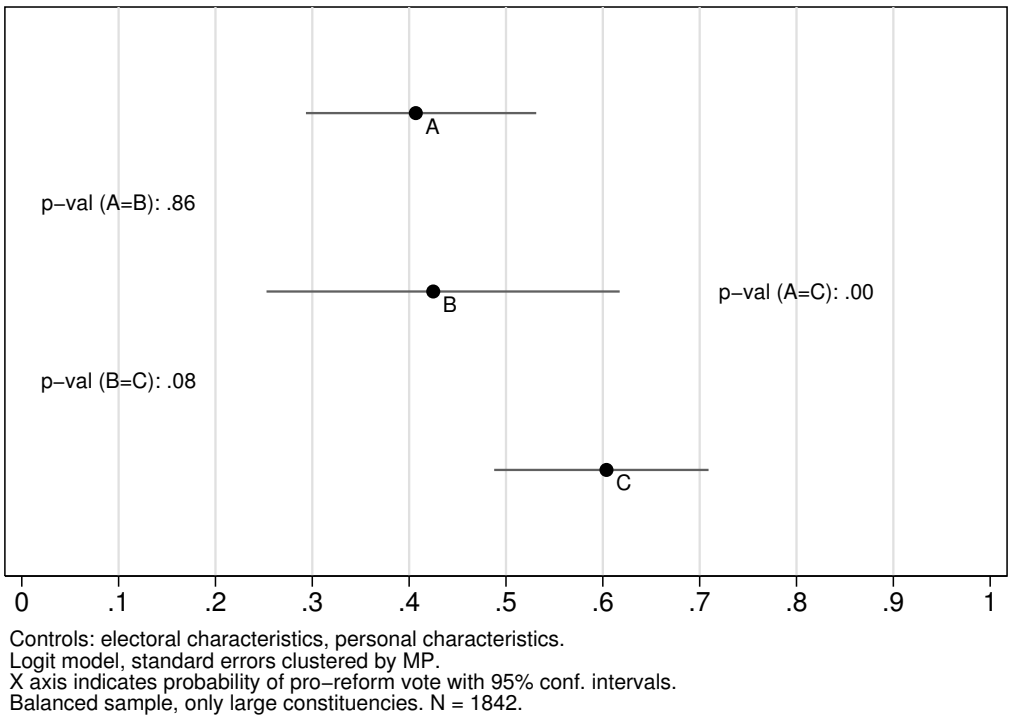


Figure 22: Voting behavior of groups A, B, and C, controls for electoral characteristics and personal characteristics. Only large constituencies.

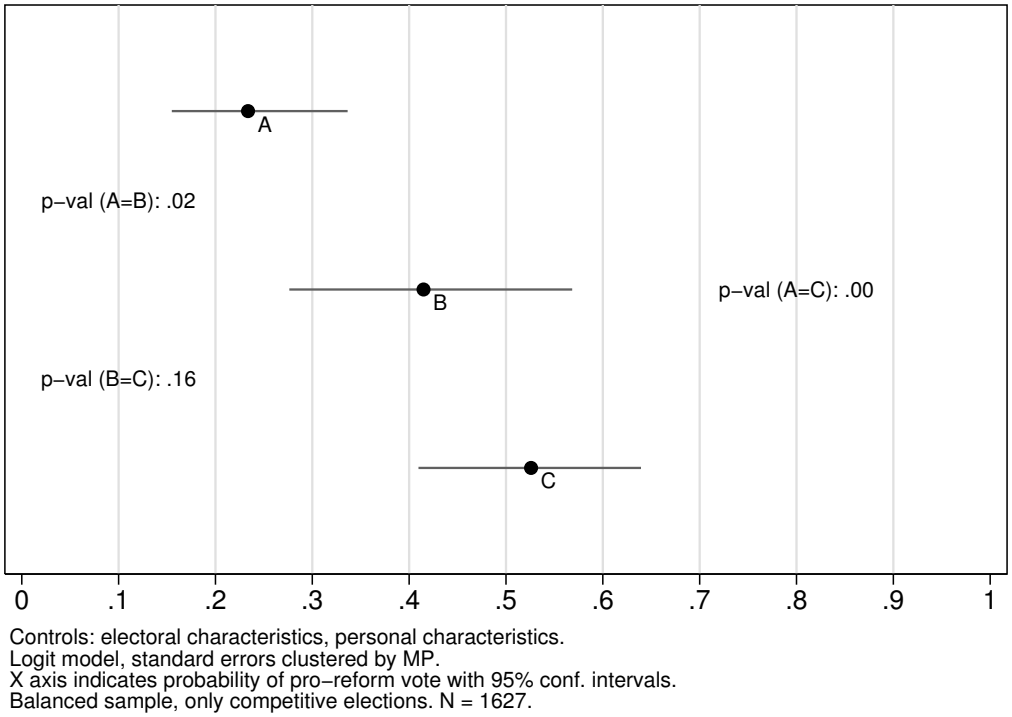


Figure 23: Voting behavior of groups A, B, and C, controls for electoral characteristics and personal characteristics. Only competitive elections.

