ESSAYS IN PUBLIC POLICY: RENT SEEKING, COMPLIANCE AND INDIRECT LOBBYING

by

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Abstract

This thesis consists of three major studies which consider various strategies undertaken by special interest groups to shape and evade public policy. Each paper makes both policy relevant and technical contributions to the existing literature.

In the first paper, a polluting firm exerts influence on environmental policy outcomes by bribing politicians to lower stringency (grand corruption), or bureaucrats to permit non-compliance (petty corruption). In determining a model of stratified corruption, the common agency framework of Grossman and Helpman (1994) and principal agent models of administrative bribery are combined and extended. The potential of political competition as means to constrain corrupt behaviour is examined. It is shown that neither petty nor grand corruption is necessarily eliminated in a more competitive political system. In particular, the former is shown to increase if enforcement mechanisms are under-developed. Grand corruption may also persist, aided by policy convergence of political parties, which insulates them from the electoral effects of accepting bribes. This explanation for policy convergence is new to the literature.

The second major paper conducts empirical tests of these results using data from the World Business Environment Survey (2000), which comprises 10,000 respondents in 80 countries. Consistent with the theoretical predictions of this thesis, political competition is only found to reduce petty corruption when the enforcement infrastructure is sufficiently strong. Moreover, threshold analysis predicts that regimes with weak enforcement will see an increase in this type of

corruption when political competition increases. Grand corruption is shown not to be significantly associated with the level of political competition.

The final paper develops a model whereby opposing special interests are able to influence environmental policy outcomes by persuading a relatively uniformed public about the level of environmental damage by sending costly messages. The paper combines elements of the Grossman and Helpman (1994) model of direct lobbying with the literature relating to signalling (Spence, 1973). The paper seeks to identify when the public will correctly infer the level of environmental damage from the messages they receive from polluters and environmentalists. This is shown to be more likely when polluters' activities are potentially very damaging to the environment or when the government is more prepared to ignore the consequences of environmental damage in return for political contributions. The results also reveal that *ceteris paribus*, when the gains from production of a polluting good are large, it is more likely that the public will remain relatively uninformed about the level of environmental damage associated with its production.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and beliefs, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

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John Wilson, 16th August, 2004.

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Chapter 1

Introduction

This thesis examines some of the factors which influence the setting of, and compliance with, government regulation. The core consists of three major essays which consider various strategies undertaken by special interest groups with a view to shaping and evading the intended consequences of public policy. The motivation for the thesis has its origins in Grossman and Helpman's (1994) common agency model where special interests are able to obtain policy concessions by making campaign contributions to government. The thesis extends upon this framework by incorporating two further possibilities: the ability to influence the public and the ability to evade regulations by other methods. Of the three core chapters, two present formal models relating to environmental regulation. The remaining chapter conducts an empirical investigation into the major determinants of different forms of corruption, which are identified in one of the theoretical papers. Due in part to a lack of available data, this empirical work does not confine itself to environmental policy issues.

What follows in this introductory chapter is a discussion of the general motivation for the thesis together with an overview of each of the core chapters.

1.1 Motivation

In any society there are a myriad of public policies, all of which to varying degrees effect the incentives facing, and hence the actions of agents. One can readily think of many different examples: from the creation of simple laws to define and uphold property rights to more complex policies which involve direct

intervention in the functioning of markets (for example, environmental policy, trade policy).

Most often, these public policies tend to diverge from those considered optimal for the public interest. However, as has long been noted, much of the literature which prescribes these optimal outcomes assumes that governments act as 'benevolent dictators'. This of course, does not reflect the political reality in which policy decisions are made. For example, special interest groups may receive a disproportionate voice in the setting of policy in return for monetary contributions.[1] A further complication is that the majority of the population may be uncertain regarding the welfare effects of policies. Where special interests are relatively more informed, they may also be able to persuade the public, and thus indirectly alter the government's choice. Both these forms of lobbying (direct and indirect) have the capacity to bring about a transfer of rents towards influential groups at the expense of the general welfare of citizens. Identifying the inter-relationships which may exist between these two types of lobbying and the conditions under which the influence of these special interests can be limited is an important aspect of understanding the process of policy formation.

A second issue is that even if policies are set at the welfare maximising level, agents do not always comply. This is particularly relevant when, as in the case of most policies, the government must rely on the services of a third party to enforce compliance. Again, there is a need for research examining the potential interplay between compliance issues and efforts to influence the setting of policy by special interest groups.

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[1] Of course, other methods of lobbying are possible. Examples include both formal and informal meetings with legislators, providing endorsements, and so called grass-roots lobbying where members of special interest groups are encouraged to contact their elected representatives. For a more detailed discussion, see Schlozman and Tierney (1983); Nownes and Freeman (1998).

These problems are particularly relevant in the realm of environmental policy. Arguably, both the scientific community and the general public are becoming increasingly aware of environmental issues. This has led to greater calls for policy which addresses environmentally damaging activities. However, many argue that progress has been slow.[2] Moreover, environmental policies which have been established are often plagued with problems of corruption, diluting their intended effects. Understanding of the way in which such policies are set and complied with is of prime importance if environmental problems are to be addressed in an efficient manner.

1.2 Overview of Chapters

Building on the existing literature, three distinct chapters of this thesis examine the issues discussed above. A brief introduction to each is presented below.

1.2.1 Chapter 3: Corruption, Political Competition and Environmental Policy

In this chapter, a polluting firm which wishes to minimise the costs of environmental policy (an emissions tax), can make payments to political parties in order to obtain policy concessions. In addition, as policies are administered by a low level bureaucrat, the firm can offer bribes so that all or part of its emissions are not reported to the government. This reduces its liability to the government which is calculated on reported rather than actual emission levels. Each of these strategies is considered to be a form of corruption. Consistent with the literature on corruption (see for example, Pope (1996); World Bank (1997)), the former is

[2] For example, Anderson (2002) notes that despite the environmental goals identified under the banner of 'sustainable development' at the 1992 UNCED conference, governments have taken little action. Indeed, environmentally damaging policies such as those which support farm subsidies have been maintained and in some cases increased in the U.S. and Europe.

considered as 'grand' corruption and the latter 'petty' corruption. The aim of the chapter is to examine the interplay between stratified corruption, political competition and environmental policy outcomes. The model combines two distinct strands of the literature: environmental policy models of grand corruption (for example, Fredriksson (1997a); Fredriksson and Svensson (2003) which have their origins in Grossman and Helpman (1994)), and principal agent models of petty corruption (for example, Mookherjee and Png (1995); Damania (2002a)). By considering two rival political parties, the effects of political competition on each form of corruption is considered. Moreover, this enables the weight political parties ascribe to aggregate welfare relative to bribes to be endogenised, extending upon Grossman and Helpman (1994).

The results reveal that even when political competition is intense, both forms of corruption may persist. In particular, political parties will respond by setting more stringent environmental and anti-corruption policies (penalties for under-reporting), and this is shown to improve environmental outcomes. However, when enforcement mechanisms are weak, the level of under-reporting (petty corruption) will increase with greater political competition. In addition, even when the intensity of competition between political rivals is at its most intense, grand corruption may persist. Interestingly, this occurs when the welfare effect of policies are large. It is found that rival political parties will allow their policies to converge in these circumstances in order to insulate them from the political costs of continuing to accept bribes from the polluting firm. The chapter thus provides a 'lobbying' explanation for policy convergence which is new to the literature.

1.2.2 *Chapter 4: Political Competition and Corruption: Evidence from the World Business Environment Survey (WBES), 2000.*

The results obtained in Chapter 3 are arguably of considerable policy significance. It is therefore reasonable to test these against the available empirical data. Chapter 4 conducts such an analysis using data from the World Business Environment Survey (WBES) 2000. These data contain responses of over 10,000 firms in 100 countries relating to both grand and petty corruption and the business environment in which the respondents operate. These data are not specific to environmental corruption, however, as the results of chapter 3 are applicable to many other types of regulation, this is not considered a shortcoming. Controlling for a set of other determinants, empirical analysis is conducted to test the relationship between political competition and corruption.

The results provide broad support for the predictions of the model presented in chapter 3. In particular, it is shown that petty corruption is inversely related to the level of political competition, however, the result appears to depend on the level of enforcement. To this end, threshold analysis is undertaken which suggests that, as predicted in chapter 3, regimes with a weak enforcement infrastructure are likely to suffer an increase in levels of petty corruption when political competition increases. In addition, the level of political competition is shown not to have a significant association with grand corruption.

1.2.3 *Chapter 5: The Influence of Lobby Groups on Public Opinion: The Case of Environmental Policy.*

Implicit in chapter 3 is the assumption that the public are perfectly informed regarding environmental damage. As such, a purely benevolent government would set policy at the welfare maximising level, fully internalising the production

externality. However, in a real world context, this is not likely to be the case. In particular, the public are likely to be relatively uninformed about the level of environmental damage. It thus seems possible that better informed special interest groups might have an incentive to try to change the public's belief with a view to influencing the setting of policy.

Empirical evidence seems to suggest that special interest groups do engage in advertising to shape public beliefs. Those representing environmental concerns appear to be especially likely to engage in this type of lobbying. Polluting interests, on the other hand have a greater propensity to make direct financial contributions to regulators.[3] Despite this evidence, the literature has somewhat neglected the issue of indirect lobbying.

Chapter 5 presents a model which considers the setting of an emissions tax to combat perceived environmental problems. In this model, two states of nature are assumed to exist such that a firm's production process may or may not cause environmental damage. All agents other than the general public are aware of the actual level of damage caused. Both the firm and an environmental lobby engage in sending costly signals to the public in order to influence their beliefs. This 'indirect' lobbying takes the form of a signalling model similar to that put forward by Spence (1973). In addition, the firm is assumed to make Grossman and Helpman (1994) type contributions to the government (direct lobbying).

The aim of the chapter is to identify the effect of the messages on the public's ultimate belief regarding environmental damage. The results suggest that the public are more likely to be able to infer the truth from the messages they

[3] Evidence presented in chapter five reveals that in the 2002 US election cycle, polluting interests contributed $57.8 million US dollars to party candidates. This exceeded contributions of environmental groups by a factor of over 40.

receive when the government values contributions from the firm highly (relative to the welfare of its citizens), when the public were previously poorly informed about environmental issues, and when the level of environmental damage is particularly severe.

The results also suggest that indirect and direct lobbying are to some extent strategic complements for the firm. However, this is shown to occur under very limited conditions. In addition, when polluting interests stand to gain sufficiently from reducing the level of the emissions tax, the public become more sceptical about the signals sent by this lobby and tend to ignore them.

1.3 Structure of the Thesis

Each of the chapters described above draw upon Grossman and Helpman's (1994) common agency model of endogenous policy formation to consider the effects of bribes and contributions made to the government. It is thus important to have some background as to the origins and nature of this model. In chapter 2, the relevant literature is reviewed.[4] This literature encompasses several different approaches to explain the influence of special interests in policy formation: the direct democracy approach, the political competition approach, and the political support approach. Each of these is discussed in turn, however the emphasis is on the latter approach, with which the Grossman and Helpman (1994) model has its strongest ties. This model has been applied to both environmental policy and problems of corruption. These applications are also discussed. Following this discussion in chapter 2, each of the three main chapters outlined above is presented followed by a short conclusion.

[4] Each of the individual core chapters also provides a review of the relevant literature specific to that chapter.

Chapter 2:

The Political Economy of Policy Formation

2.1 Introduction

Grossman and Helpman (1994) present a model of endogenous trade protection whereby special interest groups (henceforth 'lobbies') are able to 'buy' more favourable policy outcomes. Both of the theoretical chapters in this thesis utilise and extend this model. The purpose of this chapter is thus to provide a review of the Grossman and Helpman model. In section 2.2, an overview of the traditional approaches used to analyse the formation of policy in the presence of lobbying influence is provided. These approaches can be broadly categorised into three headings: *the direct democracy approach, the political competition approach, and the political support approach.* In section 2.3, the Grossman and Helpman (1994) model is discussed and several extensions which have been applied to this model are presented. Section 2.4 details the empirical support for the main findings of the model. While the Grossman-Helpman model has generally been applied to the structure of trade protection, it has a much wider applicability. Section 2.5 thus closes the chapter with examples of how the Grossman and Helpman model has been applied to problems of environmental regulation and corruption.

2.2 Models of Endogenous Policy Formation

There is a vast literature which examines the political economy of trade policy. As noted, these can be grouped into three broad categories, each of which are detailed below. Excellent reviews of these approaches can be found in Hillman (1989), Rodrik (1995), and Grossman and Helpman (2002).

2.2.1 Direct Democracy

Mayer (1984), building on Baldwin (1982), presents a model where there are two factors of production, one of which is specific to an import competing industry. Voting takes place over the single issue of a protective tariff for this industry. Each member of society has a different endowment of the specific factor and thus has a different preference as to the optimal level of protection. Those with a large endowment of the sector specific factor desire greater levels of protection, while those with a relatively low endowment of the same factor desire no protection, or even an import subsidy. Either side of the median voter, opposing voices regarding the level of the tariff are balanced. The rate which is optimal for the median voter thus characterises the equilibrium policy.

Grossman and Helpman (2002) observe that in this type of model, concentrated ownership of the specific factor could lead to an equilibrium policy of negative protection. For example, suppose the sector specific factor was wholly owned by one individual. In such a circumstance, the median voter would prefer an import subsidy over a tariff. In practice, however, positive protection is afforded to industries with concentrated factor ownership. There are several reasons why this might be so. For instance, Mayer (1984) argues that where voting is costly, only those who stand to gain more than the cost of voting will engage in the political process. The more concentrated the ownership of the specific factor, the fewer participants there are to share the rents associated with higher protection. Conversely, for those who do not own the specific factor, the individual's share of the gain from obtaining a lower level of protection will be small. If the gains for these individuals are so small that they do not offset the costs associated with

voting, they do not participate in the political process. Thus, the small group of specific factor owners may be able to obtain protection for their sector.

Rodrik (1995, p1466) notes that in the above setting, the calculus used by individuals in determining whether to vote or not must also include an assessment by the individual of the probability that their vote will be pivotal. In most societies, the marginal impact of any individual's vote on the political outcome would approach zero. It follows that it would generally only be optimal to engage in voting when it is costless. Further, it is unrealistic to assume that direct voting will occur over a specific policy issue. On these grounds, the direct democracy approach, while providing some useful insights, is subject to criticism.

Rather than having a passive role in influencing policy, an alternate view is that lobby groups undertake activities which help shape the political outcome.[5] Grossman and Helpman (2002) discuss this in the context of the Mayer (1984) model, noting that the small group who owns the sector specific factor would be far more likely to succeed in overcoming the free-rider problem associated with forming a pressure group to argue for greater protection.[6] On the other hand, the remainder of the voting population, who on a per capita basis stand to gain relatively little from changing trade policy are unlikely to be able to overcome free-riding problems. The *actions* of these pressure or lobby groups are of central importance under the *political competition* and *political support* approaches.

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[5] Lobby groups undertake many different activities. These include making political contributions, educating the public, and acting as a source of information for the political elite (See Schlozman and Tierney (1983).

[6] See Olson (1965) for a discussion of the free-rider problem. Damania and Fredriksson (2000) show that more collusive industries have higher incentives to form lobby groups.

2.2.2 Political Competition

Hillman and Ursprung (1988) and Magee, Brock and Young (1989) consider models in which political competition drives the formation of trade policies. In this type of model, rival political parties choose policy positions which they are credibly committed to in the event that they gain office. It is assumed that there are two opposing lobby groups, each of whom have opposite views regarding the level of trade protection, while the general public are assumed to be rationally ignorant of the effects of the policy. Announcement of the policy positions by each party generate political contributions from the organised lobbies. These contributions are then used by the political parties to sway the uninformed voters. In this manner, contributions determine the electoral success (or failure) of each candidate. The political competition approach thus formalises the relationship between the profit maximising objectives of lobby groups and the political motives of the candidates.

As first movers in this game, the political parties calculate the reaction functions of the lobby groups to policy announcements, thus acting as Stackelberg leaders. In equilibrium, political competition determines the actions of the political parties, a phenomenon which Magee, Brock and Young (1989) coin as *the powerless politician effect.* A further result is that the interest groups make specialized contributions. Specifically, those wishing for free trade make contributions solely to the more liberal candidate and those advocating protection contribute only to the protectionist candidate.[7]

[7] This result, however, does not always reflect reality. As noted by Grossman and Helpman (2002), special interest groups often make contributions to all major parties (p. 185). Using the political competition approach, Mayer and Li (1994) identify an equilibrium where both lobbies make contributions to the same party, however, they are unable to explain multiple party donations by special interests.

Hillman and Ursprung (1988) show the equilibrium trade policy to be dependent upon the instrument used. They find that tariffs are politically divisive, causing the protectionist candidate to choose a prohibitive tariff while her rival chooses free trade. As electoral success depends on the level of contributions made to each candidate, Hillman and Ursprung seek to identify when a particular party will secure more contribution funding vis-à-vis its rival. They find that the protectionist candidate will be more likely to garner contributions (and thus gain power) when imports and domestic goods are close substitutes and when domestic producers face lower levels of competition. While the use of a tariff leads to candidates adopting extremely divergent policies, voluntary export restraints are shown to lead to policy convergence between the parties.

2.2.3 Political Support

The political competition approach, despite some of its associated drawbacks, is a useful tool for explaining the differing policy positions of rival candidates who are dependent on policy contributions for their electoral success. However, political contests are usually fought out over a wide range of issues, not just the stance over a particular policy. In addition, the finer details of the policies, as noted by Grossman and Helpman (1994), are often made without the constraint of a looming political contest. For example, whether a political party will take a 'green' approach to the environment could well be investigated using the political competition approach. Details regarding the finer points of policy, such as which polluters may be targeted, or which type of instrument is likely to be used may be determined after an electoral victory. In such a circumstance, how is it that lobbies

might still exert some influence over the incumbent policy makers? The political support approach seeks to explain how this might occur.

The basis of this approach is that in choosing policy, self interested politicians are prepared to trade off the welfare of the public at large with the policy driven gains which accrue to supportive industries. In essence, the incumbent government wishes to maximise the political support received from the supportive industry subject to the constraint that the marginal political costs of a change in policy (through falls in general welfare) do not exceed the marginal gain accruing to the special interests. The lobby groups are able to use this characteristic of the government to effect transfers of wealth from the general public to themselves. The nature of 'political support' is not explicitly defined, though it could naturally be assumed to include political contributions..

In this setting, the effect of contributions and rational ignorance of voters become redundant as there is no looming political competition.[8] Further, contributions from lobby groups need not involve monetary payments to politicians, but instead could involve any form of patronage. The political support approach is particularly useful in providing insight into how special interests effect policy outcomes where political competition is low or non-existent.

In his seminal paper, Stigler (1971) lays down the arguments which form the basis of the political support approach.[9] An empirical investigation into regulation surrounding the trucking industry in 1930 is undertaken to investigate his hypotheses regarding the influences on regulation. Stigler's argument suggests that rival rail interests were likely to have had an influence over policy. He finds that

[8] Voters are however, assumed to be unable to overcome problems of free-riding as specified in Olson (1965) and as such, there is no special interest group representing their interests.
[9] Peltzman (1976), provides a more formal framework for the approach.

regulation was lower where the gains to rail interests were lower (for example, where the length of haul was larger, implying that truck based transport to be less viable) and the adverse welfare impacts on the public were higher, providing empirical evidence for his hypothesis.

Hillman (1982) formalises the ideas presented by Stigler (1971) to analyse the political incentives for providing protective support to declining industries. He considers the case where domestic producers in a small open economy are protected from imports by a government wishing to maximise its political support. In the government's objective function, the each lobby receives an exogenous weight. The case where domestic interests face a constant fall in their comparative advantage due to falls in the world price is considered. Under certain conditions, protection to the declining industry is shown to increase, however, it does not fully compensate domestic producers for the fall in world prices. As such, the best domestic producers can hope for is that the rate of decline will be slowed.[10] Crucially, the government is predicted to 'soften the blow' in this manner only when the exogenous political weight attached to the industry is sufficiently high.

2.3 The Grossman and Helpman Model

Using the common agency framework set down by Bernheim and Whinston (1986), Grossman and Helpman (1994) present a model where policy decisions are made by self interested politicians who trade off the welfare of citizens against political contributions offered by lobby groups. No challengers are explicitly modelled and contributions are not assumed to influence political contests.[11,12]

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[10] Using a general equilibrium approach, Long and Vousden (1991) find support for this result, showing that a declining industry will continue to decline.

[11] An intuitive way to consider this is that each lobby group considers its own contribution relative to total contributions to be small, and thus consider the electoral effect of their contributions to be

Lobby groups within a small open economy offer contributions which are contingent upon the level of protection afforded to their industry. As such, the model follows the tradition of the political support approach.

In their formulation of the government's objective function, Grossman and Helpman move beyond the earlier political support literature where the government was assumed to place exogenous weights on the welfare of each group in society. They instead specify an objective function for the government which has political contributions and aggregate welfare of citizens as its arguments. The relative importance of contributions generated from policy favours against the associated welfare loss is determined by an exogenous weight.[13] *Ceteris paribus*, the government is equally happy to receive contributions from any of the organised lobbies. However, the costs in terms of voter dissatisfaction and the preparedness of lobby groups to make contributions will differ across different industries.

Analysis of the structure of trade protection reveals that all represented industries will be protected, and the general level of protection will be higher when the government places a greater weight on campaign contributions relative to voter welfare. Conversely, those industries who are unrepresented (i.e. are unable to overcome problems associated with forming a lobby and thus do not make contributions) will receive negative protection.

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insignificant. While the model assumes that politicians must derive utility from contributions, the exact manner of how they are used is unimportant: they may be used for election campaign spending or for some other purpose (even private consumption).

[12] In justifying this approach, Grossman and Helpman (1994) point to evidence provided by Magleby and Nelson (1990) who note that more than three quarters of campaign contributions in the 1988 congressional campaigns went to incumbent candidates. More recent data also suggest a bias towards incumbent candidates. Leading up to the 1998 U.S. congressional elections, the *Center for Responsive Politics* note that house incumbents enjoyed a four-to-one fund raising advantage and the senate incumbents a three-to-one advantage over their challengers, for details, see: . (http://www.opensecrets.org/pubs/tracking/track.htm, accessed 15/12/03).

[13] In section 2.4, empirical studies which attempt to estimate this weight are presented.