Appendix D - Mathematical derivations

The maximization problem in (8). The problem is:

$$\arg\max_{G_o} \; T_o - G_o + \alpha u(G) \qquad \text{s.t. } G_o \in [0, T_o] \tag{97}$$

The necessary first order condition for an interior solution to the official's utility maximization problem is

$$\begin{aligned} \frac{\partial}{\partial G_o}\left(T_o - G_o + \alpha u\left(G\right)\right) &= 0 & (98)\\ \iff 0 - 1 + \frac{\partial}{\partial G_o}\alpha u(G) &= 0 & (99) \end{aligned}$$

For large values of n_E, the term $\frac{\partial}{\partial G}\alpha u(G)$ will be very small, and it can be approximated by zero by Assumption 1. Doing this in (3) above leads to $-1 = 0$, which is a contradiction, which implies no interior solutions exist. To find the argmax, it then suffices to compare the value of the official's utility function at the two extremes of the constraint set while assuming all other officials optimize in the same manner. At the point $G_o = T_o$ the utility maximizer reaches utility:

$$T_o - T_o + \alpha u\left(\sum_{o=1}^{n_O}(T_o)\right) = \alpha u\left(\sum_{o=1}^{n_O}(T_o)\right) \tag{100}$$

and at the point $G = 0$ the utility maximizer reaches utility

$$T_o - 0 + \alpha u\left(\sum_{o=1}^{n_O}(T_o) - T_o\right) \tag{101}$$

Therefore $G = 0$ is the argmax if:

$$T_o + \alpha u\left(\sum_{o=1}^{n_O}(T_o) - T_o\right) > \alpha u\left(\sum_{o=1}^{n_O}(T_o)\right) \tag{102}$$

$$T_o > \alpha u\left(\sum_{o=1}^{n_O}(T_o)\right) - \alpha u\left(\sum_{o=1}^{n_O}(T_o) - T_o\right) \tag{103}$$

By Assumption 1, the right hand side term can be approximated by zero, so for any positive values of T_o, the condition holds, and the solution to the official's utility maximization problem is $G = 0$. Now assuming all other officials choose the solution $G = 0$, at the point $G = T_o$, the utility maximizer reaches utility

$$T_o - T_o + \alpha u(T_o) \tag{104}$$

At the point $G = 0$, the utility maximizer reaches utility

$$T_o - 0 = T_o \tag{105}$$

So in this case $G = 0$ is the argmax if

$$T_o > \alpha u(T_o) \tag{106}$$

$$\iff T_o > \alpha u(0 + T_o) - \alpha u(0) \tag{107}$$

Again, by Assumption 1, the term on the right hand side can be approximated by zero, so $G = 0$ is the argmax in this case as well. This means the unique solution to the maximization problem faced by the individual official who takes into consideration that all other officials are maximizing in a similar fashion is $G = 0$. Of course, the result that T and G are zero is an approximation, as the small positive marginal utility at low levels of production of G would induce each official to produce some small quantity, but that effect can be ignored for simplicity of exposition. In case the small levels of production generated by the officials are

not approximated by zero, Assumption 2 has to be modified slightly to argue that reform is preferable in the one-shot interaction to the very small level of public good production.

The results in (15)-(16). To keep the government official's participation constraint holding with equality, set

$$\begin{aligned} V_o^* &= V_o^{OSD} && (108)\\ \iff \frac{1}{1-\delta_O}\left(R_o^* + \alpha u(G^*)\right) &= T_o^* + \alpha u(G^*) + \delta_O\left(\frac{0+\alpha u(G^*)}{1-\delta_O}\right) && (109)\\ \iff \frac{1}{1-\delta_O}R_o^* + \frac{1}{1-\delta_O}\alpha u(G^*) &= T_o^* + \alpha u(G^*) + \frac{1}{1-\delta_O}\delta_O\alpha u(G^*) && (110) \end{aligned}$$

Multiply everything by $(1-\delta_O)$:

$$R_o^* + \alpha u(G^*) = (1-\delta_O)T_o^* + (1-\delta_O)\alpha u(G^*) + \delta_O\alpha u(G^*) \tag{111}$$

Canceling the $u(G^*)$ terms leads to:

$$R_o^* = (1-\delta_O)T_o^* \tag{112}$$

which is condition (15) in the paper. The rest of the tax payment is returned as government goods, so

$$G_o^* = T_o^* - (1-\delta_O)T_o^* = \delta_O T_o^* \tag{113}$$

which is condition (16) from the paper.