An interesting case arises when all groups in society engage in buying influence. Efforts made to influence policy by lobby groups who would gain from protection (import taxes) are offset by efforts from those who benefit from low prices (import subsidies). This results in a free trade outcome. However as each lobby pays to receive this outcome, the lobbies are (collectively) worse off than they would be if no groups made contributions to the government. The intuition for this can be understood by considering the nature of contributions. Grossman and Helpman note that preferences are locally truthful around the equilibrium – that is, the special interests will equate the marginal costs of changing policy to the marginal benefits which accrue from the policy favour. Thus, equilibrium contribution schedules accurately reveal the marginal preferences of a given lobby. When all opposing groups are represented, contributions convey to the government the preferences of all citizens, leading them to set the welfare maximising policy.[14] Setting such policies leads to the government incurring no political losses while still obtaining positive contributions. This implies that the government captures all of the gains which accrue from their interaction with fully representative, opposing interest groups. Interestingly, while full representation of all interest groups does not lead to policy distortions, it does effect a transfer of rents to the government.

By contrast, when only a single industry is represented, then the lobby compensates the government for the political loss associated with a deviation from the free trade outcome. That is, the government's welfare is exactly the same as it would have been had there been no lobbying. This implies that in this case, the lobby captures the full surplus from the relationship between itself and the government. Intuitively, a single lobby faces no opposition from competing

[14] This argument is also detailed in Persson and Tabellini (2000).

interests and thus wields considerable political power. The model thus predicts that protection will be greater when there are relatively few organised lobby groups.

The level of trade protection afforded to industry depends also on the characteristics of that particular sector. In general, the level of protection will be higher when:

i. The ratio of domestic output to trade volume is higher.

ii. Trade flows are unresponsive to changes in price levels.

The intuition for each result is as follows. Recall that the government trades off the welfare of its citizens with contributions from organised lobbies. If domestic output is large, the gains which accrue to the lobby groups representing such sectors are large. At the same time, because trade volume is relatively small, the welfare costs of protective policies are lower. This implies that the political power of lobby groups representing such industries is large and hence the level of protection will be higher. A similar argument also holds for the second result. For example, if import demand is relatively inelastic, the deadweight loss associated with (say) protective tariffs will be lower and as such, so will the political costs of providing protection to that industry.

There have been several useful extensions made to the Grossman and Helpman's (1994) model. Dixit (1996) adopts the basic structure of the model but considers the case where lobbies are able to offer separate conditional contribution schedules over domestic consumer and producer taxes (and subsidies). The model is used to test one of the major results from the theory of optimal commodity taxation. This general result suggests that where government can apply commodity

taxes or subsidies on all commodities, it is optimal to apply a consumer tax (subsidy) and preserve production efficiency.[15] His results suggest that this production efficiency is violated as lobby groups, intent on increasing their sector specific rents, succeed in influencing the government to subsidise their production.[16]

Grossman and Helpman (1995) and (1996) also extend their original model, and in doing so address several of its key criticisms. In the first of these papers they incorporate special interest politics into the analysis of bi-lateral international trade negotiation. In this setting, the governments of two large countries have the choice over whether to set trade policy in a cooperative manner (trade talks) or non-cooperatively (trade wars). Each country has active lobby groups who make policy contingent contributions to their home governments. In a 'trade war', each government sets its policy without regard for the impact on the other country. The equilibrium policy for each sector is determined by the level of political organisation, as was the case in Grossman and Helpman (1994), however a second component, which reflects the optimal level of protection given the large country assumption, also enters additively into the equilibrium policy. In contrast, equilibrium policy in 'trade talks' depends only on the relative bargaining power of sectorial interest groups in each of the two countries. Importantly, the collective welfare of the governments is greater in this type of equilibrium than it is under a 'trade war'. For any given country and sector, protection will be higher where

[15] This is discussed by Dixit (1996) p375-376. See also Diamond and Mirrlees (1971).
[16] This occurs because for special interests, who also consume the good in question, any increase in consumer surplus brought about by a drop in the domestic price is offset by a revenue loss. Where preferences of all agents are uniform, as in the case of Grossman and Helpman (1994), the optimal consumption tax is zero, leaving a production subsidy as the only instrument used.

domestic interests are powerful and foreign interests for the same sector are weak.[17] In the special case where the interests are evenly balanced, free trade will prevail.

As noted earlier in this chapter, the literature of lobby group influence is divided over the motivation for campaign giving. In the political competition approach, contributions are made specifically to influence the chances that a favoured candidate will gain power. In the political support and Grossman-Helpman approaches discussed so far, contributions are made solely to influence policy outcomes. In Grossman and Helpman (1996), a model is developed where *either* motivation for making contributions is permissible. In this model, rival political parties, who are assumed to maximise their representation in the legislature, have a set of pliable policies which they will adjust in return for contributions from the organised lobbies.[18] However, the contributions can be given contingent upon the policy chosen (influence motive) or unconditionally (electoral motive). These contributions are used by the political parties to sway a subset of voters who are rationally ignorant about policy issues.[19]

The results indicate that the influence motive always holds: lobby groups are always prepared to make contributions in return for more favourable policy outcomes. The electoral motive is shown to exist only under certain conditions. In particular, policies between the parties must be sufficiently divergent, the result of the political contest particularly sensitive to campaign spending, and the lobby must have a large stake in the policy issue (and thus gain substantially from influencing

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[17] In this context, political power is larger when: 1. the sector specific factor owners are relatively well organised, 2. the domestic government which is more malevolent towards the public interest, 3. the fraction of the population represented by the lobby is smaller, and 4. the price responsiveness of domestic demand or foreign supply is smaller.

[18] There are other policies which are not malleable. These may be policies which reflect prior promises or ideological preferences of the parties.

[19] Baron (1994) makes a similar distinction between informed and uniformed voters.

the election), relative to the stake of the electorate as a whole.[20] Where there are several lobby groups who support the same candidate (policy), only the group with the strongest preference for the party will make contributions over and above the influence motive.[21,22]

2.4 Empirical Support for the Grossman and Helpman Model

There are several papers which empirically investigate the validity of the predictions emanating from the Grossman and Helpman (1994).

Goldberg and Maggi (1997) investigate the pattern of protection afforded to firms in the US for the year 1983. They identify that in the Grossman and Helpman model, the relationship between the ratio of domestic output to imports and the level of protection will differ depending on whether the industry is organised. In particular, the relationship will be positive if the industry is organised and negative if not. Their results suggest organised industries receive higher levels of protection. Further, they find a positive relationship between the ratio of domestic output to imports and the level of protection for this group.[23] The exogenous weight attached to aggregate welfare by the government relative to contributions is estimated and

[20] An interesting aside is that policies are more likely to be divergent when the incumbent advantage, defined as a non-policy determined predisposition of voters toward the incumbent party, is large. This implies that where the parties are evenly matched, competition drives policies together and the electoral motive for making campaign contributions falls. However, a party with a large incumbent advantage does cater to special interests, thus generating more contributions by way of the influence motive. Of course, such a party can use these funds to spend on electoral campaigns.

[21] Consider a lobby who is prepared to contribute an amount greater than required under the influence motive. At the margin, the electorally motivated contribution will equate the marginal expected benefit with the marginal cost (equal to 1 for a monetary donation). For any group with a lower preference, this equality cannot hold and thus it will not find it worthwhile to make the contribution. Note however, that the contribution made by the first firm benefits all others who prefer the recipient party. Thus, the contribution has a public good aspect to it.

[22] The finding of a limited electoral motive is inconsistent with the commonly held beliefs of the media and many other groups. For example, The Center for Responsive Politics produces detailed data regarding campaign contributions. Its website offers visitors to "investigate the major players *trying to influence the outcome of the 2004 elections*", without direct reference to possible motives to influence policy.

[23] Though this result is not significant, the authors find a negative and significant association between the ratio of domestic output to imports and protection for unrepresented industries, thus suggesting a difference in the pattern of protection between organised and unorganised sectors.

found to fall within the range of 50-88. The data reveal that overall, protection levels in the US in 1983 were quite low. The authors attribute this result to both the high weight attached to aggregate welfare and the high degree of representation by lobby groups (i.e. opposing interests neutralise each other).

Goldberg and Maggi (1997) focus on the pattern of protection across industries, rather than the predictions from the Grossman-Helpman model regarding the behaviour of lobby groups. Gawande and Bandyopadhyay (2000), using US data for the same period, incorporate this aspect into their analysis. Again, the results suggest that for organised industries, the level of protection varies positively with the ratio of domestic output to imports and negatively with the absolute elasticity of import demand. The result is shown to be opposite for those industries which are unorganised. Consistent with Goldberg and Maggi (1997), they estimate a high value for the weight attached to aggregate welfare relative to contributions (3,175) which implies that the government values aggregate welfare net of contributions almost equally as contributions received from the lobby groups.[24] On the lobbying side, it is found that the level of contributions is rising with the deadweight loss incurred from protection. Specifically, it is shown that a doubling of the deadweight loss requires a 63.9% increase in lobby group contributions. This provides some evidence for the prediction that contributions must compensate the government for the costs associated with adopting policies which favour special interests.

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[24] The authors estimate the parameter a in the government's objective function: $G = S + aW$, where S represents lobby contributions and W total aggregate welfare. This is equivalent (see Grossman and Helpman (1994, p838)) to the government maximising $G = a_1 S + a_2 (W - S)$, where a_1 and a_2 are the weights given to contributions and net aggregate welfare respectively, and $a = a_2/(a_1 - a_2)$. Rearrangement yields $a_2 = \frac{a}{1+a} a_1$. Thus, $a_1 \rightarrow a_2$ as the value of a becomes very large.

Cadot, Grether and Olarreaga (2003) revisit the issue of estimating the weight ascribed to aggregate welfare by government. They note that the estimates of this weight obtained by Goldberg and Maggi (1997) and Gawande and Bandyopadhyay (2000) appear to be unrealistically high.[25] Using data for protection in India, they obtain an estimate of 5.1 for this weight, which is significantly lower than the previous estimates.

Mitra, Thomakos, and Ulabaşoğlu (2002) examine protection in Turkey over the period 1983-1990. This study has two important distinctive features over those which have thus far been presented. First, they examine the structure of protection in a developing country. The second major contribution is that by using time series data, the conditions under which the weight attached to aggregate welfare changes can be identified. Their results again provide broad support for the Grossman-Helpman model. Of particular interest is the finding that the weight attached to aggregate welfare is higher in times of democracy relative to those where a dictatorship was in place. This result is consistent with results obtained by Branstetter and Feenstra (1999), who attempt to explain province level variations in foreign direct investment and trade flows in China. They find that the weight attached to net aggregate welfare is between $1/5^{th}$ and $1/12^{th}$ that of the weight applied to state owned enterprises welfare (who benefit from trade and capital restrictions). However, in years of greater liberalisation in China, this relative weight increases to approximately one half.

McCalman (2004) uses data on trade protection in Australia in two periods, 1968/69 and 1991/92. Consistent with other empirical work examining the Grossman-Helpman model, the predicted relationships between import penetration

[25] The implausibility of such large estimates of the weight is also noted by Grossman and Helpman (2002).

ratios for organised and unorganised industries are shown to hold. More interesting, however, is McCalman's application of the model to explaining the process of trade liberalisation in Australia between the two periods. Two hypotheses are tested. First, it is argued that these changes may have arisen because of a change in government preferences. This is tested by estimating the weight given to aggregate welfare relative to contributions in each period. The second hypothesis is that increased representation among competing interests over the period possibly resulted in an equilibrium set of policies closer to the free trade level. The data provide only weak support for the first of these hypotheses with the weight in the latter period estimated as 43.41 compared with 40.88 in the first period, a difference which is found not to be significant. More robust support for the second argument is found, with a statistically significant increase in the proportion of the population represented by lobby groups between the two periods (0.96 in the 1991/92 compared with 0.88 in 1968/69).

2.5 Applications of the Grossman-Helpman Framework to Issues of Environmental Policy and Corruption

2.5.1 Environmental Policy

This thesis utilises and extends the Grossman-Helpman framework in order to analyse the problem of corruption and of environmental policy formation. Some previous applications of this model to similar problems are reviewed in this section.

The costs of environmental damage typically befall a large number of members in society, while the gains from polluting activities are generally concentrated among relatively few individuals. These polluting interests have an incentive to organise themselves politically and attempt to influence the level (and

type) of environmental controls enacted by government. Monetary contributions are commonly made by polluting interests. For example, data from The Center for Responsive Politics reveals the energy sector donated $US67.1 million and $US57.8 million in the 2000 and 2002 election cycles in the United States.[26] Environmental groups have accused this sector of attempting to buy influence over government policy.[27] Given the scope and significant costs of environmental damage, together with the evidence on contributions made by polluting interests, several studies have adopted the Grossman-Helpman framework to analyse the setting of environmental policy.

Fredriksson (1997a) considers small open economy where rival interest groups lobby over the level of a pollution tax, and allows for the presence of a pollution abatement subsidy. In this paper, Fredriksson seeks to examine the effect of a change in the terms of trade for the polluting industry on policy stringency, together with the interaction between abatement subsidies and environmental outcomes. It is shown that a fall in the world price of the polluting good may, in some circumstances, lead to a higher pollution tax. Intuitively, a fall in the world price will cause a contraction of domestic output. This lowers the incentive for polluters to lobby over environmental policy. At the same time, the marginal disutility suffered by the opposing environmental lobby, and thus their lobbying effort, remains unchanged. Effectively, a decrease in the world price changes the relative efforts of the opposing lobby groups in favour of those who desire more

[26] This sector comprises various polluting interests representing mining, oil and gas and electric utilities. See http://www.opensecrets.org/industries/indus.asp?Ind=E for details (accessed 19/1/04).
[27] Examples attributed include the Bush administrations exemption of CO_2 emissions from its Clear Skies Act, and its refusal to ratify the Kyoto Protocol (http://www.opensecrets.org/industries/background.asp?Ind=E) accessed 19/1/04.

stringent regulation, thereby inducing a higher pollution tax.[28] This demonstrates that any policy which lowers the world price can have two reinforcing effects on pollution. In particular, both the initial fall in the world price and the resultant increase in the pollution tax rate will serve to reduce output and hence pollution levels.

The model is also extended to show that the level of pollution may be increasing in the abatement subsidy.[29] Abatement subsidies, while decreasing the per unit emissions resulting from the production process, also lower both production and abatement costs, thus inducing an increase in output. This implies the gains for polluting interests associated with a reduction in the pollution tax are relatively large, inducing a greater lobbying effort. The resultant fall in the pollution tax, together with the expansionary effect of abatement subsidies, may increase pollution sufficiently so as to offset the beneficial effects of the abatement subsidy. While this result is common in the literature, the provision of a political explanation is novel.[30]

Fredriksson (1999) further explores the effects of trade liberalisation on lobbying incentives and environmental outcomes. In this model, the domestic supply function is convex and marginal damage is a function of abatement efforts. As a result, the marginal disutility of the environmental lobby is not constant (as is

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[28] This result turns on two assumptions. First, that the damage is linear in output, implying that marginal damage is an (exogenous) constant. Second that there is an inverse and linear relationship between the world price and domestic. The former assumption can be relaxed for a convex damage function provided the gains to polluting interests from a decrease in the tax rate exceed marginal damage for any level of output. The latter assumption may have an effect on the result, as shown in Fredriksson (1999).

[29] Fredriksson (1997b) shows that while the use of an abatement subsidy in the presence of a pollution tax is inefficient, it does form part of the equilibrium policy when groups are free to lobby over both instruments.

[30] It is generally argued that greater pollution levels arise as a result of increased entry into the industry where the abatement subsidy is applied. See Baumol and Oates (1988); Kohn (1992) (both cited in Fredriksson (1997a)).

the case in Fredriksson (1997a)). This in turn implies that a policy induced change in the world price will effect the lobbying incentives faced by all organised groups.

It is shown that when protection is reduced, lower output leads to a fall in the incentives to lobby faced by both environmental and polluting interests.[31,32] The effect on the equilibrium pollution tax is thus ambiguous. If lobbying efforts of the environmental group fall relative to those of polluting interests, the tax rate will fall (and vice versa). In the case where liberalisation does lead to a decrease in the pollution tax, total pollution may increase. The intuition for this is that a decrease in the tax rate increases per unit emissions. A lower tax also induces greater production, to some extent offsetting the initial contraction in output brought about by a change in the world price.[33] These effects may override the beneficial environmental effects of the contraction of output caused by trade liberalisation.

In Fredriksson (2001), opposing lobby groups make contributions to a regional government over abatement subsidies. At the same time, a pollution tax is imposed at the federal level. The lobbies have no ability to influence this tax. Thus, while Fredriksson (1999) analyses the environmental and political effects of an exogenous terms of trade shock, this paper considers a change in an exogenous component of environmental policy. The results reveal that an increase in the federally determined pollution tax may have the perverse effect of increasing pollution. The intuition is similar to the case of trade liberalisation: an increase in the pollution tax reduces output of the polluting firm and thus the lobbying

[31] The fall in output induced by a reduction in protection implies the industry has a comparative disadvantage. In the discussion which follows, the results are reversed if the polluter holds a comparative advantage.

[32] This yields an important result: trade liberalisation will decrease (increase) the level of political conflict between opposing groups when the liberalised industry holds a comparative disadvantage (advantage).

[33] Both of these effects are contingent on the responsiveness of the pollution tax to changes in the tariff being sufficiently large.

incentives for each special interest group. The relative shift in these lobbying efforts will determine the direction of the change in the regional abatement subsidy. If subsidies decrease (increase) in response to an increase in the pollution tax and abatement subsidies are pollution reducing (increasing), efforts by the central government to increase environmental policy stringency may actually generate greater levels of pollution.[34]

Aidt (1998) considers a setting whereby rival interests lobby over environmental stringency. The government is assumed to have two possible instruments at its disposal which can be used to combat a production externality. This first is an inefficient output tax, which is assumed to alter the firms use of the polluting factor. The second is a more efficient tax levied directly on the polluting input. The results show that lobby groups and the government show a preference for the tax directed towards the polluting input.[35] However, consistent with Grossman and Helpman (1994), when some groups are unrepresented, the input tax will be set below the socially optimal level. Intuitively, lobbying results in a transfer of wealth from those who are unrepresented toward the special interests. Conversely, total representation results in full internalisation of the externality, even when the government is completely malevolent.[36]

The choice of instrument available to the government is extended further in Schleich (1999), in which the government can choose between trade policy (taxes/subsidies on exports or imports) or environmental policies (consumption or

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[34] See the afore mentioned discussion of Fredriksson (1997a) regarding the possibility that an abatement subsidy will be pollution increasing.

[35] The model thus supports the common result that the most efficient instrument is used. See Bhagwati (1971), Pigou (1932).

[36] Aidt (1998) considers competition between lobby groups with multiple objectives (some members can have preferences against environmental damage while others do not) and between those where preferences among members are homogenous. The full internalisation of environmental damage may hold for either structure of lobby group membership, provided all of society is represented.

production taxes/subsidies). Accordingly, lobby groups can make contingent contributions over either type of policy.[37] In this model, an externality may arise on the production or consumption side. Environmental outcomes are shown to differ depending on the source of the externality. In the case of a consumption externality, full internalisation will occur. In particular, when trade and domestic policies are both available, polluting (domestic) interests receive trade protection (i.e. receive higher prices for their output). At the same time, consumption policies are used to address the externality. Thus, producers are protected, but the overall level of pollution is socially optimal. In essence, through the use of these different policies, the government is able to satisfy the demands of the industry lobby group while still correcting for environmental damage. In the case of a production externality, a production tax is the most efficient instrument by which to reduce pollution. However, polluting interest demands are most efficiently satisfied by using a production subsidy. When these interests are strong, it is shown that trade policies may yield better environmental outcomes.[38] Intuitively, if polluters are successful in gaining policy concessions, the trade policy introduces consumption distortions which have a dampening effect on pollution, whereas a production subsidy does not. This result, which allows for the effects of lobbying, can be contrasted to the standard Pigouvian result that the instrument which attacks the source of the externality directly is the most efficient.

Revisiting the work of Hillman (1982) discussed earlier, Damania (2002b) considers a declining industry whose output generates environmental damage. The

[37] As in Aidt (1998), the lobby groups can have multiple objectives, i.e. some members may suffer from environmental damage and this is taken into account when the lobby formulates its contribution schedule.

[38] Polluting interests are considered to be strong if the government places a low weight on welfare, a small proportion of the population engage in lobbying, or marginal environmental damage from production is low.

results suggest that declining industry may have a stronger incentive to lobby the government in order to protect profits. A necessary requirement for this result is that the government must be sufficiently responsive to lobbying efforts. It is shown, however, that the government will always be more responsive to declining industries. Specifically, the fall in price (profits) which characterises a declining industry creates a credible threat to the government of reduced political contributions. To counter this, the government becomes responsive to contributions from this industry. As such, the marginal product of contributions for this group increases, raising the incentive to lobby. The clear implication is that protection will be provided even when an industry is in decline. Unlike Hillman (1992), protection is offered not because the government ascribes a sufficiently high (exogenous) political weight to the industry, but because it wants to maintain the level of political contributions.

2.5.2 Corruption

In most countries, legally sanctioned political contributions are made to political parties. Under what circumstances can these be considered as a form of corruption? Generally speaking, such payments are considered to be corrupt when they are made in a clandestine manner, or are given in return for policy favours.[39] The payments made by special interests in the Grossman-Helpman framework, which are contingent on the policy chosen, clearly constitute corruption under the second of these criteria. It is therefore somewhat surprising that there are few papers which directly treat payments as bribes.

[39] For more on the distinction between legally sanctioned acts of rent seeking and corruption, see Jain (2001, p 78).

Analysing the phenomenon of policy persistence, Coate and Morris (1999) consider an incumbent government which is prepared to return policy favours in return for bribes, however it is constrained by the future voting behaviour of a representative consumer. It is shown that granting a subsidy to a given sector increases its willingness to pay bribes in order to have the policy maintained in future periods. An interesting interpretation of this is that bribery may become entrenched in the political system. This issue is explored more deeply by Damania, Fredriksson, and Mani (2004) who incorporate the problem of stratified corruption into their model. A polluting firm is assumed to attempt to reduce the costs of environmental policy by bribing politicians over environmental policy stringency and judicial efficacy, or by making payments to an environmental inspector to under-report its emissions. The focus of the model is the effect political instability has on each level of corruption. Under the key assumptions that the judicial system is slower to change than the pollution tax, and that the incumbent attaches a lower weight to aggregate welfare than the rival waiting to take power (implying the latter sets more stringent environmental regulation), the model makes some strong predictions regarding the persistence of corruption in highly unstable regimes. Specifically, political instability implies that the rival party is more likely to gain power. The firm thus lobbies the current government to ensure that its rival inherits a weak judiciary. The firm is thus able to evade the rival's more stringent policy by bribing the inspector in an environment where the chances of conviction are low. The authors find empirical support for the findings of this model.