Condition (19) follows immediately from $V_c^* \geq V_c^{OSD}$:

$$\begin{aligned} \frac{1}{1-\delta_E}\left(w - T^* + \alpha u(G^*)\right) &\geq \frac{1}{1-\delta_E}\left(w - T^{**} - c + \alpha u(G^{**})\right) && (114) \\ \iff -T^* + \alpha u(G^*) &\geq -T^{**} - c + \alpha u(G^{**}) && (115) \\ (\alpha u(G^*) - T^*) - (\alpha u(G^{**}) - T^{**}) + c &\geq 0 && (116) \end{aligned}$$

Proposition 2. To show that as α goes over some α^{RC}, the condition for C tolerating corruption will always be violated, a sufficient condition is that the partial derivative with respect to α of the expression $\mathcal{E}_1 = (\alpha u(G^*) - T^*) - (\alpha u(G^{**}) - T^{**})$ is always negative, and that the growth of the expression is unbounded. Before writing this partial derivative, note that the parameters T^*, G^*, T^{**}, and G^{**} which are endogenous with respect to α are implicitly defined by their optimality conditions:

$$\begin{aligned} \frac{\partial}{\partial(G)} u(G^*) &= \frac{1}{\delta_O n_e \alpha} && (117) \\ \frac{\partial}{\partial(G)} u(G^{**}) &= \frac{1}{n_e \alpha} && (118) \end{aligned}$$

Note that the expression $\mathcal{E}_1$ is in fact the loss in consumer surplus from the corrupt system when compared to the reformed system. (An illustration is provided in figure 14). The loss in consumer surplus (Y+Z in the figure) in reform versus corruption is given by

$$\begin{aligned} \mathcal{E}_2 &= -n_E \left[\left(\frac{1}{\delta_O} - 1 \right) G^* + \int_{G^*}^{G^{**}} \alpha \frac{\partial}{\partial G} u(G) \mathrm{d}G - (G^{**} - G^*) \right] && (119) \\ &= -n_E \left[\frac{1}{\delta_O} G^* - G^{**} + \alpha u(G^{**}) - \alpha u(G^*) \right] && (120) \\ &= n_E \mathcal{E}_1 && (121) \end{aligned}$$