Finally, applying the Grossman-Helpman framework to the problem of corruption, Fredriksson and Svensson (2003) consider the interaction between political instability and environmental policy under varying degrees of corruption.

The exogenous weight which the government places on aggregate welfare relative to bribes received from the firm is used as a natural indicator of the extent to which the regime is corrupt. The effect of political instability on environmental policy is shown to turn on two effects. The first is a *welfare effect* under which greater instability leads the incumbent to abandon the public interest, and adopt less stringent policy. At the same time, the higher probability of government turnover makes polluting interests less likely to offer bribes to the incumbent. This *bribery effect* applies upward pressure on the stringency of environmental policy. It is shown that when a regime is very corrupt (low weight attached to aggregate welfare), it is the second effect which dominates and thus environmental stringency may increase with greater political instability, while regimes in which corruption is low follow the opposite path. Using cross-country data on environmental policy stringency, Fredriksson and Svensson (2003) find support for this result.

Chapter 3:

Corruption, Political Competition and Environmental Policy

3.1 Introduction

The phenomenon of corruption, defined by Bardhan (1997) as the 'use of public office for private gain' has been receiving increased attention in the literature. Corruption has been associated with lower economic growth (Mauro (1995); World Bank, (1997); Rose-Ackerman (1999); Easterly and Levine (1997)), lower foreign investment (Wei, 1997) and is claimed to dilute the intended effects of economic policies (Rose-Ackerman, 1978).

In an environmental context, a growing body of evidence suggests that corruption is one of the major causes of environmental degradation in developing countries. The large rents associated with resource extraction can be used to evade environmental regulations in a number of ways, with significant economic and environmental costs (World Bank, 1997). For instance, the surpluses can be used to influence policies through the payment of political contributions to policy makers (Ascher 1999). Alternatively, environmental regulations can be evaded by paying bribes to lower level bureaucrats who are responsible for administering policies (Desai 1998).

It has long been recognised that corruption may occur at different levels of government. Rose Ackerman (1978) identifies two major types of corruption. The first exists in the relationship between citizens and elected officials and typically results in policy distortions. The second involves corruption in the bureaucracy where bribes can dilute the intended effects of policy. Examples of these types of corruption abound in the environmental arena. For instance, in an examination of

illegal activities in the forestry sectors of developing and transition economies, Callister (1999) provides evidence of political parties granting harvesting concessions in return for payments from logging interests. In Indonesia, licences to conduct environmentally damaging activities were typically granted to interests supportive of the Suharto regime, resulting in significant environmental degradation (Renner (2002); Winbourne (2002)).[40] In Liberia, Charles Taylor's regime has been accused of actively assisting those involved in illegal logging in order to capture a share of revenues estimated at $US100 million (Hayman and Brack, 2002).

Examples of widespread bureaucratic corruption are also common. In the forestry sector for example, falsifying harvesting records to exclude protected species, under-reporting harvesting volumes, and facilitating illegal transportation of timber have all contributed to the depletion of the worlds forests.[41] In 2002, for example, the proportion of harvests taken illegally in Brazil and Cambodia were 80 and 90 percent respectively. In the same year the volume of the illegal timber harvest in Russia was estimated to be approximately 716,000 cubic metres (Guertin, 2003). The World Bank (2002a) estimate that the global value of resources lost from public lands as a result of these illegal activities range between $US10 and $US15 billion per annum.

Despite the economic significance of this problem, the existing environmental policy literature has neglected the implications of stratified corruption, and focused mainly upon the economic and environmental consequences

[40] Lippe (1999) notes that two companies responsible for providing Jakarta's water supply were given policy concessions totalling 1.4 billion US dollars by the Suharto regime. As a result of this, residents of the city were forced to pay higher prices for clean water and other environmental goals were compromised.

[41] Illegal harvesting of natural resources is of course not restricted to woodlands. For example, the trade in tigers has taken the species to the brink of extinction (Damania, 2003). A decline in African elephant populations has resulted from illegal trade in ivory, despite a quota system being established in 1989 (Hayman and Brack, 2002).

of bribes paid to policy makers (Fredriksson (1997a), Fredriksson and Svensson (2003); Aidt (1998); Schleich (1999)). One exception is a recent contribution by Damania, Fredriksson and Mani (2004), who consider the persistence of corruption. Their model examines the link between political instability and corruption, which occurs at two levels: the bribing of politicians to influence the setting of environmental and anti-corruption policies, and the bribing of lower-level bureaucrats to avoid the consequences of environmental policy. An important assumption in the model is that the enforcement mechanisms are slow to change, and hence any efforts to increase their efficiency only yield benefits in later periods. It is shown that in politically unstable regimes, corruption is not only greater but is also more persistent. In particular, faced with a high (exogenous) probability of losing power, the incumbent government has little incentive to consider the future welfare effects of its current policies and thus by implication, places a relatively high weight on immediate political contributions. These contributions are offered in return for policy favours, one of which includes the continued persistence with an inefficient enforcement regime. In turn, this weak enforcement infrastructure is inherited by the incoming government, restricting its short run ability to implement policies aimed at reducing corruption.

This paper also recognises the stratified nature of corruption. Unlike Damania, Fredriksson and Mani (2004) we consider the competitiveness of the political system rather than political instability. In particular, this paper models the process as a competitive game between two political parties rather than considering an exogenous changeover probability. This political struggle is in part settled by the policies of each party. At the same time, these policies are influenced by bribes

paid by polluting interests. This allows for a potential interaction between corruption and the political process itself.

The hypothesised link between the competitiveness of the political system and corruption has been typically uncritically accepted in the literature (Jain, (2001); Rose-Ackerman (1999); Johnston (1999); World Bank (1997)). There are numerous empirical studies of this hypothesised relationship. For example, using cross country data, Lederman *et al.* (2001) show that countries with more democratic governments have lower levels of corruption. Pritchett and Kaufmann (1998) show that lower levels of civil liberties and democracy result in greater failure rates in government run projects, citing corruption as a major contributing factor. Similarly, Deacon (2003) argues that corruption in autocratic regimes is partially responsible for an under-provision of public goods relative to their more democratic counterparts. Persson, Tabellini, and Trebbi (2003) use the size of voting districts to proxy for the level of political competition, hypothesising that larger districts imply lower barriers to entry. Using Transparency International data on cross-country corruption, they find that countries with greater political competition have lower levels of corruption. Further empirical evidence of the negative relationship between political competition and corruption is found in Treisman (2000), Sandholtz and Koetzle (2000), Mocan (2004) and Hellman, Jones and Kaufmann (2000). Of these, Treisman (2000) and Mocan (2004) identify that democracy may take time to have an effect on corruption.[42] Despite the prevalence of empirical work of this type, there has been very little formal modelling to

[42] The other studies mentioned find that *current* levels of democracy influence corruption levels. The study by Sandholtz and Koetzle (2000) finds evidence for both the long and short run relationships. Hellman *et al.* (2000) find a non-linear relationship whereby the extent of reform to civil liberties is crucial in reducing corruption. These empirical studies are discussed in greater length in Chapter 4.

support the hypothesised relationship, in particular, in the context of stratified corruption.[43] The aim of this chapter is to explore this issue in greater detail.

In the model, we adopt the definitions proposed by the World Bank (1997), and distinguish between "grand" and "petty" corruption. The former is defined as an attempt to influence the setting of policy by making payments to politicians, while the latter reflects payments made in an attempt to avoid the consequences of a given policy. It is clear that grand corruption will impinge on the setting of policy, while petty corruption will determine the level of compliance. Both issues are important when evaluating the effectiveness of environmental policy.

We consider a polluting firm which can adopt one or both of the following strategies to minimise the costs associated with environmental policy. First, it can make contributions to political parties in return for more favourable policy outcomes (grand corruption). A second strategy is to avoid compliance with policy by bribing an inspector to under-report emission levels (petty corruption). We evaluate the effects of political competition on environmental and policy outcomes, and examine its role in the elimination of petty and grand corruption

Our results suggest that increasing political competition will yield more stringent policy and better environmental outcomes. In addition, political competition may lead to lower levels of petty corruption, however this is not assured. In particular, if enforcement mechanisms and judicial institutions are weak, rather than promoting less petty corruption, a more competitive political system induces an increase in both non-compliance and the bribe paid to downstream bureaucrats. We also find that even under intense political competition, grand corruption may persist. Interestingly, this occurs when the

[43] The aforementioned work of Damania, Fredriksson and Mani (2004) is possibly the only example of this.

welfare cost of environmental damage is sufficiently high. Rival parties can minimise the political costs of deviating from the welfare maximising policy by allowing their policies to converge. Policy convergence thus insulates rival parties from the effects of political competition.

This explanation for convergence differs from the existing literature. In particular, under the 'median voter theorem', parties move from their more favoured policy positions in order to gain the support of a greater share of moderate voters.[44] Thus, convergence occurs from a desire of the parties to maximise their political support. In this paper, policy convergence allows the parties to sell policy favours at the expense of the general public without fear of political retribution. This explanation is to the best of our knowledge, new to the literature.

These results are arguably of considerable policy significance, particularly in the formation of global reform programs designed to combat corruption. Corruption is usually defined as the *"use of public office for private gain"* (Bardhan, 1997). Our analysis suggests the need for a more precise definition of corruption that takes account of the economic effects of bribery. Since political competition may lead to both policy improvements and higher bribes being paid, the results suggest that there is no necessary relationship between the level of bribery (i.e. the degree of rent extraction, or abuse of public office for private gain) and the resulting economic distortions. Depending on the level of political competition, corruption may simply lead to a transfer of rents, rather than policy distortions. This finding has implications for the way in which corruption is defined and measured by organisations such as the World Bank and Transparency International, which focus on subjective measures of the amount of money paid in bribes.

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[44] For example, see Downs (1957).

The results are also instructive for the formulation of effective anti-corruption strategies. There is growing recognition in the policy literature of the need to distinguish between different forms of corruption.[45] As the composition of corruption may vary between countries, the development of well targeted anti-corruption policies requires an understanding of the determinants of, and relationships which exist, between each type of corruption.[46] Our results suggest that when judicial institutions are weak, an increase in political competition will provide incentives for agents to switch resources from grand to petty corruption. Such a switch does not necessarily entail a reduction in overall corruption levels, suggesting the need for simultaneous reform of the political system and enforcement infrastructure.

This paper combines elements from two distinct strands of literature: environmental policy models of grand corruption and principal-agent models of administrative corruption. The grand corruption component of the model is most closely related to the work of Fredriksson (1997a), Fredriksson and Svensson (2003), and Aidt (1998), which were discussed in chapter 2. The model presented here extends upon these studies, which have their origins in Grossman and Helpman (1994) in two important ways. First, we explore the possibility that political competition acts to constrain the corrupt behaviour of policy makers and second, the model endogenises the weight that policy makers place upon social welfare when determining optimal policies.

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[45] For example, in their analysis of transition economies, Hellman, Jones and Kaufmann (2000) find that the adverse effects of grand corruption (state capture) on investment are greater than those of petty corruption and that the causes of each may differ. This study is one of the few which attempts to differentiate the effects of various types of corruption. Most empirical work has tended to use aggregate' measures of corruption such as those derived by Transparency International (see for example Treisman (2000), Ades and DiTella (1999)).

[46] In fact, a discussion of stratified corruption can be traced back to early work by Rose Ackerman (1978) who identifies several different forms of corruption, including those considered as 'grand' and 'petty' in this paper.

Modelling of petty corruption takes the form of a principal-agent model. This type of model has its origins in the literature on tax evasion and thus focuses on the interaction between taxpayers and tax collectors. Several of these studies centre around the design of optimal enforcement schemes, in particular auditing regimes which maximise revenue for the tax collector. For example, Reinganum and Wilde (1985) contrast 'random' and 'cut-off' audit schemes. The former, as suggested by its name, implies that every taxpayer is audited with some exogenous probability. The second scheme acknowledges that when reported income is low, it conveys information to the tax collector to the effect that she believes it more likely that income has been misrepresented. In a 'cutoff' auditing regime, all tax payers under a certain threshold income are audited with certainty. Conversely, those who report income greater than this threshold are never audited. This type of auditing is shown to always dominate a random audit and can induce truthful reporting. Border and Sobel (1995) also show that it is optimal for audit probabilities to fall as reported income is larger. An audit rule consistent with these studies is used in this paper.

Mookherjee and Png (1995) consider the case of a polluting firm who is able to bribe bureaucrat to under-report pollution levels in order to evade environmental policy. Their results reveal that increasing the penalty on the bribe taker (bureaucrat) will lead to higher equilibrium bribes being paid and may result in higher pollution levels. Further, increasing the returns (percentage of collected revenues) paid to the inspector will generate more intense monitoring and thus lower pollution. However, a reduction in corruption is not assured as the polluting firm may simply offer a larger bribe to the inspector (given that a higher wage

implies a greater penalty if caught). Finally, for any given situation, it is demonstrated that the elimination of corruption will enhance welfare.

Damania (2002a) uses a similar framework to identify the optimal level of policy stringency and enforcement. The results show that more stringent environmental policy increases the incentive to under-report pollution levels. Consistent with Border and Sobel (1987), lower levels of reported pollution induces an increase in auditing efforts. However, as auditing is costly, the government's optimal policy must equalise the marginal benefits of environmental policy stringency with the marginal costs of its auditing policy. This leads to an equilibrium policy which differs from the Pigouvian level. It is shown that the optimal design involves an emissions tax which is increasing and concave in emissions and an audit rate which is decreasing and convex in reported emissions.[47]

The remainder of this paper is organised as follows: section 3.2 provides an overview of the model and derives the equilibrium properties. Section 3.3, examines the effects of political competition on bribes, policies and compliance levels. Section 3.4 provides some concluding remarks and discussion.

3.2 The Model

We present a model in which a polluting firm seeks to evade regulations either by bribing politicians who determine policies (i.e. grand corruption), and/or bribing bureaucrats who administer policies (i.e. petty corruption). For simplicity we focus on the case of a single firm that discharges pollution, which is controlled

[47] This has an interesting implication when considering income tax and tax evasion. Chander and Wilde (1992) also advocate an increasing and concave tax function in order to deter under-reporting of income. This introduces the possibility of regressive taxes as a means to reduce tax evasion, something which the authors note as "something which could not be advocated or voted for in a democratic society" (p20).

through an emissions tax.[48] The analysis is based on the following sequence of events.

There are two political parties i and j who compete for power. In the first stage the polluting firm simultaneously offers each political party a bribe, or contribution schedule. This consists of a continuous function that maps every policy vector that each party might choose into a specific political contribution or bribe. In stage 2 given knowledge of the firm's contribution schedule offered to it, each party announces its optimal policies. Once policies have been announced, an election or political struggle occurs, and the winner of the political struggle implements the announced policy vector. Finally, given knowledge of the policy settings, the firm and an inspector who administers the tax, interact and bargain over the level of compliance and the bribe that will be paid.

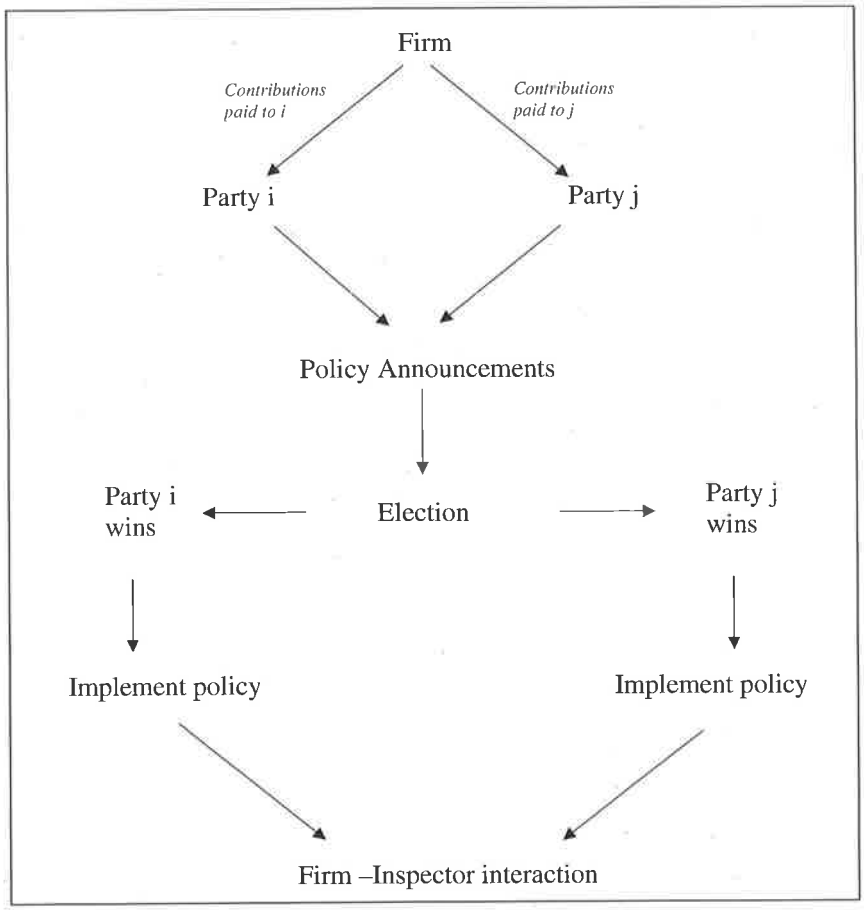
Figure 3.1 provides an overview of the game and the sequence of events. The model is solved by backwards induction, hence we begin by describing the firm inspector interaction.

3.2.1 The Firm – Inspector Interaction

Consider a firm (f) which as a result of its production process, discharges emissions *(e)*. For simplicity, we assume that there is no pollution abatement and adopt the normalization that one unit of output generates a single unit of emissions. Emissions result in environmental damage $D(e)$, with $D'>0$ and $D''>0$. Production costs are assumed to be zero.

[48] While the results here hold for any form of environmental regulation, we use an emissions tax for reasons of simplicity.

Figure 3.1 Overview of the Game



To combat the problem of environmental damage, the government can levy a tax *(t)* on each unit of emissions. An informational asymmetry exists such that the government must rely on the services of an inspector *(m)* to report pollution levels. In return for a fixed wage *(w)*, the inspector reports the level of emissions of the firm to the government.[49] The tax is thus levied on the level of emissions *reported* by the inspector.

[49] While the assumption of a fixed wage is realistic, it is well known that more honest reporting can be induced by paying efficiency wages. However, the payment of an efficiency wage typically triggers strong incentives for bureaucrats to engage in extortion and this perhaps explains why efficiency wages are seldom used in the real world. Moreover, Hindriks, Keen and Muthoo (1999) examine the problem of tax collection and corruption and show that corruption can be minimised by paying inspectors a fixed wage and imposing penalties proportional to the extent of misreporting. We follow this approach.

In order to reduce its tax burden, the firm may offer a bribe (B), to the inspector to induce a report of emission levels $\hat{e} \leq e$. This form of bribery is referred to as 'petty' corruption. The level of under-reporting is defined by $v \equiv (e - \hat{e}),\ \hat{e} \leq e$.[50]

The government can commission an audit to deter non-compliance. The probability of being audited is given as $\sigma(\hat{e}), \sigma \in (0,1)$, with, $\sigma' < 0, \sigma'' > 0$, which implies that the probability of being audited is ceteris paribus higher (lower) when the level of reported emissions is lower (higher). This audit rule is consistent with previous literature which demonstrates that the optimal audit frequency is declining in the report (see for example, Erard and Feinstein (1994), Border and Sobel (1995), Heyes (2001), Damania (2002a)).[51] With probability, η the audit uncovers the actual level of emissions and leads to a successful prosecution of both the firm and the inspector. The parameter η captures two practical problems associated with the enforcement of environmental regulation: the ability of the policy maker to detect cheating and the ability of the legal system to convict guilty offenders (i.e. the efficiency of the judiciary). Both are of relevance, especially in developing countries, where evidence of polluting activities is often difficult to obtain (for example, due to the activity being undertaken in a remote location) and where the judicial infrastructure is weak and underdeveloped.

A possible complication is that of corruption further up the administrative or judicial hierarchy. This issue has been studied by Basu *et al.* (1992) and Sanyal

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[50] For simplicity, we exclude the possibility that the level of reported emissions could be higher than actual emissions ($\hat{e}>e$). This implies that if required, the firm can provide incontrovertible evidence of emission levels, thus precluding extortion by the inspector.

[51] Our use of this rule is similar in spirit to earlier work by Heyes (2001) in which an initial inspection of a firm reveals a noisy signal regarding its pollution levels. Where this signal exceeds a certain threshold, a more thorough audit is triggered. In our model, a low level of reported emissions acts as a trigger for a higher probability of receiving an audit.

(2002), who show that hierarchical corruption alters the equilibrium parameters over which bribery occurs but does not alter the qualitative features captured by the simpler model used in this paper. Hence, the effects of hierarchical corruption are ignored in this analysis.

Since the focus of the analysis is on the short run, for simplicity it is assumed that η is fixed. In the longer term it is likely that an efficient and competitive political system will trigger improvements in the judicial system. The assumption of a fixed η is also consistent with recent experience in transition economies such as Russia. Empirical work by Treisman (2000) suggests that it may take 20 years of uninterrupted democracy to reduce corruption, a lag which may reflect institutional rigidities.[52]

The expected probability of a conviction is thus defined by: $\lambda(\hat{e}) = \sigma(\hat{e})\eta$. The expected fine payable is: $E\left(F^g\right) = \lambda\left(\hat{e}\right) h\left(\theta^g, v\right)$, $g = f, m$, where h is the penalty imposed on agent $g = f, m$, which depends upon the marginal fine $\left(\theta^g\right)$ and the level of non-compliance, $\left(v = e - \hat{e}\right)$. It is assumed that $\partial h/\partial\theta > 0$, $\partial^2 h/\partial\theta^2 > 0$; $\partial h/\partial v > 0$, $\partial^2 h/\partial v^2 > 0$. The latter assumption implies that the penalty is increasing in the degree of non-compliance (i.e. 'the punishment fits the crime').

We begin by establishing the equilibrium bribe and reported level of emissions. In considering its prospective bribe, the firm must consider the benefits from reducing its tax burden and the expected costs of non-compliance. Let gross

[52] For supporting anecdotal accounts see Gonzalez (1999), Hammergren (2002). and Varese (1997), Varese notes the case of a British based firm who filed a complaint with the Russian Court of Arbitration alleging that a share register of a major Russian company had been tampered with. In a media interview, the vice president of this court stated: '*This share business is too complicated for us. We do not understand it. We have no laws to deal with it. Our laws do not deal with these new questions. We are paralysed*' (p584).

profits when a bribe is paid be given by $\pi(e) = P(e)e$, where $P(e)$ is the price of the good and $P'<0$, $P''<0$.[53] Further, let B be the bribe paid to the inspector, and $\hat{e}$ be the resulting reported emissions level. The emission tax paid by the firm on reported emissions is $t\hat{e}$. It follows that the payoffs to the firm from corrupt behaviour are given by: $\pi(e)-\left(B+t\hat{e}+\lambda h^f(\theta^f,v)\right)$. On the other hand, if the firm complies with regulations and correctly reports emissions, gross profits are given by $\pi(e^c) = P(e^c)e^c$ and the payoffs from compliance are: $\pi(e^c) - te^c$, where superscript c denotes compliance with the regulation and hence honest reporting. Thus the expected gains to the firm from bribery are:[54]

$$\Psi^f = \left[\pi(e)-\left(B+t\hat{e}+\lambda h^f(\theta^f,v)\right)\right]-\left[\pi\left(e^c\right)-t\left(e^c\right)\right] \qquad (1a)$$

The inspector faces a similar trade off. The payoffs from accepting a bribe are: $\left[w+B-\lambda h^m\left(\theta^m,v\right)\right]$. Hence the expected gains from bribery are:

$$\Psi^m = \left[w+B-\lambda h^m\left(\theta^m,v\right)\right]-w \qquad (1b)$$

where $h^m(\theta^m,v)$ is the penalty imposed on a corrupt inspector who is convicted.

Taking the tax and penalty rates as given, reported and actual emissions are chosen to maximise the expected joint payoffs from the bribe:

$$\underset{\hat{e},e}{Max}\ J \equiv \left(\Psi^f+\Psi^m\right) \qquad (2)$$

The first order conditions are:

$$\frac{\partial J}{\partial \hat{e}} = -t+\lambda\frac{\partial h^T(\theta,v)}{\partial v}-\eta\frac{\partial \sigma}{\partial \hat{e}}h^T(\theta,v)=0 \qquad (3a)$$

---

[53] Notice that production and abatement costs are ignored and one unit of output results in one unit of emissions. Hence e may simply be interpreted as the level of output (which is equivalent to the level of pollution). Hence profits gross of fines, bribes and taxes are simply defined by total revenue which is $P(e)e$. The introduction of (convex) costs complicates the algebra without adding any analytical insights.

[54] For notational brevity, the arguments of λ are ignored.

$$\frac{\partial J}{\partial e}=\frac{\partial \pi(e)}{\partial e}-\lambda\frac{\partial h^T(\theta,v)}{\partial v}=0 \qquad (3b)$$

where $h^T = h^f + h^m$. Note that equation (3a) specifies that in equilibrium, reported emissions are set such that the marginal cost of compliance (i.e. the marginal rate of tax) is equated to the marginal expected cost of non-compliance (i.e. the expected marginal fine). By equation (3b) actual emissions are determined by equating marginal revenue from production with the marginal expected penalty.

The equilibrium bribe is determined by a Nash bargain between the firm and the inspector, where both are assumed to have equal bargaining power. This assumption is made for simplicity. Under-reporting can be sustained in the model provided both parties can gain from the interaction. In the event that bargaining powers are different, the distribution of rents will differ, and the party with the stronger bargaining power will capture a greater share of the rents from bribery. With equal bargaining power, the firm and the inspector share equally the benefits from corruption.[55] The bribe is determined by the following Nash bargain,

$$\max_B\left(\Psi^f\Psi^m\right) \qquad (4)$$

Using (1a) and (1b), the equilibrium bribe is given as:

$$B=\frac{1}{2}\left[\pi(e)-\pi\left(e^c\right)+t\left(e^c-\hat{e}\right)-\lambda\left(h^f\left(\theta^f,v\right)-h^m\left(\theta^m,v\right)\right)\right] \qquad (5)$$

To ensure that higher fines always reduce the equilibrium bribe, the following regularity condition is adopted: $h^f > h^m$. This assumption requires that penalties on the bribe giver are more severe than those on the recipient.[56,57]

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[55] Formally, asymmetric bargaining power could be modelled using $\max_B\left(\Psi_f^a\Psi_m^{1-a}\right)$ where a and $(1-a)$ represent the respective bargaining powers of the firm and inspector.

[56] To see why this is necessary note that an increase in the marginal fine on the inspector may increase the level of the bribe. To see this, consider the case where the marginal fine increases and

Appendix A.1 details some useful properties of the firm-inspector interaction. Several of the key results are discussed below:

Property 2: $\frac{de}{dt} < 0$

Property 5: $\frac{de}{d\theta} < 0$

Property 8: $\frac{de}{d\eta} < 0$

These properties reveal that emissions are decreasing in the emissions tax, marginal fines and the prosecution rate. Intuitively, stricter environmental regulation, greater penalties for evasion and an increased probability of being prosecuted all raise the costs associated with polluting. As such, the firm adjusts its emission levels accordingly.

Property 3: $\frac{dv}{dt} > 0$

Property 6: $\frac{dv}{d\theta} < 0$

Property 9: $\frac{dv}{d\eta} < 0$

Properties 6 and 9 reveal that the level of under-reporting falls when enforcement becomes stricter. Intuitively, when penalties and the chances of being successfully prosecuted are high, the gains from under-reporting fall. Property 3 reveals that under-reporting increases when environmental policy becomes more stringent. A higher emissions tax imposes greater costs on the firm and *ceteris paribus*, the gains

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$\partial h^f / \partial \theta^f < \partial h^m / \partial \theta^m$. Provided (1a) remains positive, the firm will simply offer a larger bribe to the inspector in order to compensate her for the greater expected loss.

[57] For simplicity, it has been assumed that the gains from petty corruption are shared equally between the inspector and the firm. This assumption is made for simplicity and does not alter any of the main results. Bardhan (1997) notes that most gains typically fall to the bribe giver (p. 1326-27). This further justifies the assumption of more severe penalties being imposed on the firm.

from evasion are greater. Note that combined with Property 2, this suggests that more stringent environmental regulation will increase petty corruption, but still result in lower emission levels.

3.2.2 *The Political Equilibrium*

Having examined the firm-inspector outcome, attention is now turned to the political equilibrium. There are two political parties i and j who compete for political power. Consistent with Grossman and Helpman (1994), Aidt (1998) and Fredriksson (1997a), the firm lobbies policy makers in each party by offering political contributions (or bribes) that are contingent upon announced policies. In contrast to previous work, our lobbying model incorporates political competition and also allows the firm to lobby both parties in the electoral contest.[58]

Politicians value the political contributions received from lobby groups and the rewards of winning power. *Ceteris paribus*, the probability that a party wins the political contest is increasing in the level of welfare that voters expect to receive from the party's announced policies. Accordingly the level of aggregate welfare is defined as the sum of all agents utility in the model:[59]

$$W = \int_0^e P de - D(e) - C(\theta) \qquad (6)$$

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[58] These features represent an extension of the standard common agency model of environmental lobbying (see, e.g. Fredriksson (1997a)).

[59] Aggregate welfare is the sum of consumer surplus $\left(\int_0^e P(e)de - P(e)e \right)$, the firm's profits *((P(e)-te)*, the government's revenue from the tax, the cost of imposing fines *(C(θ))* and environmental damage *(D(e))*. Taxes and contributions paid by the firm are received by the government, the wage received by the inspector is paid by the government and the firm pays bribes received by the inspector. These obviously cancel out in aggregate. Aggregate welfare is increasing in both the tax and the marginal fine.

where $C(\theta)$ represents the costs of administering the penalty and judicial regime with $C'>0$ and $C''>0$ and $D(e)$is environmental damage which is increasing and convex in emissions $(D'>0, D''>0)$.

Let $\rho(W^i, W^j) \in (0,1)$ be the policy dependent level of support for party i. The following reasonable assumptions are made, which are consistent with the literature on political competition: $\frac{\partial \rho}{\partial W^i} > 0$, $\frac{\partial^2 \rho}{\partial W^{i2}} < 0$, $\frac{\partial \rho}{\partial W^j} < 0$, $\frac{\partial^2 \rho}{\partial W^{j2}} > 0$, $\frac{\partial^2 \rho}{\partial W^i W^j} \leq 0$.[60] These assumptions imply that support for party i increases when it announces welfare improving policies, and decreases when its rival does the same. Concavity of ρ in W^i (and convexity in W^j) captures the idea of diminishing marginal political returns to welfare enhancing policies.

We further allow for the possibility that the political contest may be influenced by possible ideological bias. Without loss, assume that voters have a preference for party i which is captured by a parameter $\alpha \in [0, 1]$.[61] The probability that party i wins the political struggle is thus given by: $\Omega \equiv \left(\alpha + (1-\alpha)\rho(W^i, W^j)\right)$.[62] Similarly, the probability that party j wins the election is: $(1-\Omega) = \left[1 - \left(\alpha + (1-\alpha)\rho(W^i, W^j)\right)\right]$. Thus, the probability of electoral success of each party is to some degree determined by the welfare implications of their policies. The policy dependent level of support for party i is given by

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[60] There is a significant literature regarding the nature of political competition (see for example: Downs (1957), Romer (1975), Roemer (2002), Johnson (1988), Grofman (1993)). In this paper, the exact details of the political struggle are not explicitly modelled.

[61] Grossman and Helpman (1996) also model political bias in a similar manner.

[62] In this model ideological bias is used to measure a party's ability to avoid the political effect of its policies. For example, it may measure incumbency bias, ethnic preferences, or the effectiveness of a party in preventing certain groups from voting, or the ability to rig an election outcome. Moreover, for any $\alpha>0$, the incumbent has some political advantage and is thus distinguished from its rival. Such heterogeneity between parties implies that lobbying interests may prefer one party over the other. As such, this structure addresses some of the concerns expressed by Dijikstra (2004).

$\rho(W^i, W^j) \in (0,1)$. However, this is tempered by the ideological bias for party i ($\alpha \in (0,1)$). A high bias in favour of party i has the effect of lowering the importance of gaining political support by adopting welfare enhancing policies.

Recall the sequence of events in the model. First, the firm makes policy contingent contributions to both political parties. Following this, the parties announce their tax and penalty rate to maximise expected utility. After the announcement of policies, an election occurs. It is assumed that the victor of the political struggle faithfully implements its policies. Each political party announces an emission tax policy ($t^k, k = i, j$) and penalty policy ($\theta^k, k = i, j$) to maximise expected utility.[63] The expected utility to each party from winning office is:

$$G^i = \Omega R + S^i\left(t^i, \theta^i\right) \qquad (7a)$$

$$G^j = [1-\Omega]R + S^j(t^j, \theta^j) \qquad (7b)$$

where R denotes the exogenous returns to being in office. $S^k(t^k, \theta^k)$ are the contributions received from the firm by party $k = i, j$, which are contingent upon the announced policies $\Phi^k = t^k, \theta^k$.[64] Thus, the weight apportioned to general welfare relative to contributions will be determined by Ω which captures the political costs associated with abandoning the public interest. These costs are determined in the model by the political bias and the responsiveness of the electorate to changes in environmental policy. For simplicity, R is set to zero when a party is not in office.

Observe that equations (7a) and (7b) are based on the assumption that political contributions convey private benefits to the recipients, but have no effect

[63] The analysis could be extended to also include an audit policy or a prosecution policy. However, for brevity we focus on only one aspect of compliance policy. As noted earlier, this analysis makes the reasonable assumption that changes to the judiciary and improvements in detection capability require institutional reforms that are slow to undertake and uncertain in their impacts. The focus here is thus on predictable short run policies.

[64] Φ is adopted to represent either the tax rate or the marginal fine for notational brevity.

on the outcome of the political struggle. This is consistent with a large volume of empirical work examining the effect of campaign spending on outcomes. Most find spending by the incumbent government has no significant effect on electoral prospects (e.g. Glantz et al (1976); Erikson and Palfrey (1993), Levitt (1994)). Similarly, Schulze and Ursprung (2001) and Grossman and Helpman (1994) argue that political contributions are used by lobbyists to influence policy positions, rather than the election outcome.

Maximising (7a) and (7b) yields the following first order conditions:

$$\frac{\partial G^i}{\partial \Phi^i} = (1-\alpha)\frac{\partial \rho}{\partial W^i}\frac{\partial W^i}{\partial \Phi^i}R + \frac{\partial S^i}{\partial \Phi^i} = 0 \qquad \Phi^i = t^i, \theta^i \qquad (8a)$$

$$\frac{\partial G^j}{\partial \Phi^j} = (\alpha-1)\frac{\partial \rho}{\partial W^j}\frac{\partial W^j}{\partial \Phi^j}R + \frac{\partial S^j}{\partial \Phi^j} = 0 \qquad \Phi^j = t^j, \theta^j \qquad (8b)$$

Equations (8a) and (8b) reveal that in each party, policies are determined by equating the politically relevant marginal benefits and costs. Thus, each party sets its policy such that the marginal benefit in the form of a greater bribe is equated to the marginal political cost of the policy, which is defined by the change in the probability of losing power. *Ceteris paribus* the greater the welfare loss from a policy change, the greater will be the probability of losing power to a rival and hence the higher are the political costs of the policy. Accordingly, in equilibrium the weight given to the welfare costs of a policy is determined endogenously by the intensity of political competition. This contrasts with the standard common agency lobbying model where the weight given to social welfare is assumed to be exogenous.

Totally differentiating equations (8a) and (8b) yields the slopes of each party's policy reaction function, which is given by:

$$\frac{dt^i}{dt^j} > 0 \text{ and } \frac{d\theta^i}{d\theta^j} > 0. \qquad (9)$$

Thus under political competition, policies are strategic complements. Intuitively, as the second mover political parties take contributions/bribes as given. If party *i* sets more stringent policies, this increases its chances of electoral success. This compels a rival seeking power to also raise the stringency of its policies. Thus, in general, electoral competition tends to induce policies to move in the same direction.

In the first stage of the game the firm determines contributions by maximising its expected payoffs (equation (10)), taking account of the political parties optimal responses and the anticipated interaction with the inspector. The expected payoffs to the firm from lobbying are:

$$U^f = \Omega\Pi^i + (1-\Omega)\Pi^j - S^i(t^i,\theta^i) - S^j(t^j,\theta^j) \qquad (10)$$

where $\Pi^k = P(e^k)e^k - t^k\hat{e}^k - B^k - \lambda f^f(\theta^k, v^k)$ are profits under policies of party $k = i, j$. The first-order conditions from maximising equation (10) are:

$$\frac{\partial U^f}{\partial S^i} = \frac{\partial \Phi^i}{\partial S^i}\left(\Omega\frac{\partial \Pi^i}{\partial \Phi^i} + (1-\alpha)\gamma^i A + \frac{d\Phi^j}{d\Phi^i}\left[(1-\Omega)\frac{\partial \Pi^j}{\partial \Phi^j} + (1-\alpha)\gamma^j A\right]\right) - 1 = 0 \qquad (11a)$$

$$\frac{\partial U^f}{\partial S^j} = \frac{\partial \Phi^j}{\partial S^j}\left((1-\Omega)\frac{\partial \Pi^j}{\partial \Phi^j} + (1-\alpha)\gamma^j A + \frac{d\Phi^i}{d\Phi^j}\left[\Omega\frac{\partial \Pi^i}{\partial \Phi^i} + (1-\alpha)\gamma^i A\right]\right) - 1 = 0 \qquad (11b)$$

where $\gamma^k \equiv \frac{\partial \rho}{\partial W^k}\frac{\partial W^k}{\partial \Phi^k}$ $\quad k = (i, j)$ and $A = \Pi^i - \Pi^j$.

Equations (11a) and (11b) imply that the firm pays contributions to each party, for each policy, to equate the expected marginal benefits from a policy change to the

marginal costs of increased lobbying.[65] There are three components to the expected marginal benefits of a policy change by a party. We summarise each below with reference to equation (11a). First, policy concessions made by party i have a direct effect on the firms profits (i.e. $\Omega\frac{\partial\Pi^i}{\partial\Phi^i}$). Second, as policies are strategic complements, a policy change by party i will induce a policy change by the rival party j, which alters expected profits under party j (i.e. $\frac{d\Phi^j}{d\Phi^i}\left(\Omega\frac{d\Pi^j}{d\Phi^j}\right)$). Finally, changes in policy by both parties alter welfare levels and hence the outcome of the election. This electoral effect is captured by the terms $(1-\alpha)\gamma^i A$ and $\frac{d\Phi^j}{d\Phi^i}\left((1-\alpha)\gamma^j A\right)$. As a first mover, the firm will take into account these electoral effects when deciding its contributions.

Finally, for completeness it is useful to note that by total differentiation of (11a) and (11b) contributions to each political party are strategic complements (i.e. $\frac{dS^j}{dS^i}>0$). Intuitively, to offset the effects of political competition, the firm must secure more favourable policies from both parties. Hence higher contributions

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[65] The equilibrium described here is consistent with the concept of 'local truthfulness'. Given knowledge of its own contributions each party will announce policies to maximise its expected utility. From lemma 2 of Bernheim and Whinston (1986) and Proposition 1 of Grossman and Helpman (1994), the optimal policies of each party satisfy the following criteria:

$\Phi^K \in \arg\max G^k \qquad k=(i,j) \qquad \Phi^i=\left(t^i,\theta^i\right)$ (B1)

$\Phi^K \in \arg\max U^f+G^k \qquad k=(i,j) \qquad \Phi^j=\left(t^j,\theta^j\right)$ (B2)

$U^f=\Omega\Pi^i+(1-\Omega)\Pi^j-S^i-S^j=E(\Pi)-S^i-S^j$

Condition (B1) implies that each party chooses the equilibrium tax rate and penalty rate are chosen to maximise its expected utility given the offered contributions from the firm. (B2) requires that the joint utilities of the firm and the political parties are maximised. Performing appropriate substitutions into (B1) and (B2) and rearranging yields $\frac{dE(\Pi)}{d\Phi^k}=\frac{dS^k}{d\Phi^k} \quad k=(i,j)$.

This condition tells us that the contribution are offered to equate the marginal cost of changing policy with the marginal effect on expected profits.

to (say) party i are accompanied by higher contributions to the rival party. Thus, *ceteris paribus,* bribes (contributions) are used to distort policies of both the incumbent and rival parties simultaneously.

3.3 Policies, Corruption and Political Competition

Having defined the political equilibrium , we now examine how the level of contributions and policy platforms of the parties change with the level of political competition. We also investigate the effects of political competition on the level of petty corruption and discuss the interaction between the two forms of corruption. All proofs are presented in Appendix A.2.

Recall that the parameter α is a measure of political bias. A large α implies that the electoral prospects of party i are less effected by the welfare consequences of its policies. Thus α may be used as a proxy for the intensity of political competition, with lower levels implying a more competitive environment.

We begin by considering the effects of political competition on policy positions.

Proposition 1a

If the returns to winning government (R) are sufficiently large, an increase in political bias toward the incumbent party (i.e. a rise in α), results in both parties announcing less stringent policies

i.e. $\frac{d\Phi^i}{d\alpha} < 0$, $\frac{d\Phi^j}{d\alpha} < 0$ $\quad \left(\Phi^i = t^i, \theta^i,\ \Phi^j = t^j, \theta^j \quad i \neq j\right)$.

The intuition for this result is straightforward. As the political advantage of party i grows, there is less political competition. Hence the political cost of lowering the stringency of environmental controls falls. As a result, each of the political parties has less incentive to adopt welfare improving policies. An

alternative way of expressing this result is that the parties are completely self interested and only care about welfare from the perspective of political gain. Greater political bias for a party lowers the importance of improving welfare compared with procuring contributions from the firm. Conversely, this implies that policy will become more stringent when political competition increases (i.e. α diminishes).

Proposition 1b

An increase in political competition results in a decrease in the level of emissions and thus brings about better environmental outcomes (i.e. $\frac{de}{d\alpha} > 0$*).*

An increase in political competition results in more stringent policy in terms of both the marginal fine and the tax rate. This raises the costs of polluting for the firm, so that the level of emissions fall. Hence political competition always leads to environmental improvements. However, as Proposition (1c) shows the effects of political competition on petty corruption and compliance levels may be ambiguous.

Proposition 1c

When political competition increases, the effects on compliance levels and the equilibrium bribe are ambiguous. (i.e. $\frac{dv}{d\alpha} \gtrless 0$, $\frac{dB}{d\alpha} \gtrless 0$*)*

An increase in political competition leads to a higher tax rate and a higher marginal fine (Proposition 1a). Higher taxes increase the benefits from under-reporting emissions. This 'evasion effect' acts as an incentive for the firm to under-report emissions. However, at the same time an increase in the fine dilutes the benefits of under-reporting. This is the 'deterrent' effect, which reduces the incentive to under-report emissions. As these effects work in opposite directions, the overall impact of an increase in the level of political competition is ambiguous.

Similarly, the effects of political competition on the equilibrium bribe are determined by the change in compliance levels *(v)*, and the marginal effects each policy instrument has on the bribe, which is in general ambiguous. In the special case when judicial institutions are weak so that the expected probability of being convicted is low, political competition induces higher levels of bribery and lower compliance. This result is summarised in the following proposition:

Proposition 1d

When the exogenous prosecution rate (η) is sufficiently low and/or the costs associated with enforcement are sufficiently high, an increase in political competition will increase the level of under-reporting and the equilibrium bribe will be higher (i.e. $\frac{dv}{d\alpha} < 0, \frac{dB}{d\alpha} < 0$ *when η sufficiently low,* $\frac{dC}{d\theta}$ *sufficiently high).*

The intuition for this result rests upon the incentives for engaging in petty corruption. When political competition increases, both the marginal fine and the tax rate increase. The effect this has on the level of petty corruption depends on the relative size of the evasion and deterrent effects. In the case where the enforcement infrastructure is weak (e.g. η small), an increase in the fine has little effect on the expected costs of being corrupt and hence the evasion effect dominates.