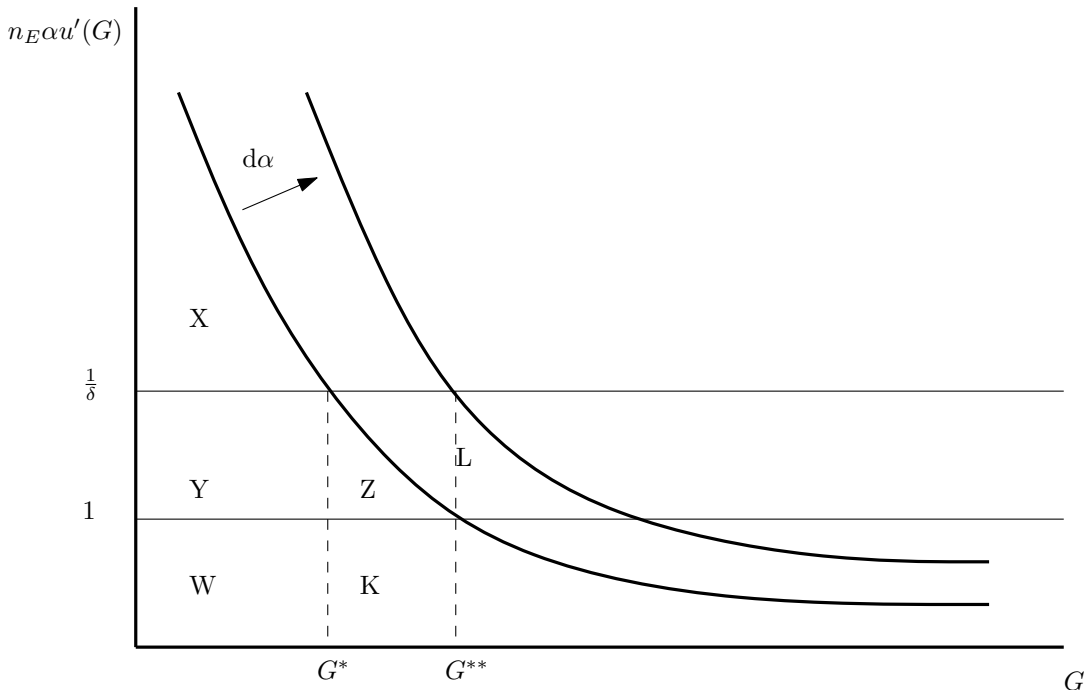


Figure 24: Consumer surplus in corruption = X; Consumer surplus in reform = X+Y+Z; Rents paid = Y; Total payment in corruption = Y+W; Total payment in reform = W+K; Loss in consumer surplus from corruption = Y+Z; Extra loss in consumer surplus with $d\alpha$ = L

The sufficient condition for $\mathcal{E}_2$ to become more negative is that for all α:

$$\frac{\partial}{\partial \alpha} G^* > 0 \text{ and } \frac{\partial}{\partial \alpha} G^{**} \geq 0 \tag{122}$$

This is because any additional unit of G^* could have been obtained for the lower price of 1 instead of $\frac{1}{\delta}$ under reform, so it can only add to the loss in surplus from corruption. So to establish that $\mathcal{E}_1$ decreases with α it suffices to show that condition (26) holds. To do so, the implicit function theorem can be applied to the two expressions that implicitly define $G^*$and G^{**}. Taking the first expression in (122):

$$\begin{aligned}
\frac{\partial G^*}{\partial \alpha} &= -\frac{\partial \left[n_E \alpha \frac{\partial}{\partial G} u(G^*) - \frac{1}{\delta_O} \right]}{\partial \alpha} \left(\frac{\partial \left[n_E \alpha \frac{\partial}{\partial G} u(G^*) - \frac{1}{\delta_O} \right]}{\partial G} \right)^{-1} \\
&= -n_E \frac{\partial}{\partial G} u(G^*) \left(n_E \alpha \frac{\partial}{\partial G} \frac{\partial}{\partial G} u(G^*) \right)^{-1} \\
&= -\frac{\partial}{\partial G} u(G^*) \left(\alpha \frac{\partial^2}{\partial G^2} u(G^*) \right)^{-1}
\end{aligned}$$

It is known that $\frac{\partial}{\partial G} u(G^*) > 0$ and $\frac{\partial^2}{\partial G^2} u(G^*) < 0$ so the expression on the right hand side is strictly positive, which leads to $\frac{\partial}{\partial \alpha} G^* > 0$. A similar derivation using the optimality condition for G^{**} will lead to:

$$\frac{\partial G^{**}}{\partial \alpha} = -\frac{\partial}{\partial G} u(G^{**}) \left(\alpha \frac{\partial^2}{\partial G^2} u(G^{**}) \right)^{-1}$$

This again shows that $\frac{\partial}{\partial \alpha} G^{**} > 0$, which leads to to $\frac{\partial}{\partial \alpha} \mathcal{E}_1 < 0$. This shows that the loss in consumer surplus from corruption is strictly increasing in α. To be sure that as α increases the condition for tolerating corruption fails, it has to be checked that, while increasing, the loss is not bounded. Looking at $\mathcal{E}_1$ as a loss in consumer surplus, this is equivalent to checking that the increase in consumption of G is not bounded as α increases. This can be checked by taking the limit as α increases in the implicit definitions of G^* and G^{**}. This will lead to $\frac{\partial}{\partial G} u(G^*) \to 0$ which implies $G^* \to \infty$ and similarly $G^{**} \to \infty$. This

means the loss in consumer surplus is not bounded, so there always exists an α^{RC} such that for all $\alpha \geq \alpha^{RC}$ condition (19) in the paper does not hold.