The equilibrium bribe is also shaped by similar forces. A higher tax rate implies that the firm will be willing to increase the bribe offer. Conversely, higher expected penalties decrease the expected payoffs from petty corruption and thus decrease the equilibrium bribe. Again, when the prosecution rate is low, the evasion effect dominates the deterrent effect so that the equilibrium bribe increases. In this case, increased political competition, while leading to policy improvements, induces greater down-stream corruption.

We now turn attention towards the effect of greater political competition on contributions made to each party.

Lemma 1

An increase in incumbent advantage (α) *has an ambiguous effect on contributions made to both political parties* $\frac{dS^i}{d\alpha} \gtrless 0 \quad ; \quad \frac{dS^j}{d\alpha} \gtrless 0$

Appendix A.2 reveals that the effect on contributions of a change in political competition will be ambiguous. There are two opposing effects at work. First, greater political competition implies that the political costs of deviating from the welfare maximising level will be greater. As the firm must compensate the parties for this loss, the marginal effect of contributions on policy outcomes will be smaller. As policies are strategic complements, any change in contributions will effect the policy of both political parties. The political outcome will thus depend on the relative shift in policy of the two parties. This will turn on the responsiveness of each party to policy changes by its rival.

Proposition 2a

When the rival (incumbent) is very responsive to changes in its competitor's policy, contributions to the incumbent (rival) will increase when political competition increases:

$$\frac{dS^i}{d\alpha} < 0 \left(\frac{dS^j}{d\alpha} < 0 \right) \text{when } \frac{\partial \Phi^j}{\partial \Phi^i} \text{ is sufficiently large.}$$

$$\frac{dS^i}{d\alpha} > 0 \left(\frac{dS^j}{d\alpha} > 0 \right) \text{ when } \frac{\partial \Phi^j}{\partial \Phi^i} \text{ is sufficiently small}$$

The players will be responsive to each other when the degree of strategic rivalry is high.[66] To see the intuition for this, consider the case where the rival adopts a more stringent policy than the incumbent party, implying A>0. It follows that the incumbent is preferred by the firm while the rival holds a political advantage (since its policy is closer to the welfare maximising ideal). Consider now an increase in political competition. The political disadvantage of the incumbent now becomes a more important issue, as the outcome of the political struggle is more dependent on public support. The firm has a strategic incentive to reduce the advantage which the rival holds. Consider the possible strategies with regard to contributions made to the incumbent. First, the firm can decrease payments to the incumbent. This will, *ceteris paribus*, increase its policy stringency. However, as policies are strategic complements, the rival will also increase the stringency of its policy. If the rival is sufficiently responsive to changes in the incumbent's policy $\left(\frac{\partial \Phi^j}{\partial \Phi^i} \text{ is large}\right)$ there will be no political gain for the incumbent. In these circumstances, it is worthwhile for the firm to increase contributions to party i to reduce policy stringency. The rival, who reacts strongly to these policy changes by the incumbent, also reduces the stringency of its policy. Note also, that as contributions made to each party are strategic complements, an increase in contributions made to the incumbent will be accompanied by an increase in those made to the rival.

In essence, when the party who holds the political advantage (as defined by its policy position) is responsive to policy changes made by its rival, the firm acts to corrupt both parties, thus undermining the potential positive effects of political

[66] This level of strategic rivalry is contingent on parameters of the model.

competition. In this example, one can think of this as inducing the incumbent party to adopt a 'puppy dog strategy' with regard to competing with its rival.[67] By ensuring that the incumbent does not attempt to increase its policy stringency (and thus not provoke a response form the rival), the firm keeps in check the consequences of an increase in the policy dependent component of the political struggle brought about by a decrease in incumbent advantage.

Proposition (2a) reveals that there are some circumstances under which political competition will induce an increase in contributions. In fact, even when the political system is at its most competitive, grand corruption may not be eradicated. This is detailed in the following proposition and corollary.

Proposition 2b

When the welfare costs of environmental damage are sufficiently high and political competition is intense, the policies of the political parties tend to converge:(i.e. $\Phi^i = \Phi^j$ *when* γ^k *is large(k=(i,j)))*

When environmental policy has a sufficiently large effect on welfare, the parties adopt policies which are identical. If the welfare costs of a policy are large, so too are the electoral costs of deviating from the welfare maximising equilibrium. In such circumstances, the parties can insulate themselves from these political costs by allowing their policies to converge (and thus offering the electorate no policy choice).

[67] For a discussion of this type of strategy in a more general context, see Fundenberg and Tirole (1984).

Corollary 1

Even when the political system is at its most competitive (α=0), and the public are sufficiently sensitive to environmental damage, grand corruption may persist.

In general, when the political system is more competitive, the weight ascribed to aggregate welfare relative to contributions increases, resulting in more stringent policy, lower emission levels and increased public welfare (Propositions (1a) and (1b)). However, the parties are still prepared to accept bribes for distorting policies, provided they are adequately compensated for the political costs. Proposition 2b reveals that in the special case where the political costs are sufficiently large, we observe policy convergence. This shields the parties from the political costs associated with deviating from the welfare maximising level and allows grand corruption to persist.

When is policy convergence likely to emerge? Taken together, these results reveal that there are two conditions under which convergence is most likely: (*i*) the existence of high political costs from a policy distortion and (*ii*) the ability of political parties to earn high (sufficient) rents from a policy distortion. The political (or electoral) costs of deviating from voters' preferences will be high, if voters care sufficiently about a policy issue. Rival political parties can avoid these political costs, by removing the policy issue from the electoral agenda – which can be achieved through policy convergence. However, policy convergence implies that each party is prepared to forgo the electoral benefits of setting policy which more closely reflects citizen preferences. It follows that each party must be adequately compensated for this loss. For such compensation to be worth paying, the rents accruing to the beneficiaries from the policy favour must be adequate. This implies that convergence is most likely to occur when the amount at stake is high, so that

there is intense lobbying from the firm. The somewhat gloomy conclusion that emerges from the analysis is that political competition cannot necessarily be relied upon to eliminate rent seeking behaviour. While empirical tests of the link between democracy and corruption are sparse, consistent with this result, Fisman and Gatti (2002) find that greater political competition is not associated with less corruption. However, as with most cross country empirical studies, their results are obtained using an aggregate measure of corruption.

3.4 Conclusion

The focus of the paper is on whether political competition has a role in combating environmental damage, petty and grand corruption, and if so, under what circumstances. The results suggest that higher levels of political competition will lead to the adoption of more stringent environmental policy and higher fines for evading their effects. Importantly, more stringent policy always reduces emission levels. In this respect, the model suggests political competition to be important in achieving a reduction in environmental damage. However, petty corruption has the capacity to temper the magnitude of this outcome. We find that political competition by no means guarantees the elimination of this form of corruption. Where the prosecution rate is very low, as is likely where judicial institutions are weak, an increase in political competition will actually increase petty corruption. This is because the gains from avoiding more stringent policy are large and the chances of being prosecuted for doing so are small. Thus, even if penalties are severe, the overall enforcement system is ineffectual. Such regimes will also see a rise in the amount of the down-stream bribe and the level of under-reporting.

Similarly, grand corruption, which takes the form of contributions to each of the parties, may not be eliminated when political competition is at a maximum.

This is because, provided they are sufficiently compensated, policy makers are willing to trade off the welfare of citizens. Further, under some circumstances policy matching by the parties minimises the electoral impacts of deviating from the welfare maximising level. The model presented here thus provides an explanation for the circumstances under which policy convergence will occur – a reason which to our knowledge is new to the literature.

While there are no formal empirical tests of this convergence result, there is some anecdotal evidence, which is consistent with this explanation. For instance, (alleged) unsustainable timber felling in the old growth native forests of Tasmania and Western Australia remains deeply unpopular with the electorate.[68] Despite vocal and often violent public opposition, the two main rival parties in these States continue to support the same timber harvesting policies (Commonwealth of Australia 1992, 2003). Arguably, policy convergence allows the parties to extract contributions from the logging industry and avoid the political costs of adopting unpopular policies.[69] The issue of environmentally harmful subsidies is perhaps yet another example of this phenomenon. Government subsidies are ubiquitous in the agricultural sector in most OECD countries. Many of these subsidies are known to be economically inefficient, distortionary and environmentally harmful (OECD 2003). However, despite growing public awareness and opposition, few democratic countries have succeeded in dismantling these environmentally harmful subsidies.

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[68] Some current examples of professional groups who oppose clear felling include: www.doctorsforforests.com; www.liberalsfor.forests.org.au; www.lawyersforforests.asn.au. For a summary of the lobbying prowess of the logging industry in Australia see *Lords of the Forests* http://www.abc.net.au/4corners/content/2003/transcripts/s1046232.htm (accessed 2nd May, 2004).

[69] For instance, data from the Australian Electoral Commission reveal that three major firms with interests in forestry made combined political contributions of $261,650 to the major political parties (Labor and Liberal) during 2000/01. Of these, Labor received $120,000 (46%) and Liberal captured $141,650 (54%). See: http://search.aec.gov.au/annualreturns/arwDefault.asp?SubmissionID=3.

(Lingard 2002).[70] Once again it is possible that policy convergence allows rival political parties to extract rents from the beneficiaries of the subsidies, while negating the electoral costs.

This paper demonstrates that even in a simplified setting, there are significant complexities surrounding the issue of corruption. Our results are suggestive of the subtle relationship which exists between corruption in the administration and setting of policies, and political competition. One important implication of the analysis is that it may be more useful to consider corruption in the context of its resulting economic distortion, rather than the level of bribery. For instance, our analysis reveals that political competition unambiguously forces policy towards the welfare maximising level. If grand corruption is defined in terms of the level of policy distortion, grand and petty corruption may be substitutes or complements depending on the efficacy of the enforcement system. This has clear consequences for the development of anti-corruption policy.

[70] New Zealand and Australia are notable exceptions. However, in these countries too, subsidy reform was supported by the two main rival political parties – an outcome that is consistent with the predictions of this model.

Chapter 4

Political Competition and Corruption, Evidence from the World Business Environment Survey (WBES), 2000

4.1 Introduction

In chapter 3, a theoretical model of stratified corruption was presented. This model considered the case where a polluting firm attempted to lower its obligations under an environmental tax by bribing an inspector to under-report emission levels and by bribing the government to set less stringent environmental and anti-corruption policies. The focus was an analysis of how political competition influenced the level of each type of corruption. While the model was presented in the context of environmental policy, it should be noted that the results generalise to many other forms of regulation. For example, the model could easily be applied areas as diverse as the avoidance of worker safety regulations or the payment of tax on profits.

As noted earlier in this thesis, the problem of corruption has become an increasing focus of academic and non-academic literature. With the adverse impact of corruption on economic growth, investment, health, environmental outcomes, and on the formulation of public policy being well documented, a concerted effort by organisations such as the World Bank to develop anti-corruption strategies has been undertaken.[71] For such programmes to be successful, it is essential that we first have a thorough understanding of the determinants of corruption. In this context, the results derived in chapter 3 have significant public policy implications. It is

[71] See for example Mauro (1995) for effects on growth, Wei (1997) on investment, Tanzi and Davoodi (1997) on health, Callister (1999) on environment.

therefore important to examine how well these results stand up to the empirical data we have on corruption. This is the purpose of this chapter.

The existing empirical literature, which is reviewed in section 4.2 tends to have two common characteristics. First, there is a tendency to ignore the fact that different forms of corruption exist. It may be that factors such as the level of political competition may interact differently with different forms of corruption. Second, most studies concentrate on cross country comparisons of corruption.[72] This strategy has provided insight regarding the differences in aggregate levels of corruption between countries. However, the data used in these studies are often subjective, relying on measures such as those derived by Transparency International. This leads to the possibility of country specific bias. A further problem is that the micro level data are often ignored. There is likely to be substantial within country variation in the levels of corruption. Such variation may depend on the relative levels of regulation across industry, differing levels of law enforcement between sectors or even geographical regions, or differences in firm characteristics such as size.[73]

This paper goes some way to bridging this gap in the literature. First, the empirical analysis is extended to two different types of corruption: petty and grand, as defined in the previous chapter. A second contribution is the use of the *World Business Environment Survey* (WBES), 2000 (World Bank, 2000b) to empirically investigate the phenomenon of corruption. These data provide responses from 10000 firms in 100 countries regarding corruption, the regulatory environment and firm specific characteristics. At the time of writing, we are unaware of any formal

[72] Recent exceptions are Svensson (2003) who uses firm level data to analyse corruption in Uganda and the Hellman, Jones and Kaufmann (2000) which uses data from the Business Enterprise and Enterprise Development Survey, 2000, Mocan (2004) and Swamy *et al.* (2001).

[73] Becker (1968, p169) notes that enforcement levels differ across different types of legislation. Contreras-Hermosilla (2001) suggests that the remoteness of forestry activities makes regulations difficult to enforce.

studies which use the WBES.[74] Use of firm level data such as these permit within country variation (as discussed above) to be considered.

Particular attention is obviously placed on evaluating the effects of political competition on grand and petty corruption. The theoretical results from chapter 3 suggest that petty corruption can be lowered when a political system becomes more competitive, however the result is contingent on the level of enforcement. In the event that enforcement is weak, greater levels of political competition are shown to increase petty corruption (Proposition 1d). The model also predicts that even when the political system is at its most competitive, grand corruption may persist (Corollary 1). This suggests political competition may not be effective in reducing corruption. However, the political parties in this model have no altruistic desire to improve the welfare of citizens. Indeed, when the incumbent has a complete political advantage (which implies no political competition), there is no constraint on the level of grand corruption. Thus, while the results suggest that political competition will not eliminate grand corruption, there does appear to be a link between the two. The somewhat ambiguous relationship suggests that it may be fruitful to pursue the investigation empirically.

The results tend to support the predictions of the theoretical model presented in chapter 3. In particular, the level of petty corruption is found to be inversely related to the level of political competition. However, threshold analysis reveals this result turns on the level of enforcement. In fact, the data suggest that increasing political competition when enforcement is very weak may increase petty corruption. Grand corruption is not found to be lowered by higher levels of political competition.

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[74] The World Bank website enables users to gain some summary statistics regarding cross country levels of corruption.

Some general results from the model are also tested using the WBES data. It is found that both forms of corruption are lower when the enforcement infrastructure is stronger. There is also evidence that where the gains to corruption are large, agents will be more likely to be corrupt. These results, as will be shown, are consistent with the model presented in chapter 3 and the existing literature on corruption.

The remainder of this paper is organised as follows. In the following section, a discussion of the model's main results which are to be tested is presented in the context of the existing empirical literature. Section 4.3 provides an overview of the data used and the econometric model. In section 4.4 the results are presented with appropriate discussion. Section 4.5 concludes with suggestions for future research in this area.

4.2 Existing Empirical Literature and Chapter 3 Results

The model presented in chapter 3 yields several hypotheses which can be tested empirically. To better understand how the results of the model fit with the existing literature, the discussion is constructed around three criteria which Jain (2001) considers essential for corruption to exist:

i. Someone must have discretionary power

ii. There must be economic rents associated with this power.

iii. The legal and judicial system must offer a sufficiently low level of detection.

Each of these is first discussed in the context of the general results from the model. Following this, we consider the results which relate to political competition. It is

argued that each of Jain's three criteria are effected by this variable. A review of the relevant empirical literature is presented for each identified hypothesis.

1. Someone must have discretionary power

A bribe will only be offered in order to receive some benefit from the recipient. Clearly, if the recipient has no discretionary power, or the service can be obtained at zero cost in some other manner, the bribe will never be offered. Using the framework of chapter 3 as an example, the inspector is able to secure payments from the firm in return for a false report of emission levels. Were there to be no information asymmetry between the government and inspector with regard to pollution, the inspector would be unable to do this. The firm may also bribe the government to change environmental policy. The discretionary power in this case arises due to the government's control over policy.

2. There must be rents associated with the corrupt activity

The existence discretionary power does not ensure that corruption will occur. In addition, the parties must derive some sort of gain from their corrupt activities. Where these gains are larger, we expect more corruption. For example, the polluting in firm in chapter 3 will be more prepared to offer a bribes to the political parties or the inspector where the gains (increase in profits) from doing so are large. Recall that by property 3 an increase in the rate of environmental tax will increase petty corruption. Obviously, the higher the rate of tax, the greater are the gains from avoiding it. A similar logic applies to grand corruption: where the gains from inducing a more favourable policy are large, then the firm is prepared to pay more in bribes to the political parties. This notion is captured by the local truthfulness condition: $\frac{dE(\Pi)}{dt} = \frac{dS}{dt}$. This implies that the marginal contribution

made by the firm will depend on the sensitivity of expected profits to changes in policy. It is thus hypothesised:

Hypothesis 1: Petty and grand corruption will be higher (lower) when regulation is more (less) harmful to the firm.

Most empirical studies of corruption attempt to use some proxy for the level of rents. In general, these models suggest that where the government is intrusive in economic life, there will be greater gains from corruption. This is generally proxied by the size of government or the stringency of regulation. More intrusive government policy and more stringent regulation would both be expected to lead to not only larger rents from avoiding regulations, but also will increase potential discretionary power of regulators.

Goel and Nelson (1998) examine the 'size and scope of the public sector' on corruption. Their analysis suggests that where the public sector is large, suggesting that the regulatory burden is also large, corruption will be greater. Similarly, Slemrod (2002) finds that tax cheating increases as the size of government grows. Pritchett and Sethi (1994) find evidence that avoidance of an import tariff in Pakistan increases when the tariff rate is higher. Johnson, Kaufmann and Zoido Lobatón (1999) find that countries with more stringent regulation have a higher share of an unofficial economy as a share of GDP. Ades and DiTella (1999) show that countries who pursue more active industrial policy, will exhibit greater levels of corruption.

Another proxy used to measure rents from corruption is that of the intensity of competition. Firms who earn large profits might be expected to gain more from corrupt activities. There is some evidence that firms in a more competitive industry are less likely to be corrupt. Jain and Tirtiroglu (2000) show that there was a

marked decrease in contributions made to policy makers when US banks were opened up to international competition. Similarly, Ades and DiTella (1999) and Treisman (2000) find that greater openness to trade can reduce corruption. In one of the few studies in which firm level data are used, Hellman, Jones and Kaufmann (2000), examine the relationship between firm characteristics and corruption levels.[75] They construct a measure of market power using individual firms' estimates of the effect of a price increase on product demand. Their measurement is thus based on the elasticity of demand, with greater inelasticity being associated with greater market power. Their focus, rather than on the rents which may be associated with market power, is that firms with market power are less susceptible to demands for bribes from low level bureaucrats. Apart from this 'grabbing hand' hypothesis, a measure of monopoly power may also be a proxy for the ability of industry to form special interest group.[76] Despite these hypotheses, they find no significant relationship between market power and either form of corruption.[77]

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[75] The data used in their study are from the World Bank's *Business Enterprise and Enterprise Performance Survey (BEEPS),* a data set that is similar to those used in this analysis. One difference is that the BEEPS survey is limited to ex Soviet or so called transitional economies.

[76] Where there are many firms or individuals, it may be optimal to 'free ride' on the efforts of other firms. This may lead to a disintegration of the entire lobby. Olson (1965) discusses at length the problem of free riding in the context of lobby group formation.

[77] One possible reason may be that using price elasticity as a measure of market power may be problematic. The response categories for this question are: (i) Our customers would buy from our competitors instead, (ii) Our customers would continue to buy from us at much lower quantities, (iii) Our customers would continue to buy from us at slightly lower quantities and (iv) demand for the product would remain unchanged. Category (ii) could relate to a monopolist, who will always face an elastic demand.

3. The penalty and/or enforcement regime must be sufficiently weak

While the first two criteria create incentives for corruption, the penalty and enforcement regime acts as a deterrent. Where penalties are higher or the probability of detection and conviction is higher, agents will be less likely to engage in corruption. This is because the gains from corruption activities as described above are diluted by the expected costs.

In chapter 3, petty corruption is shown to be falling in both the severity of the fine (property 6) and the ability to detect and prosecute offenders (property 9).[78] By imposing greater penalties for under-reporting, the costs associated with petty corruption increase, making it less attractive. These expected costs, however, also turn on the effectiveness of detection mechanisms and the judiciary. Where these are stronger, it is more likely that offenders will be penalised. There is also a more subtle relationship between the ability to detect cheating and the notion of discretionary power. For example, in the model presented in chapter 3, the discretionary power of the inspector only arises because the government cannot perfectly observe emission levels. If it were the case that audits could be conducted (at zero cost) and with perfect efficiency in that true emissions were always uncovered, there would indeed be no need to employ the services of the inspector whatsoever. As such, poor detection rates might also imply greater discretionary power and hence greater levels of petty corruption.

While the results do not flow directly from the model presented in chapter 3, grand corruption is also hypothesised to be inversely related to the strength of enforcement. The model suggests that abandoning public welfare lowers the chances of a political party gaining office. In this theoretical world, the public have

[78] Unfortunately, a direct test of property 6 can not be conducted as the WBES contains no data pertaining to penalties.

complete information. Hence, they are aware of the appropriate (welfare maximising) level of policy and that any deviation from this ideal implies that the government is accepting bribes from the polluting firm. In reality, this may not be the case, and the general public may rely on the exposure of corrupt politicians by the media or an independent law enforcement agency. Further, penalties imposed by the courts against corrupt politicians will also reduce the expected gains from corruption. This type of argument implies that grand corruption will be lower when enforcement is strong. This allows the following hypotheses to be stated:

Hypothesis 2: Petty and grand corruption will be higher (lower) when detection is poor (strong)

Hypothesis 3: Petty and grand corruption will be higher (lower) when the prosecution rate is low (high)

The literature examining the importance of enforcement mechanisms can be traced back to Becker (1968). In a theoretical setting, he shows that corruption is deterred by higher probabilities of detection and higher fines. Rose-Ackerman (1978) also highlights the importance of detection and penalties in various levels of corruption.

There are several studies which empirically test these ideas. Goel and Nelson (1998) use the main results of Becker's 'Crime and Punishment' model in an attempt to explain cross state variation in corruption of public officials in the United States. They find that states who spend more on police or have more employees in the Justice and Legal Services department have less corruption. Johnson, Kaufmann and Zoido-Lobatón (1999) find a negative relationship between a strong 'rule of law', as measured by Political Risk Services *Country Risk Guide*, and corruption. A

similar result is also found by Ades and DiTella (1997), who use corruption data from the 1989 *World Competitiveness Report.*

In their study using data from the *Business Enterprise and Enterprise Performance Survey (BEEPS)* (World Bank, 2000c), Hellman, Jones and Kaufmann (2000) suggest both petty and grand corruption will be higher when property rights are insecure.

Using data from Transparency International's (TI) *Corruption Perceptions Index,* Treisman (2000) finds that countries with British heritage are less likely to be corrupt. He suggests that this may be due to the propensity of former British colonies to adopt common law systems. Treisman argues that the common law system tends to concentrate on procedural fairness at the expense of social hierarchy. Taking this as given, his results would support the strong enforcement argument. However, a similar study by Sandholtz and Koetzle (2000) does not reveal a significant relationship between British colonialism and corruption.

4.2.1 Political Competition and Corruption

There are three ways by which political competition might be hypothesised to decrease the level of corruption. The first is that under more intense political competition, politicians are more accountable to the public, limiting their ability to trade off aggregate welfare for contributions. This type of electoral constraint reduces the payoffs from their corrupt activities and, in some sense, limits the degree of discretionary power they have. Similarly, the prospect of a change of government in the future implies that the incumbent politician is unable to guarantee the duration of a favourable policy change to the bribe giver. This can be thought of as decreasing the rents associated with corruption for the latter, or once again as a limit on the long run discretionary power of politicians. Finally, political

competition is often accompanied by a more free and independent press, who assist in the exposure of corruption.[79] As noted, such exposure may act as an important detection mechanism in the context of grand corruption. The existence of strong opposition parties who are willing to highlight the corrupt activities of their rivals would also contribute to greater exposure. It is thus evident that political competition has an influence over each of Jain's aforementioned criteria (Jain, 2001).

The model presented in chapter 3 captures many of the ideas discussed above. First, recall that as per Proposition (1c), political competition does have the capacity to reduce petty corruption. When faced with more intense competition the parties respond by setting policy closer to the welfare maximising level. This involves raising environmental policy stringency and penalties for corruption. Raising the emissions tax is shown to increase the incentives to under-report while higher fines have the opposite effect. A reduction in corruption will thus only be brought about by a more competitive political environment when the deterrent effect of penalties dominates. In the model this is determined by the exogenous levels of detection and prosecution. Where these enforcement parameters are strong, petty corruption will fall in the presence of greater political competition. Where they are weak, the reverse holds. This leads to the following hypotheses.

Hypothesis 4a: Greater political competition will reduce petty corruption when enforcement is 'sufficiently' strong.

Hypothesis 4b: Greater political competition will cause an increase in petty corruption when enforcement is 'sufficiently' weak.

[79] Empirical evidence of this relationship is found by Brunetti and Weder (2003) who find that countries which have a more free press are less likely to be corrupt.

There are several points to be made about hypotheses (4a) and (4b). The first is that exactly what 'sufficiently weak' or 'sufficiently strong' enforcement regimes look like is unclear in the model. This is an empirical matter which we try and capture in this paper. The second point relates to the exogenous nature of enforcement. As noted in chapter 3, the important thing here is that enforcement mechanisms are *slower* to change than other policy parameters. This would seem reasonable. For example, the time taken to replace or retrain an inefficient judiciary would generally be greater than that taken to adjust the marginal rate of an emissions tax. This may be particularly true for countries who have just embarked on the democratic process. For example, Varese (1997) notes that post-socialist Russia was characterised by a lack of judicial reform and poor definitions of property rights. While there were clear policy changes which led Russia towards a market based economy, the necessary legal and institutional framework was static, causing corruption to increase.[80]

In the context of grand corruption, the results from chapter 3 are somewhat less clear. The structure of the model suggests that grand corruption will be unconstrained in the absence of political competition. In this case, the incumbent is perfectly secure in its position and is immune from the political consequences of its actions. This implies that it is most receptive to payments made by the firm. At the other end of the spectrum, when political competition is at a maximum, the political costs of deviating from welfare maximising policies are relatively large. As the firm must compensate the government for these political losses, we would expect the marginal change in policy stringency per unit of contributions to fall. Ideally,

[80] Kamiński and Kamiński (2001) also point to this problem in Russia and other CIS states. They argue that an initial 'go slow' approach to reform led to poor institutional reform which created a perfect environment for corruption to flourish. A vicious cycle has emerged in these countries where special interests who exert large influence, if not control over the state, oppose economic and political reforms to perpetuate their rent seeking activities.

this should lead to lower levels of grand corruption. The theoretical results refute this notion. In particular, Lemma 1 reveals that the effect of political competition on contributions made by the firm to political parties is ambiguous. Further, it is shown that even when competition between the incumbent and rival political parties is at a maximum, grand corruption persists (Corollary 1). If environmental damage and the associated welfare costs are large, the parties allow their policies to converge (Proposition 2b). This reduces the electoral costs associated with deviating from the welfare maximising level and raises the marginal productivity of contributions made by the firm.

The above discussion implies that political contributions from the firm may be very productive when the system is perfectly competitive *or* when there is no competition at all. That said, proposition (1a) from chapter 3 reveals that policy does move closer to the welfare maximising level when the political system becomes more competitive. As noted, this calls into question the definition of grand corruption. Indeed, political competition unambiguously reduces grand corruption if it is defined in terms of the resulting policy distortion. Unfortunately, data which capture this type of definition are unavailable and we rely instead on a measure of an individual firm's efforts to influence policy by making monetary payments. In this way, we seek an empirical answer as to how this measure correlates with political competition variables.

There has not been a large amount of empirical work examining the effects of political competition on corruption. Availability of data has resulted in most of these studies focussing on cross country differences in corruption levels.

Johnston (1999) examines various case studies to suggest that increased democratisation decreases the level of corruption. He notes that democratisation,

while generally reducing corruption, may in some circumstances lead to a 'corrupt scramble to extract gains in a newly insecure environment' (page 33).

In his cross country analysis, Treisman (2000) concludes that democracy may reduce corruption, but it may take decades to do so. His results suggest that it may take up to 40 years of uninterrupted democracy to reduce corruption. Whether a country is democratic or not at a single point in time is not found to be significantly associated with the level of corruption. Sandholtz and Koetzle (2000) confirm the impact of long run democracy in decreasing perceived corruption levels. However, contrary to Treisman, they find that countries which are currently more democratic are less likely to be corrupt.

The idea that democracy or political competition may initially be associated with higher levels of corruption followed by a decline has been tested by several authors. These studies describe an 'inverse U' shaped relationship between political competition and corruption. Montinola and Jackman (2002) find evidence of this relationship using data from the Interuniversity Consortium for Political and Social Research (ISPCR) which capture the freedom of group association, level of political rights and the effectiveness of the legislative process. Hellman, Jones and Kaufmann (2000) use Freedom House's *Civil Liberties Index* for 1997 and 1999. They regress this against a country based index of state capture for former Soviet controlled countries compiled from the BEEPS (World Bank, 2000c) survey. They conclude the initial increase in corruption associated with political competition is due to a loss of control resulting from the dismantling of the controlling apparatus of the communist party. In particular, they argue that the development of checks on the abuse of power tend to take time. This empirical work is perhaps the closest in the literature to the results of the model presented in chapter 3. In a more specific study, Earnhart (2001) examines environmental protection in the Czech republic pre

and post communism. He finds that while the political power of special interests was greater under communism, so too was enforcement for non-compliance with environmental regulations.

Persson, Tabellini and Trebbi (2001) assess the possibility that corruption is influenced by differing electoral rules. They hypothesise two relationships: first, as per the model suggested by Myerson (1993), they suggest that voters ability to punish corrupt incumbents through the electoral system is greater when the barriers to entry into the electoral system are lower. They proxy this level of greater competition using the size of the voting district, assuming that larger voting districts will have lower barriers to entry and thus be less corrupt. Their second assertion, the *career concern effect*, captures the idea that proportional representation is more prone to lead to corruption of politicians than those selected under a plurality rule. Under the former, the public vote for political parties who select their candidates from party lists while the latter involves direct election by the public. The argument is that selection from party lists dilutes the one-to-one relationship between the politician and the voter, resulting in candidates who are selected based upon other criteria (such as their party loyalty), rather than their performance in providing benefits to voters. Both of these hypotheses relate to grand corruption, however the authors use data from Transparency International's *Corruption Perceptions Index*, which provides a single composite measure of corruption. This measure incorporates indicators of both grand and petty corruption. Despite the inability to distinguish between these different forms of corruption, empirical support is found for both of the hypotheses stated above.

There are few studies which use micro-level data to analyse the determinants of corruption. Exceptions are Svensson (2003), who analyses corruption levels of 176 firms in Uganda, and Swamy *et al.* (2001) who use data from 350 firms in

Georgia to explore the relationship between gender and corruption, suggesting a male bias in the propensity to be involved in bribery. More relevant to this study is recent work by Mocan (2004) who uses data from the *International Crime Victims Survey* (united nations, 1996) which incorporates responses from 54000 individuals in 29 countries to examine the determinants of corruption. The results reveal that a host of personal characteristics influence the level of corruption. In particular, being male, having higher levels of education and income are associated with involvement in bribery. Critically, the measure of corruption is whether individual's were *asked* to pay a bribe. As such, the results incorporate extortion, something which is not examined here. Controlling for specific country characteristics, Mocan finds that uninterrupted democracy leads to lower levels of corruption.

4.3 Estimation and Data

In 2000, the World Bank conducted a survey of 10000 individual firms in 80 countries – The World Business Environment Survey (WBES)(2000). The survey provides a cross section of information relating to the characteristics of the business and institutional environment in the sector/country within which each respondent firm transacts, together with measures of perceived corruption.

These data are characterised by responses which capture individual firms' perceptions regarding their business environment. Such perceptions may differ between firms in different countries or even in different sectors of the economy. Unfortunately, this type of problem is common to all unit record cross-country data. In the case of corruption, however, we can imagine that country or sector based differences in perceptions could be particularly severe.

Despite this, data such as those provided in the WBES have some attributes which make them particularly useful for analysing corruption. Its biggest advantage is the large number of observations available. Often, measures of corruption (for example those used by Transparency International) are compiled from individual responses in such a manner as to yield a country based index. This type of approach has the advantage of facilitating cross country comparisons, however, much information is lost in the aggregation process. For example, in making decisions regarding corruption, each respondent must consider its own circumstances: what are the gains to *it* from paying a bribe?, what is the probability that *it* will be caught doing so?, how does *it* assess the probability that if caught, a penalty will be imposed. These questions may be specific to each firm based upon the industry in which they operate, its size or some other characteristic.

In the following section, the variables chosen to proxy the level of corruption and other key determinants discussed in the previous section are outlined and discussed.

4.3.1 *Measures of Corruption*

1. Petty corruption

There are several measures of petty corruption contained in the WBES. The variable used here is the set of responses to the following question: *What percentage of revenues do firms like yours typically make in irregular or unofficial payments to get things done?*[81,82] Importantly, the World Bank assures respondents that the questions relate not specifically to their own firm but to 'firms *like* yours'. This, presumably, has the effect of ensuring that the firms can answer without fear of recrimination, thus inducing more honest responses.

The responses provide a quantitative measure of the amount of bribes paid. Importantly, there is no onus on the respondent to make any value judgement as to whether this constitutes corruption or not. There is nothing to suggest that the unofficial payment is not perfectly proper.

The responses are broken down into 8 categories as per the following:

Category	% Revenues
1	*0*
2	*<1*
3	*1-1.99*
4	*2-9.99*
5	*10-12.99*
6	*13-25*
7	*>25*
8	*Don't know*

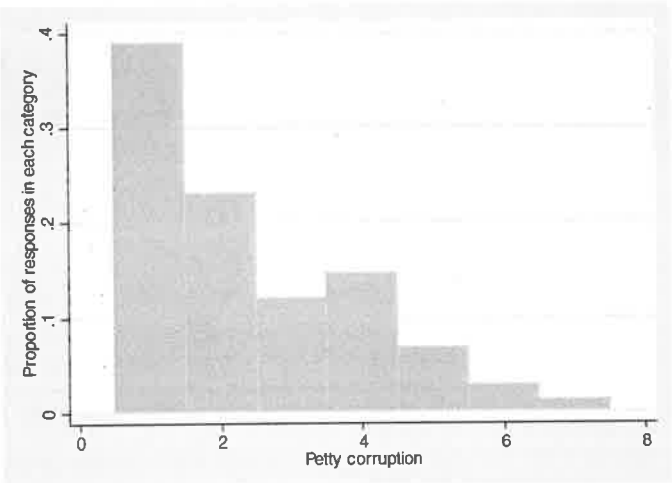
[81] This appears to be a reasonable proxy for petty corruption, however, the question does not make a formal distinction between petty and grand corruption. Strictly speaking, one could envisage 'getting things done' as meaning getting a law or regulation changed by a policy maker (i.e. senior public official).

[82] Hellman, Jones and Kaufmann (2000) study uses the same measure of petty corruption which is also found in the Business Enterprise and Enterprise Performance Survey (BEEPS), 2000. This survey is very similar in structure to that of the WBES, however all respondents are from countries in transition from former Soviet control.

All observations under the 'don't know' category were recoded as missing. As shown in figure 4.1, the distribution of this variable was skewed towards the no corruption case (mean 2.41, standard deviation 1.54).

Importantly, responses for this question are not available for some countries (in particular all of the African countries). A full list of countries included in the sample appears in Appendix B.1 (Table B1). The final number of observations for this dependent variable is 4849, representing responses from firms in 54 countries.

Figure 4.1 Histogram - Petty Corruption



2. Grand Corruption

Our meaning of grand corruption is the attempt to buy influence over policy from senior government officials. Firms in the survey were asked: *How often do firms like yours make irregular or unofficial payments to influence the content of new laws or decrees*?

Unfortunately, unlike the measure of petty corruption, this is not quantified as the amount paid, but instead is a measure of the frequency of payments as summarised below:

Category	Frequency
1	*never*
2	*seldom*
3	*sometimes*
4	*frequently*
5	*mostly*
6	*always*
7	*don't know*

Again, the sample is restricted to certain countries, in this case 'transitional economies' of eastern Europe.[83] The final number of observations for this variable was 2763.[84] A full list of countries included appears in Appendix B.1 (Table B2). As expected for this type of variable, the distribution is again skewed towards the no corruption case (mean 1.32, standard deviation 0.88).[85] A histogram showing the distribution appears in figure 4.2.

4.3.2 Explanatory Variables

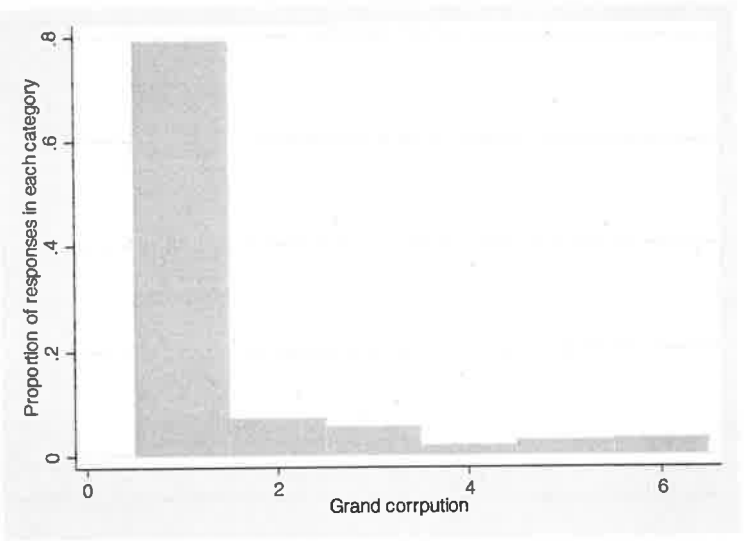
The following details the variables used to examine the determinants of corruption. These variables tend to follow those discussed in section 4.2. Summary statistics of each variable appear in Appendix B.1 (Tables B3 and B4).

[83] In the sample, there were 2928 observations coded as zero for this variable. Contact with the World Bank revealed that these represented missing values and that only firms in transitional economies had the question put to them. That said, there were a total of 152 observations from non-transitional countries (e.g. US (7 observations), Germany (10 observations)). Attempts to estimate a fixed effects ordered probit model by country resulted in the failure of the maximum likelihood estimator to converge. This is a case of the 'incidental parameters problem', under which the estimates are not consistent (see Greene, 2003, page 697). As such, these observations were dropped.

[84] Category 7 'don't know' was treated as a missing value.

[85] As expected, the data almost perfectly match those used by the Hellman, Jones and Kaufmann (2000) who use the same question from the BEEPS data set. From 2874 observations, they report a mean of 1.3 and a standard deviation of 0.9.

Figure 4.2 Histogram - Grand Corruption



1. Political Competition

We use three separate measures of political competition. The first is an index of 'Voice and Accountability' constructed by Kaufmann, Kraay and Zoido-Lobaton (2002) for the year 2000. This is a composite of the ability of citizens to participate in the selection of their government. Included in this variable are measures of aspects of the political process, civil liberties and political rights.[86] The measure also includes an indicator which is a proxy for the independence of the media. Estimation is conducted using an unobserved components model. This allows an estimate of a measure of governance to be obtained in addition to an estimate of its precision. The latter is ignored for the purposes of this paper. In terms of the model presented in chapter 3, this is used as a proxy for the parameter α, which measures the political/incumbency advantage. All else being equal, we could expect a low value of α to imply a more competitive environment, with the public having a larger say in the selection of government. High political advantage

[86] One of these sources is the WBES, though none of the variables used appear in our regressions.

implies that the public have little say in that political parties do not have to consider the welfare effects of citizens to such a high degree when formulating policy.

A second measure of political competition is taken from the Polity IV project (Marshall and Jaggers, 2000). This series provides a composite measure for the level of institutionalised autocracy which encompasses weighted factors such as regulation and competition of political participation, constraints on the powers of the chief executive, and the openness of executive recruitment. A similar measure of institutionalised democracy is also constructed. For both the autocracy and democracy measures, a score out of ten is derived. By subtracting the score of autocracy from that of democracy, a combined measure is obtained ranging from 10 (strongly democratic) to -10 (strongly undemocratic). Marshall and Jaggers (2000) provide a detailed explanation of the composite indicators and the component variables used in their construction. The use of a combined measure which includes both autocracy and democracy measures allows for cases where a democratic process, while established, is undermined by the ability of rulers to insulate themselves from any loss of power. Such cases might be thought of as 'puppet' democracies.[87]

The third measure of political competition, compiled by Tatu Vanhanen (Vanhanen, 2000) is the Polyarchy dataset. This data set combines measures of competition (100 – share of the total vote/seats won by the strongest party) and participation in the political process (the percentage of the adult population voting in elections) to derive an index of democracy. There are two problems associated with this measure. First, is the use of total population rather than *voting age*

[87] The following provides an example of the Polity scoring system. Data reveal that for the year 2000, Singapore had respective democracy / autocracy scores of 2 and 4, yielding a Polity score of minus 2. For the same year, the corresponding values in the UK were 10 and zero, yielding a Polity score 10.

population in the numerator when calculating the participation measure. Vanhanen argues that this is due to greater accuracy over time in total population data as opposed to age based data. However, countries with a large young, ineligible population will have a downward biased measure of participation. The second problem is that countries with compulsory voting systems will have inflated participation results. Despite this, the Polyarchy data have the major advantage of being objective. The 'Voice and Accountability' and 'Polity' measures of governance rely heavily on subjective evaluations by citizens or external 'experts'. These measures are likely to have problems of country based (or other) perceptions bias from which the Polyarchy data do not suffer. Further, the other two proxies for political competition discussed above tend to focus measuring factors which may be a consequence of the political system rather than defining it. For example, the Polity measure captures the effect of guarantees to civil liberties and institutionalised constraints on the chief executive.

2. Enforcement

Data measuring the level of fines or other forms of punishment imposed by the countries in our sample were unavailable. However, there are a number of variables which act as proxies for the detection and prosecution rate. Respondents were asked to what extent they agreed with the notion that the judiciary was able to uphold property rights.[88] The results from this question are used as a proxy for the quality of the judiciary (and in the context of chapter 3, the exogenous prosecution rate). A similar measure of the quality of the police force is also incorporated as a proxy for the probability of detection.

[88] Responses were coded along the interval 1 (strongly disagree) to 6 (strongly agree). For full details see Appendix B.1.

An indicator variable which identifies whether the firm's financial accounts are audited is also included. While this is somewhat correlated along country lines and size characteristics of the firm, it is also likely that firms who have audited statements would find it more difficult to hide illegal or unofficial payments.[89] This is hypothesised to act as a constraint on corruption.

3. Rents

Higher rents are hypothesised to induce greater levels of corruption. We assume that market power is associated with higher rents. A crude measure of this is constructed using the number of competitors faced by the firm. In the WBES, firms were asked to identify the number of competitors they face in the domestic market. The responses are segmented into three categories: none, 1-3 and greater than 3. It was assumed that firms within the first two categories were more likely to hold market power. A dummy variable was constructed, with firms responding in the first two categories being classified as holding market power. Higher levels of economic rent are expected to generate greater corruption of both types. However, industries with fewer participants might also be expected to overcome the problems of free riding associated with the formation of special interest groups more easily than industries comprised of many firms. This leads to the hypothesis that firms with market power may be likely to use grand corruption as their preferred means. Thus, while the theory would suggest that higher rents implied by monopoly power lead to greater levels of both forms of corruption, we may actually see lower levels of petty corruption and higher levels of grand corruption among firms with market power. This, of course, makes an assumption that the two forms of corruption are

[89] Correlation coefficients are as follows: ρ(audited statements, country) = 0.11 and ρ(audited statements, small firm) = -0.32.

strategic substitutes as opposed to being complementary. There is little theoretical or empirical work which identifies this type of relationship with certainty.[90]

Another important issue is the extent to which regulation impinges on the activities and profitability of firms. Where the regulatory burden is large, we would expect the incentives for both petty and grand corruption to be greater. Firms in the survey were asked to identify how problematic they found various forms of regulation.[91] A measure of stringency was obtained by averaging the responses for these various types of regulation.[92]

4. Other firm characteristics

There are several other firm characteristics which could be expected to have an effect on the level of grand and petty corruption. These are detailed briefly below:

Exporter: Openness to trade has been previously associated with lower levels of corruption (for example, see Ades and DiTella (1997)). Firms exposed to international competition are expected to face more competition and would more likely make lower profits. In addition, firms which export must use international markets and it is likely that the ability of an individual firm to obtain special treatment by using bribery is lower. Further, the government of any particular country ostensibly has little control of the regulations which govern international

[90] In the previous chapter, it is shown that when the judiciary is weak, greater political competition may lead to greater levels of petty corruption. At the same time, policy distortions decrease with greater competition between political parties. Thus, the two forms of corruption might well be considered as substitutes. However, the analysis treats grand corruption in terms of policy distortions rather than the level of contributions paid. There are no data available which will allow the testing of this hypothesis.