Proposition 3. To show that as α increases, A players become less likely to desire reforms, note that the right hand side of equation (22) in the paper, $\mathcal{E}_4 = \alpha u(G^{**}) - \alpha u(G^*)$ is again a difference in consumer surpluses for a consumer who pays a price of zero for the public good (e.g. the official). From the implicit definition of $G^*$and G^{**} it follows that $\lim_{\alpha\to\infty}(G^{**} - G^*) = 0$, so $\lim_{\alpha\to\infty}(\alpha u(G^{**}) - \alpha u(G^*)) = 0$. The left hand side is the rent received by the o player, which is linearly dependent on the rent lost by all e players under corruption. Since the total rent lost by e players is always $\left(\frac{1}{\delta_O} - 1\right) G^*$, and it has been shown that $\frac{\partial}{\partial G} G^* > 0$ and the increase in consumption is unbounded, it follows that the rent lost by e players increases with α and is not bounded, so the rent received by each o player, which is a linear function of that, also increases with α and is not bounded. Therefore increases in α make the right hand side of the inequality lower and the left hand side higher, so higher α make A player be less in favor of reforms.

Equilibrium conditions. The fact threats to remove the tax payment of an individual O player who deviated are credible is derived from the fact that V_C^* and $V_c^{*1}$are equal as long as $n_o \geq 2$. This follows from the fact that n_o does not appear in the equilibrium conditions of either e or o players. So as long as the corrupt equilibrium is desirable, it is also the case that the threat of removing payments from one o player is credible. Another question is then whether it is not possible to generate corrupt equilibria that more resilient than the ones generated by the use of the individual punishments. In such an alternative equilibrium, the other credible punishment, that of having all players revert to the one-shot equilibrium in which reform is enacted, should be used. These strategies are clearly not able to generate equilibria that the individual punishment strategy cannot generate, as writing

the participation constraint for o players in case they are threatened with reform leads to:

$$\begin{aligned} V_c^{*(REF)} &\geq V_c^{OSD} \\ \frac{1}{1-\delta_O}\left(R_o^{*(REF)} + \alpha u\left(G^{*(REF)}\right)\right) &\geq T_o^{*(REF)} + \alpha u\left(G^{*(REF)}\right) + \delta_O\left(\frac{0+\alpha u\left(G^{**}\right)}{1-\delta_O}\right) \\ R^{*(REF)} &\geq (1-\delta_O)T_o^* + \delta_O\alpha\left(u(G^{**}) - u(G^{*(REF)})\right) \end{aligned}$$

Therefore the rents required for equilibria sustained by the threat of reform are greater than the rents required for equilibria sustained by the threat of individual punishment, $R_o^{*(REF)} > R_o^*$, so it cannot be that the value for c players of equilibria sustained by the threat of reform is greater than the value of equilibria sustained by the threat of individual punishments. If C players do not want to participate in a corrupt equilibrium sustained by individual punishments, they are sure to not want to participate in a corrupt equilibrium sustained by the weaker punishment of overall reform. This allows the analysis to concentrate on equilibria sustained by individual punishments.

The result in (24) is given by replacing w with $(w^{-S}+w^S)$ or w^{-S} in the value functions of B players. For players in B, the value function for the cooperative equilibrium path is similar to that for C players, with the replacement of w by $(w^{-S}+w^S)$:

$$V_b^* = \frac{1}{1-\delta_E}\left(w^{-S} + w^S - T^* + \alpha u(G^*)\right) \tag{123}$$

However, the value function for reform has to take account of the loss of w^S:

$$V_b^{REF} = \frac{1}{1-\delta_E}\left(w^{-S} - T^{**} - c + \alpha u(G^{**})\right) \tag{124}$$

Setting $V_b^* \geq V_b^{REF}$ leads to

$$w^{-S} + w^S - T^* + \alpha u(G^*) \geq w^{-S} - T^{**} - c + \alpha u(G^{**}) \tag{125}$$

$$(\alpha u(G^*) - T^*) - (\alpha u(G^{**}) - T^{**}) + c + w^S \geq 0 \tag{126}$$

Proposition 4. The fact that $\alpha^{RB} > \alpha^{RC}$ is given by the fact that the pivotal B player's problem is identical to that of the C players, except the expression $\mathcal{E}_1 = (\alpha u(G^*) - T^*) - (\alpha u(G^{**}) - T^{**})$ needs to be even lower than in the case of a C player for reforms to be preferred (this is assuming O players have a reason to try to prevent B players from voting for reform). This is because now this expression needs to become lower than $(-c - w^S)$, whereas in the case of the C players, it needed to be lower than just $(-c)$ for reform to be desirable. It has been established that $\mathcal{E}_1$ is monotonically decreasing in α and unbounded, so it is known that above a certain α^{RB} it will become lower than the threshold $(-c - w^S)$, but as the threshold is lower than the one for C players, it is also the case that $\alpha^{RB} > \alpha^{RC}$.

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