[91] The following types of regulation were included in the construction of a variable to measure stringency: business licensing, customs, labour, foreign currency, environmental, fire/safety, tax administration, and the level of taxation. Firms were asked to rate the level of difficulty from 1 (no problem) to 4 (major obstacle).

[92] Two other variables were constructed. The first was to take the maximum value (most problematic) of any type of regulation and the second was to take the minimum. Both these variables yielded similar results.

markets. As such, the scope for grand corruption may be lower. This of course, discounts the possibility that exporting firms might lobby the domestic government for subsidies to promote sales of their product. We use a dummy variable to indicate whether the firm exports its good. The expectation is that exporters will be less likely to engage in grand and petty corruption.

Size of the firm: Following the Hellman, Jones and Kaufmann (2000), smaller firms are expected to engage in lower levels of grand corruption and greater levels of petty corruption. This may support the notion of the 'grabbing hand', where bureaucrats are able to extract extortive bribes from small operators.[93] It could also reflect the relationship between the costs associated with the two forms of corruption. In the context of grand corruption, the search costs associated with making contacts at the senior level of government may be large and in some cases preclusive. This may leave petty corruption as the only means by which to evade the effects of regulation.[94] An alternative hypothesis could be that the size of a firm is positively correlated with rents. Under such circumstances, we would expect large firms to have a greater propensity to engage in both forms of corruption than their smaller counterparts. We construct categorical variables to measure the size of the firm. These categories are *small* (less than 50 employees), *medium* (50-500 employees) and *large* (greater than 500 employees).

Origins of the firm: The data incorporate many countries which have undergone transition from socialist style rule to more democratic rule (the so called transition economies). Associated with this was the opening up of markets which allowed

[93] Although Bardhan (1997) notes that the benefits from corruption accrue in the main to the bribe giver.

[94] This argument is closely aligned to the one presented earlier where it was suggested that industries with many participants might be less likely to overcome the free riding problems associated with lobby group formation, and thus might be less prone to engaging in grand corruption.

previously precluded private firms to enter, and the privatisation of formerly nationalised industries. We hypothesise that state owned firms are more likely to have informal ties to government officials. Private firms, on the other hand, could not expect preferential treatment based upon such relationships and thus might rely on making illicit payments to a greater extent. Firms which were owned by the state but have since been privatised might also be expected to be more corrupt, though it is possible that previous links with government officials may not be severed instantly.[95] Three categorical variables were constructed to indicate whether the firm was established as a private firm (*de novo*), was privatised (*privatised*) or is state owned (*state*).

4.4 Results

The measures of the political environment described above are country specific. The reported coefficients for the Voice and Accountability, Polity and Polyarchy measures are therefore likely to pick up other effects such as GDP and moral/social attitudes to corruption. Several steps are taken to try and alleviate this problem. First, a measure of real GDP per capita is included.[96] It is likely (but not assured) that more developed countries will have lower levels of corruption. Thus, political variables may capture some of this effect if a measure of real GDP is not included. We also estimate models which allow for country specific effects. It is not possible to identify all the country specific relationships which may exist with regard to corruption. The inclusion of an expanded intercepts model allows this

[95] Care needs to be take here. We refer to state owned firms as being less likely to be corrupt because the yield influence over policy makers. This, of course, is another form of corruption where influence, rather than cash flows is a means to change regulation or escape its effects. The Hellman, Jones and Kaufmann (2000) consider this type of corruption in detail. In this paper, we are concerned with payment based corruption.

[96] This is taken from the *World Development Indicators* (World Bank, 2002b). The measure is 1999 real GDP per capita expressed in 1995 US dollar prices.

type of bias to be removed and enables us to concentrate on the variables of interest.[97]

All regressions examining the determinants of petty corruption are estimated using an ordered probit model. The use of this type of model is especially suited to cases where the dependent variable is ordinal. Consider the following model of petty corruption:

$$y_i^* = \beta' X_i + e_i \qquad i=1,2,\ldots,n$$

where

y^* is the actual percentage of revenues paid in bribes, X represents a set of independent variables and e_i is the random error term. In practice, the latent variable, y^* is not directly observed. Instead, the survey data provide us with the following information:[98]

$$y_i = \begin{cases} 1 \text{ if } y_i^* = 0 \\ 2 \text{ if } 0 < y_i^* < 1\% \\ 3 \text{ if } 1 \le y_i^* \le 1.99\% \\ 4 \text{ if } 2 \le y_i^* \le 9.99\% \\ 5 \text{ if } 10 \le y_i^* \le 12.99\% \\ 6 \text{ if } 13 \le y_i^* \le 25\% \\ 7 \text{ if } y_i^* > 25\% \end{cases}$$

With data such as these, use of OLS regression will treat a move from say 1 to 2 as the same as a move from 5 to 6. The former involves a maximum change in the corruption level of 1 percent, while for the latter, the change could be as high as 12 percent. One possible remedy would be to assign a value to each category. For example, category 6, which captures the range of 13 to 25 percent could be assumed

[97] Heteroskedasticity was considered likely, a matter discussed in more detail later in this chapter (see page 94). All regressions were estimated using Huber-White robust standard errors.
[98] In the case of the dependent variable for grand corruption, the thresholds are effectively unknown.

to take on a value of (say) 19 percent.[99] However this imposes a restriction on the level of the dependent variable. When responding, each firm makes an approximation of the level of corruption and assigns this to the appropriate category. As such, the boundaries of each category can be interpreted as threshold parameters which denote the transition from one level of corruption to another. We cannot make assumptions about the distribution of each category. Using an ordered probit model, under the assumption that the term e_i is normally distributed ($e_i \sim (0,1)$), we can calculate the conditional probability of a firm being in any particular category.

$$\Pr(y=1) = \Phi(-\beta' X)$$
$$\Pr(y=2) = \Phi(1-\beta' X) - \Phi(-\beta' X)$$
$$\Pr(y=3) = \Phi(1.99-\beta' X) - \Phi(1-\beta' X)$$
$$\Pr(y=4) = \Phi(9.99-\beta' X) - \Phi(1.99-\beta' X)$$
$$\Pr(y=5) = \Phi(12.99-\beta' X) - \Phi(9.99-\beta' X)$$
$$\Pr(y=6) = \Phi(25-\beta' X) - \Phi(12.99-\beta' X)$$
$$\Pr(y=7) = 1-\Phi(25-\beta' X)$$

Where $\Phi(.)$ is the cumulative distribution function of the standard normal $N(0,1)$.

While the ordered probit model accommodates the discrete nature of the data, the interpretation of the estimated coefficients can be problematic. In particular, the coefficient does not represent the marginal probability of being in any particular category. However, the sign of the coefficient is instructive as to the probability of being in either of the two extreme categories. For example, in the model outlined above, suppose the estimated coefficient on the *Polyarchy* variable is negative. This implies that as this variable increases, the probability of being in the highest (lowest) category decreases (increases). However, for the middle five

[99] This strategy is adopted by the Hellman, Jones and Kaufmann (2000).

categories of the dependent variable, the interpretation may be ambiguous.[100] This may explain why Hellman, Jones and Kaufmann (2000) study makes assumptions about the level of corruption implied by each categorical response and estimates a model using OLS. This allows the coefficients to be interpreted as the marginal effect on the percent of revenues paid in bribes from a change in the variable of interest. However, the results are somewhat sensitive to the assumptions made about the level of corruption. Appendix B.1 (Table B5) presents a model which was estimated using OLS as per the Hellman, Jones and Kaufmann (2000) study. Sensitivity analysis was then conducted by assuming different levels of corruption for each category. The results for the *Polyarchy* variable revealed that the reported coefficient had a range of –0.11 to –0.31, depending on the assumptions made regarding the dependent variable. This obviously implies a potential margin of error.[101] In the results which follow, we prefer not to make this type of assumption. The hypotheses being tested here are based upon the comparative static results of paper 1. Of primary interest is thus the sign of the coefficients. Where threshold analysis is undertaken to test the strength of political competition in lowering petty corruption under differing levels of enforcement, the relative size of the coefficients is sufficient. This is facilitated by the fact that each coefficient is instructive regarding the extreme categories of the dependent variable (as outlined above).

[100] For a detailed summary, see Greene (2003) pp737-738. *Stata* software does allow the marginal effects of each variable on the probability of each outcome of the dependent variable to be estimated. Results from such estimation are presented in Appendix B.1 (Tables B6 and B7).

[101] Full results of regressions for a simplified model appear in Appendix B.1 (Table B5). Of course, only a small number of different combinations of values for the dependent variable were used. In reality, there are virtually an infinite number of different specifications.

4.4.1 Petty Corruption

Table 4.1 contains 2 basic specifications of the model. In the first, all of the hypothesised determinants discussed earlier are included. Model 2 is a more parsimonious specification, in particular omitting some of the variables which may be highly correlated with other variables in the regression. Country specific effects are included, however the coefficients are not reported here.[102] Appendix B.1 (Tables B8 and B9) reports the estimated results where country specific effects are not included.

A potential problem in estimating the model was the potential for heteroskedasticity. In determining a model which explains corruption, it is unlikely that all relevant variables will be captured. Heteroskedasticity will thus arise where these omitted variables are picked up in the error term. Similarly, firms surveyed in a particular country may also have general characteristics which differ widely from their overseas counterparts, which could imply that the variation in their propensity to be corrupt may also be systematically different. While an attempt has been made to allow for such country specific effects, it is likely that these differences will result in heteroskedasticity in this type of model. Unfortunately, testing for heteroskedasticity in an ordered Probit model using *Stata* software is problematic. First, tests such as the White test, which is optimal in this instance given that the exact form of heteroskedasticity is unknown, have no counterpart using maximum likelihood estimation. This is due to the fact that with heteroskedasticity, maximum

[102] Country specific effects are included to correct for country specific bias. The coefficients obtained are not of interest in testing the hypotheses stated in section 4.2. A sample of these are presented in Appendix B.1 (Tables B10 and B11) (estimation using the *Polyarchy* variable).

likelihood estimation is inconsistent.[103] Further, the *Stata* software did not enable residuals to be predicted after estimation using the ordered Probit model.

To conduct a rough test for heteroskedasticity, 'pseudo residuals' were calculated using the following procedure. First, the model was estimated and probabilities for each category of the dependent variable were calculated. The observed (dependent) variable was identified and an 'error' of 1 minus the predicted probability for that category obtained. This process generated a series of errors for each observation. For each of the regressions using the *Polyarchy* variable presented in Tables 4.1 and 4.1, a plot of the errors against the observed values of the dependent variable was made. These appear in Appendix B.1. A visual inspection suggests that there is indeed a heteroskedasticity problem.[104] A test of normality for each residual series was also conducted. In all cases, the null of a normal distribution was rejected.[105]

Correction for heteroskedasticity was undertaken by using the Huber White (H-W) robust standard errors as generated using *Stata* software. The details surrounding the calculation of the H-W standard errors is detailed in Wooldridge (2002, p55-58), who notes that these standard errors are asymptotically valid in the presence of heteroskedasticity, regardless of its form. Thus, statistical inference can be made regarding the estimated coefficients. Notwithstanding, potential inconsistency of the estimates makes the efficiency of the standard errors for statistical inference somewhat redundant. Unfortunately, it is likely that heteroskedasticity and its associated problems are not easily dealt with using the

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[103] I am grateful to Bill Becker/Bill Greene for pointing this fact out. Inconsistency in ML estimation arises because, unlike in OLS regression where unbiasedness is achieved provided the independent variables and the error are not correlated, the residuals from a Probit estimation are a construct of the estimation process itself.

[104] The *Stata* do file used to complete this appears in Appendix B.2 (B.2.3).

[105] A Shapiro-Francia test was used. The test statistics obtained were as follows. Petty Corruption: 6.17 (Model 1), 5.65 (Model 2). Grand: 9.045 (Model 1), 9.045 (Model 2). All of these reject the null at $p<0.0000$.

current data set. As such, the results which follow should be taken with some degree of caution.

When country specific effects are included, many of the coefficients are unchanged regardless of the measure of political competition used.[106] The measures of political competition provided by Kaufmann *et al.* (*Accountability)* and the Polyarchy data set (*Polyarchy*) are negative and significant. This suggests that firms from countries where political competition is strong are less likely to be corrupt. With the exception of the *Polity* variable, there is general overall support for the hypothesis that the level of petty corruption is inversely related to political competition. Interestingly, *Real GDP per capita* is not significantly associated with lower levels of petty corruption.[107] Interaction terms of real GDP and the quality of the police and judiciary were also included to control for institutional effects in estimating the effects of GDP. Neither of these variables reach significance.

Our proxy for the stringency of regulation (*Stringency*) provides support for the notion that where the burden of regulation is higher, so too are the gains from engaging in corrupt behaviour. We also find that, as expected, measures of the quality of the police (*Police*) and the ability of the judiciary to uphold property rights (*Security of Property Rights*) are both inversely related to the level of petty corruption and are both significant. These results hold for both specifications of the model.

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[106] This is because the only variable to change in each specification is country specific – i.e. the measure of political competition. Thus, the only changes are to the coefficients of the country specific effects and real GDP per capita, both of which are common to all firms within a particular country.

[107] The real GDP measure is divided by 100. The coefficient thus represents the effect of a $100 change in real GDP per capita.

Table 4.1: Petty Corruption – Country Specific Effects

	Model 1			Model 2		
Accountability	**-0.313** (0.015)			**-0.407** (0.012)		
Polity		**-0.0003** (0.982)			**0.0018** (0.886)	
Polyarchy			**-0.013** (0.044)			**-0.013** (0.031)
Stringency	**0.205** (0.000)	**0.205** (0.000)	**0.205** (0.000)	**0.195** (0.000)	**0.195** (0.000)	**0.195** (0.000)
Security of property rights	**-0.063** (0.003)	**-0.063** (0.003)	**-0.063** (0.003)	**-0.063** (0.002)	**-0.063** (0.002)	**-0.063** (0.002)
Quality of Police	**-0.089** (0.000)	**-0.089** (0.000)	**-0.089** (0.000)	**-0.093** (0.000)	**-0.093** (0.000)	**-0.093** (0.000)
AFS (y/n)	**-0.048** (0.318)	**-0.048** (0.318)	**-0.048** (0.318)			
Market Power	**0.031** (0.612)	**0.031** (0.612)	**0.031** (0.612)	**0.057** (0.315)	**0.057** (0.315)	**0.057** (0.315)
Small	**0.305** (0.000)	**0.305** (0.000)	**0.305** (0.000)	**0.311** (0.000)	**0.311** (0.000)	**0.311** (0.000)
Medium	**0.218** (0.001)	**0.218** (0.001)	**0.218** (0.001)	**0.241** (0.000)	**0.241** (0.000)	**0.241** (0.000)
Large						
Exporter (y/n)	**-0.002** (0.972)	**-0.002** (0.972)	**-0.002** (0.972)			
De novo	**-0.065** (0.441)	**-0.065** (0.441)	**-0.065** (0.441)			
Privatised	**-0.102** (0.233)	**-0.102** (0.233)	**-0.102** (0.233)			
State owned						
Real GDP/capita	**-0.0018** (0.284)	**-0.0035** (0.053)	**-0.0016** (0.396)	**-0.0016** (0.329)	**-0.0038** (0.021)	**-0.0023** (0.210)
RGDP_Police	**-.0.0002** (0.538)	**-.0.0002** (0.538)	**-.0.0002** (0.538)	**-0.0022** (0.437)	**-0.0022** (0.437)	**-0.0022** (0.437)
RGDP_crt	**-0.0002** (0.387)	**-0.0002** (0.387)	**-0.0002** (0.387)	**-0.0009** (0.732)	**-0.0009** (0.732)	**-0.0009** (0.732)
LL	**-4275**	**-4275**	**-4275**	**-4797**	**-4797**	**-4797**
p>chisq (Wald)	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Pseudo R^2	**0.1705**	**0.1705**	**0.1705**	**0.1634**	**0.1634**	**0.1634**
n	**3249**	**3249**	**3249**	**3625**	**3625**	**3625**

a. Dependent variable is percent of revenues paid in bribes (categorical).
b. p values in parentheses.
c. p values based upon Huber White robust standard errors.
d. Real GDP per capita sourced from WDI (2000). Reported coefficients are for real GDP per capita divided by 100.
e. Country specific effects estimated but not reported.
f. A correlation matrix for the explanatory variables is provided in Appendix B (Table B12)

The results suggest some interesting relationships between the characteristics of the firm and petty corruption. First, small and medium sized firms are more likely to engage in petty corruption than their larger counterparts. This

could provide support for the 'grabbing hand' hypothesis or alternately could reveal something about the preferred or most accessible means of corruption for smaller firms. Contrary to expectations, it is found that private and privatised firms are less likely to be corrupt than state owned firms, though the relationship is not significant.

The sign of the coefficient for *Market Power* is positive, though the it fails to reach significance. Earlier it was suggested that firms who have market power would be able to form lobby groups more easily and thus tend to rely on grand corruption. Where the two forms of corruption are substitutes, firms with market power would be less likely to engage in petty corruption. There appears to be little support for this notion in these results. One interpretation of a positive coefficient may be that firms with market power may earn higher rents which in turn imply that there higher gains to corruption for these firms. Given that the coefficient fails to reach significance, this relationship cannot be conjectured from this study and is left as an issue for future research.

4.4.2 Grand Corruption

The estimated models of grand corruption appear in table 4.2. Again, a country specific effects model is estimated.[108]

In general, the results suggest that higher levels of political competition actually may increase the likelihood of grand corruption, although only the *Polyarchy* variable is significant.[109] This result is of major significance for the

[108] Results of a simplified estimation ignoring country specific effects are included in Appendix B.1 (Tables B8 and B9).

[109] Despite the fact that the sample for grand corruption contains only transitional economies of eastern Europe, it is important to note that there is still substantial variation between countries in the measures of political competition. For example, With the sample used for the analysis of petty corruption, which includes 50 countries, the mean and standard deviation of the Polyarchy variables were 18.04 and 11.47 respectively. For the sample used in the analysis of grand corruption, the

design of anti-corruption programmes, which currently assume that increased levels of political competition will reduce corruption of both types. Our results suggest that, as predicted by the theoretical model presented in chapter 3, grand corruption cannot be reduced by political competition.[110] In fact, the results go further and suggest we may see an increase in grand corruption as a result of greater political competition. Further empirical and theoretical work is required to examine the possibility that as political competition increases, there is a substitution from petty to grand corruption.

An extra variable used to measure the amount of time senior management spend with senior government officials was also included. This was hypothesised to be positively associated with greater grand corruption – firms with greater access to those in power having more potential influence (and perhaps acting as a proxy for the ability to lobby).[111] This variable is of the expected sign and significant.

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corresponding figures are 22.27 and 10.67. The equivalent results for the accountability variable are: μ (petty) = 2.19, σ(petty) = 0.82 versus μ(grand) = 2.09 σ(grand) = 0.74. For the polity measure: μ (petty) = 4.5, σ(petty) = 5.5 versus μ(grand)=5.04 σ(grand) = 5.3.

[110] Recall that Treisman (2000) found there to be no significant relationship between corruption and *short run* democracy. As this sample incorporates countries for whom the democratic process is evolving, the result appears consistent with Treisman's findings.

[111] Grossman and Helpman (2001) note that access to legislators is commonly sought by special interest groups (SIGs). They report evidence that 36% of SIGs identify this as their most time and resource consuming behaviour.

Table 4.2: Grand Corruption – Country Specific Effects

	Model 1			Model 2		
Accountability	**0.381** (0.153)			**0.366** (0.164)		
Polity		**0.019** (0.379)			**0.0186** (0.409)	
Polyarchy			**0.022** (0.039)			**0.0245** (0.017)
Stringency	**0.267** (0.000)	**0.267** (0.000)	**0.267** (0.000)	**0.269** (0.000)	**0.269** (0.000)	**0.269** (0.000)
Security of property rights	**-0.022** (0.603)	**-0.022** (0.603)	**-0.022** (0.603)	**-0.058** (0.050)	**-0.058** (0.050)	**-0.058** (0.050)
Quality of Police	**-0.105** (0.016)	**-0.105** (0.016)	**-0.105** (0.016)	**-0.073** (0.011)	**-0.073** (0.011)	**-0.073** (0.011)
AFS (y/n)	**0.019** (0.818)	**0.019** (0.818)	**0.019** (0.818)			
Market Power	**-0.012** (0.892)	**-0.012** (0.892)	**-0.012** (0.892)			
Small	**-0.093** (0.552)	**-0.093** (0.552)	**-0.093** (0.552)	**-0.143** (0.324)	**-0.143** (0.324)	**-0.143** (0.324)
Medium	**-0.043** (0.75)	**-0.043** (0.75)	**-0.043** (0.75)	**-0.062** (0.633)	**-0.062** (0.633)	**-0.062** (0.633)
Large						
Exporter (y/n)	**0.093** (0.329)	**0.093** (0.329)	**0.093** (0.329)			
De novo	**0.45** (0.000)	**0.45** (0.000)	**0.45** (0.000)	**0.462** (0.000)	**0.462** (0.000)	**0.462** (0.000)
Privatised	**0.27** (0.024)	**0.27** (0.024)	**0.27** (0.024)	**0.276** (0.020)	**0.276** (0.020)	**0.276** (0.020)
State owned						
Time spent with senior officials	**0.077** (0.007)	**0.077** (0.007)	**0.077** (0.007)	**0.085** (0.003)	**0.085** (0.003)	**0.085** (0.003)
Real GDP/capita	**-0.002** (0.713)	**-0.0009** (0.897)	**-0.0009** (0.897)	**.00051** (0.864)	**.00032** (0.332)	**.00089** (0.689)
RGDP_Police	**0.0015** (0.331)	**0.0015** (0.331)	**0.0015** (0.331)			
RGDP_crt	**-0.0014** (0.282)	**-0.0014** (0.282)	**-0.0014** (0.282)			
LL	**-1126**	**-1126**	**-1126**	**-1181**	**-1181**	**-1181**
p>chisq (Wald)	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Pseudo R2	**0.069**	**0.069**	**.069**	**.068**	**0.068**	**0.068**
n	**1649**	**1649**	**1649**	**1649**	**1649**	**1649**

a. Dependent variable is frequency of payments to influence laws and decrees (categorical).
b. p values in parentheses.
c. p values based upon Huber White robust standard errors.
d. Real GDP per capita sourced from WDI (2000). Reported coefficients are for real GDP per capita divided by 100.
e. Country specific effects estimated but not reported.
f. A correlation matrix for the explanatory variables is provided in Appendix B (Table B13).

Again, the coefficient of the *stringency* variable is positive and significant. This indicates that where regulation is more problematic, there is a greater propensity to engage in grand corruption. Greater market power is associated with

less grand corruption, though again the relationship is not significant. Nonetheless, the result is unexpected as market power was hypothesised to be associated with higher rents and importantly, facilitate the formation of lobby groups. As opposed to petty corruption, the sign of the coefficient for small and medium sized firms is negative, suggesting that these firms engage in less grand corruption than their large counterparts. The results, however, are not significant. One reason for this may be that the sample used to analyse grand corruption is biased towards the inclusion of small firms. In particular, only 9 percent of firms were 'large' in the data used for grand corruption models compared with 19.5 percent in the larger sample used to analyse petty corruption. The results tentatively suggest that smaller firms may not have the resources or access to senior officials, promoting more petty corruption and less grand corruption among this group.

In model one, interaction terms are included to control for the quality of institutions. These interactions terms, in addition to the measure of real GDP in both models fails to reach significance.

Finally, a more efficient police force is associated with lower levels of grand corruption. This represents the expected costs which must be offset against the benefits of bribing policy makers. As expected, raising the expected costs deters corruption. This was not the case for the measure of the quality of property rights in the first specification (model 1), perhaps due to colinearity with the interaction term. The second specification, which does not include interactions supports the hypothesis that a more efficient judiciary will reduce corruption.

4.4.3 Threshold Analysis – Petty Corruption

The model presented in chapter 3 of this thesis suggests that the effect of political competition on petty corruption is contingent on the enforcement infrastructure available to support anti-corruption measures (propositions 1c and 1d). This suggests that there might be some threshold where political competition is ineffective, or as suggested by the model, even generates greater levels of petty corruption. To test for this, a simple procedure of breaking the data into 'high' and 'low' enforcement regimes is used. We specify a simplified model, ignoring country specific effects, other than by using a measure of real GDP per capita.[112,113] The absence of these country specific effects suggests that the results should be interpreted with caution. For each value of the *property rights* variable, we run a separate ordered probit model. The following provides definitions of the 5 thresholds estimated:

	Threshold Values for *Security of Property Rights*	
Threshold 1	<2	≥2
Threshold 2	<3	≥3
Threshold 3	<4	≥4
Threshold 4	<5	≥5
Threshold 5	<6	=6

Security of Property Rights coded in the WBES, 2000 from 1 (very bad) through 6 (very good) – for details see Appendix B.1.

[112] When regressions were attempted on a small subset of data (for example, when the *property rights* variable was at its minimum) using country specific effects, the ML estimator failed to achieve convergence (i.e. we again encounter an incidental parameters problem).

[113] The model specified is: petty corruption = *f(accountability/Polyarchy, stringency, police, small, medium, real gdp per capita).*

Using these thresholds allows analysis of the effect of political competition, holding the level of enforcement fixed.[114] We conduct the analysis using use the *Accountability* measure of Kaufmann *et al.* and the *Polyarchy* measures of governance. The results for these variables, contingent on the split of *Security of Property Rights* are presented in Tables 4.3 and 4.4.

With the exception of thresholds 4 and 5 using the voice and accountability measure, the effect of political competition when property rights are relatively more secure, appears to be greater.

The threshold analysis using Vanhanan's measure of governance (*Polyarchy*) yields particularly promising results. If we first consider the results for the model when all data are used (i.e. under the null that there is no threshold), we can see that the coefficient for Polyarchy is negative but not significant. In earlier specifications of the model which were presented in Table 4.1, this variable was negative and significant. The difference between the two models is the exclusion of the variable measuring property rights.[115] This may *a priori* indicate that political competition as measured by the *Polyarchy* variable is dependent on the level of enforcement. Importantly, for each threshold, the value of the coefficient for *Polyarchy* is larger when enforcement is greater and does not have a significant effect in any of the 'low enforcement' sub-samples. Further, in the models where the sample is restricted to observations where the *Security of Property Rights* variable is less than 3, the coefficient is positive, suggesting that increased political competition may be associated with greater levels of petty corruption (though the coefficients are not significant). The tables reveal that political competition has a

[114] It is likely that the political system is also correlated with the level of enforcement. In these data, the correlation between *Accountability* and *Security of property rights* is 0.13. The *Polyarchy* variable is less correlated with the *security of property rights* (ρ=-0.05)

[115] This variable cannot, for obvious reasons of co-linearity, be included in the specification for the purposes of threshold analysis.

stronger corruption reducing effect when enforcement is relatively strong for all threshold estimates using the *Polyarchy* measure.

When threshold analysis is undertaken, the effect of political competition in the sub-sample which captures the higher level of enforcement appears generally to be greater. However, is the difference significant? As the covariance between the political competition variables in the high and low enforcement samples could not easily be calculated, a bootstrap procedure was used in lieu of a standard *t* test to create confidence intervals for the difference between the high and low enforcement groups. From the original data set of T observations, a sample with replacement was drawn until a bootstrap sample of the same size (T) was obtained. The threshold models were then estimated and the difference in the coefficients of the variable measuring the effect of political competition was obtained. The process was repeated 1000 times in order to generate confidence intervals.[116] The results appear in tables 4.5 and 4.6.

[116] For an overview of bootstrap measures in general, see Chernick (1999). The Stata 'Do file' used to generate the results in Table 4.6 is reproduced in Appendix B.2.

Table 4.3: Threshold Regressions – Voice and Accountability

	Threshold 1		Threshold 2		Threshold 3		Threshold 4		Threshold 5		Total sample
Security of property rights	**<2**	**≥2**	**<3**	**≥3**	**<4**	**≥4**	**<5**	**≥5**	**<6**	**=6**	
Accountability	**-0.132** (0.226)	**-0.169**** (0.000)	**-0.149** (0.033)	**-0.163**** (0.000)	**-0.163**** (0.001)	**-0.149**** (0.000)	**-0.18**** (0.000)	**-0.137**** (0.007)	**-0.162**** (0.000)	**-0.24*** (0.016)	**-0.168**** (0.000)
Stringency	0.073	0.119**	-0.049	0.156**	0.064	0.144**	0.083*	0.161**	0.083**	0.237*	0.116**
Police	-0.050	-0.159**	-0.147**	-0.138**	-0.171**	-0.406**	-0.16**	-0.084**	-0.151**	0.086	-0.152**
Small	0.539*	0.569**	0.809**	0.502**	0.718**	0.455**	0.557**	0.554**	0.55**	0.808**	0.573**
Medium	0.497*	0.408**	0.614**	0.372**	0.537**	0.341**	0.439**	0.307**	0.414**	0.399*	0.418**
Real GDP	-0.004*	-0.003**	-0.005**	-0.004**	-0.003**	-0.004**	-0.003**	-0.005**	-0.004**	-0.006**	-0.004**
n	282	3343	702	2923	1410	2215	2558	1067	3264	361	3625
LL	-483.03	-4826.74	-1172.78	-4126.62	-2296.83	-2993.66	-3971.54	-1319.8	-4930.36	-353.04	-5317.44
Pseudo R^2	0.033	0.074	0.054	0.071	0.051	0.075	0.057	0.097	0.063	0.134	0.073
LL Total	-5309.77		-5299.4		-5290.49		-5291.34		-5283.4		n/a

a. p values for 'voice and accountability' in parentheses.
b. *significant at p<0.05
c. **significant at p<0.01
d. all regressions obtained using Huber-White robust standard errors.

Table 4.4: Threshold regressions – Polyarchy

	Threshold 1		Threshold 2		Threshold 3		Threshold 4		Threshold 5		Total sample
Security of property rights	**<2**	**≥2**	**<3**	**≥3**	**<4**	**≥4**	**<5**	**≥5**	**<6**	**=6**	
Polyarchy	**0.007** (0.299)	**-0.003*** (0.05)	**0.002** (0.565)	**-0.005*** (0.022)	**-0.002** (0.487)	**-0.005*** (0.033)	**-0.002** (0.317)	**-0.009*** (0.018)	**-0.003** (0.122)	**-0.010** (0.172)	**-0.003** (0.167)
Stringency	0.048	0.112**	-0.06	0.146**	0.051	0.136**	0.064	0.157**	0.073*	0.242*	0.106**
Police	-0.049	-0.158**	-0.141**	-0.135**	-0.17**	-0.103**	0.159**	-0.081**	-0.149**	-0.08	-0.15**
Small	0.502*	0.591**	0.788**	0.524**	0.72**	0.473**	0.572**	0.562**	0.567**	0.8337**	0.593**
Medium	0.461	0.421**	0.597**	0.385**	0.545**	0.353**	0.449**	0.312**	0.424**	0.406*	0.428**
Real GDP	-.00006*	-.00005**	-.00006	-.00004**	-.00004**	-.00005**	-.00004**	-.00006**	-.00004**	-.0007**	-.00005**
n	282	3343	702	2923	1410	2215	2558	1067	3264	361	3625
LL	-483.02	-4838.42	-1174.63	-4135.09	-2301.47	-2999.51	-3982.2	-1319.18	-4941.24	-354.57	-5331.13
Pseudo R^2	0.033	0.072	0.053	0.069	0.049	0.074	0.054	0.097	0.061	0.13	0.07
LL Total	-5321.44		-5309.72		-5299.98		-5301.38		-5295.81		n/a

a. p values for 'Polyarchy' in parentheses.
b. *significant at p<0.05
c. **significant at p<0.01
d. all regressions obtained using Huber-White robust standard errors.

Table 4.5: Bootstrap Generated Confidence Intervals – Voice and Accountability

Threshold	*High Enforcement*	*Low Enforcement*	*Difference*
1	-0.172 : -0.168	-0.136 : -0.117	-0.053 : -0.034
2	-0.166 : -0.162	-0.153 : -0.142	-0.023 : -0.01
3	-0.153 : -0.148	-0.168 : -0.16	0.009 : 0.018
4	-0.142 : -0.133	-0.186 : -0.18	0.04 : 0.05
5	-0.248 : -0.231	-0.166 : -0.161	-0.084 : -0.067

Table 4.6: Bootstrap Generated Confidence Intervals – Polyarchy

Threshold	*High Enforcement*	*Low Enforcement*	*Difference*
1	-0.0041 : -0.0038	0.0076 : 0.0087	-0.0123 : -0.0115
2	-0.0052 : -0.0048	0.0021 : 0.0028	-0.0079 : -0.0071
3	-0.0056 : -0.0052	-0.0025 : -0.0021	-0.0034 : -0.0027
4	-0.0088 : -0.0082	-0.0027 : -0.0023	-0.0063 : -0.0056
5	-0.01 : -0.0088	-0.0035 : -0.0031	-0.0067 : -0.0055

Tables 4.5 and 4.6 reveal respective 99 percent confidence intervals for the *Accountability* and *Polyarchy* measures of political competition. The first column of each table provides the confidence interval for the coefficient estimated using the sub-sample with the relatively high level of property rights. The second column presents the same interval for the coefficient estimated using the sub-sample with low property rights. For each of the 1000 repetitions, the difference between the coefficients in each sub-sample was recorded (coefficient for the high enforcement group minus that of the low enforcement group). The confidence interval for this measure is presented in column 3. A negative value indicates that political competition has a stronger anti-corruption effect when enforcement is strong.[117]

[117] This is because, in general, the coefficients are negative. It is possible that in the bootstrap, we could obtain two positive values. In this circumstance, the difference would be negative where the

The tables reveal that coefficient on the *Polyarchy* variable has a stronger anti-corruption effect when enforcement is strong at any threshold. For example, examining threshold 1 in Table 4.6, note that the 99 percent confidence interval for the *Polyarchy* variable in the high enforcement sub-sample is always negative (range of -0.0041 to -0.0038) while in the low enforcement sub-sample, the confidence interval lies in the positive range (0.0076 to 0.0087). Indeed, for the first two thresholds, the confidence interval for the coefficient estimated from the 'low enforcement' sub-sample is positive, indicating that greater political competition actually may increase the level of petty corruption. The *Accountability* measure has a greater 'anti-corruption' effect in the high enforcement sub-sample for thresholds 1, 4 and 5. Interestingly, however, thresholds 3 and 4 reveal the opposite result.

A second way to test the validity of the threshold hypothesis is to examine the overall fit of the model and compare this to the fit of a restricted model (no threshold). Examination of the log-likelihood ratios in tables 4.3 and 4.4 reveal that for both the *Accountability* and *Polyarchy* variables, any of the threshold regressions provide a better fit than the restricted model. In both cases, the best fitting model appears to be obtained by splitting the sample on the *Security of Property Rights* variable as per Threshold 5.[118] A likelihood ratio test (LR) can be used to indicate whether the improved fit is significantly better. The test is based on the critical value of the chi square distribution with the number of restrictions determining the number of degrees of freedom. Such a test, however, under these

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coefficient on political competition for the high enforcement sub-sample is less than that of the corresponding variable in the low enforcement sub-sample. Thus, on a number scale basis, this would still indicate that the high enforcement result has stronger 'anti-corruption' tendencies. In any event, this occurred only four times for the bootstrap using Polyarchy and nine times using voice and accountability (out of 1000).

[118] Thus two sub-samples are obtained – one where the *Security of Property Rights* is at a maximum (equal to six) and the other which incorporates the remainder (less than six).

circumstances may not yield robust results. This is because under the null hypothesis, we estimate a model which is restricted to the entire sample. Thus, the null hypothesis is that there is no threshold, while the alternate is that there is a threshold at some split between property rights. This could be any split as per tables 4.3 and 4.4. As we cannot say with certainty at which point the threshold occurs, we have 'nuisance parameters' under the alternative which do not appear under the null. Under these circumstances, the standard LR test is not optimal.[119] To overcome this, we adopt the procedure described below to generate a bootstrap sample of the LR statistic.[120]

- Estimate the restricted model (i.e. under the null hypothesis of no threshold).
- Assuming that the null is correct, use the regression results to generate probabilities for each category of the dependent variable.
- Generate a random sample of observations uniformly distributed on (0,1).
- Map this sample to the estimated probabilities under the null to generate a new dependent variable.
- Run the restricted and unrestricted models using the generated data
- Obtain the LR statistic
- Repeat the process 10,000 times.

The value of the LR test statistics for the *Accountability* and *Polyarchy* samples are 68.09 and 70.64 respectively.[121] The respective critical values of the

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[119] In particular, choosing the degrees of freedom for the LR test is problematic. See Andrews and Ploberger (1995) for a more rigorous discussion of this problem.

[120] Stata 'Do files' which were written to perform this bootstrap are included in the Appendix B.2.

[121] Where the LR test statistic is equal to $2(LL_{unrestricted} - LL_{restricted})$. For both the *Polyarchy* and *Accountability* measures, the LR statistic was calculated using threshold 5. Using data from Tables 4.3 and 4.4, the calculations were: *Polyarchy*: $\text{LR} = 2(-5295.81-(-5331.13)) = 70.64$.

Accountability: $\text{LR} = 2(-5283.4-(-5317.44)) = 68.08$

bootstraps following the above procedure ($p<0.01$) are 30.07 and 31.31. Thus, we can reject the null that there is no threshold for each case.

Overall, the results suggest that the when examining the effects of political competition on petty corruption, inclusion of a threshold is warranted. This is particularly the case when using the Polyarchy data to proxy for political competition. The results suggest that where enforcement is weak, the corruption reducing effects of political competition are reduced or even reversed. The results here do not include country specific effects due to data constraints, however real GDP per capita was included to try and capture some of the possible bias. The results are therefore only suggestive at this stage.

4.5 Conclusion

This paper examines the determinants of petty and grand corruption using data from the WBES (2000). It is the first study using this data set to comprehensively examine the effect of political competition on the level of each type of corruption.

The results show that there is tentative support for the hypothesis that political competition is associated with lower levels of petty corruption. The data suggest that this relationship is weaker when enforcement mechanisms are weak. In fact, it may even be reversed. Thus, there is empirical support for the relationship between petty corruption and political competition derived in chapter 3.

The evidence suggests that grand corruption is not reduced by political competition and that the relationship may even be reversed. This could imply that as the political system becomes more competitive, we see a substitution from petty to grand corruption. However, the results at this stage are not strong enough to allow such a conclusion to be drawn. In particular, only a small subset of countries

were included in the sample used to examine grand corruption, all of whom have only limited experience with democracy. However, the results are suggestive and certainly warrant further investigation.

Both forms of corruption are also shown to increase when the regulatory burden is large. Heavy regulation implies greater rewards from corrupt activities. This suggests that the marginal impact of policies tends to decrease as they become more stringent. This finding has implications for interpreting the effect of welfare enhancing policies such as pollution controls. Such knowledge is important when evaluating the possible effects of international agreements for pollution control such as the (now defunct) Kyoto Protocol, where the level of stringency and the constraints to corruption differ between participants.

Chapter 5

The Influence of Lobby Groups on Public Opinion: The Case of Environmental Policy.

5.1. Introduction

In chapter 2, an overview of the Grossman and Helpman (1994) common agency model of endogenous policy formation was presented. By making political contributions, special interest groups were shown to be able to induce government to deviate from the welfare maximising policies. There would seem little doubt that this model provides a rich framework by which to understand the process of policy formation under the influence of special interests. It has been applied to a wide range of policy issues and has received substantial empirical support.[122]

There have been several applications of Grossman and Helpman's model to the analysis of environmental policy (see, for example, Fredriksson (1997a,1999), Aidt (1998), Schleich (1999) and Damania (2002b)). In these models, rival polluting and environmental interests typically compete with one another by making contributions to government. Greater policy concessions are shown to fall the way of those groups who have a greater stake in the policy issue (and who have a greater preparedness and ability to pay).

Interestingly, contributions made by interest groups with environmental concerns are dwarfed by those of polluting interests. For example, during the 2002 election cycle in the U.S., environmental groups contributed $US1.4 million compared with total contributions by the energy and natural resources sector of

[122] For example see Gawande and Bandyopadhyay (2000); Goldberg and Maggi (1997); Mitra *et al.* (2002) ; McCalman (2004).

$US57.8 million.[123] How might we interpret this? In theory, this could suggest that environmental groups stand to gain little by influencing environmental policy. However, their actions would not seem consistent with this view. In particular, spending of environmental groups seems to be directed towards other types of activity. For example, during the period 2001/2002, the Sierra Club spent $US77 million dollars on programmes designed to combat environmental damage, some of which involved directly educating members of the public. Perhaps most striking is that only $US518,871, or 0.67% of this expenditure took the form of political contributions.[124] This pattern of expenditure would suggest that the ability or willingness of the Sierra Club to use such contributions is limited. Nonetheless, environmental groups like the Sierra Club do appear to have significant influence over policy outcomes.

This chapter seeks to provide a more complete explanation of environmental policy formation by considering the provision of information to an uncertain public regarding the level of environmental damage. It is shown that this type of indirect lobbying enables environmental interests to influence policy even when their rivals continue to make Grossman and Helpman type contributions.

The premise behind any democracy is that public policy will reflect the beliefs and preferences of citizens. However, public policy is made up of a myriad of complex and numerous issues, and it is well established that voters will not find it optimal to become informed about each.[125] Thus, policy outcomes may become a

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[123] Of this, $US24.9 million and $US21.5 million were contributed from the 'Oil and Gas' and 'Electric Utilities' respectively. For more details, see www.opensecrets.org and www.opensecrets.org/payback/issue.asp?issueid=EN2&&&&CongNo=108 , accessed 11/3/04.

[124] Details of political contributions obtained from www.opensecrets.org , accessed 11/3/04. Expenditure details taken from the Sierra Club Foundation 2002 Annual Report, available online at www.sierraclub.org/foundation/inside/tscf2002.pdf , accessed 11/3/04.

[125] This turns on the fact that the marginal effect an individual voter has on an election outcome approaches zero. See, for example, Olson (1965), Rodrik (1995).

function of how informed, or ignorant, voters are. Some studies have recognised this, however, very few have focused on the role of indirect lobbying by special interests.

One arm of the existing literature considers how mass media effects voting behaviour and policy outcomes. In a recent contribution, Stromberg (2004) considers competition between mass media producers and the resultant incentives regarding who the delivery of information should be targeted towards. Not surprisingly, it is found that larger groups will tend to be the focus of attention for the mass media. Information dissemination and public policy thus becomes biased towards the interests of these large groups. Politicians are shown to react simultaneously by implementing policy changes which reflect the changes in awareness of these voters. This has the effect of negating any potential changes in voting behaviour or preferences of those receiving information from the mass media. The result is consistent with empirical studies which show that while mass media can generate a more accurate perception of rival political parties positions, it does not have a significant effect on voting behaviour (Lazarsfeld *et al.* (1944); Bartels (1993)).

Some authors have also considered the role of information in a quite different setting – that of wage arbitration. For example, Farber (1980) provides a model where an arbitrator holds an exogenous belief regarding the level of a fair outcome in a wage dispute. The opposing parties (an employer and employee) submit bids to the arbitrator who then chooses the bid which is closest to her predetermined belief. In this model, the cost of sending a message takes the form of the probability that a bid will not be accepted. Clearly, these expected costs rise when a more extreme bid is presented to the arbitrator. It is shown that more risk

averse agents will typically submit bids closer to the arbitrator's ideal and thus will have a higher chance of receiving a settlement in their favour.

A crucial problem with Farber's model is that the arbitrator's ideal settlement is independent of the offers made by the parties. Gibbons (1988) attempts to deal with this problem by constructing a model where the arbitrator is able to acquire information from the offers submitted by each of the parties. In his model, there exists information regarding the employment relationship between the two parties, the knowledge of which enables a fair settlement to take place. The arbitrator, however, has imperfect information regarding this, while the parties are relatively better informed. Upon receiving offers, the arbitrator uses Bayes' rule to update her beliefs regarding the true state of the employment relationship. Gibbons demonstrates the existence of separating equilibria where the arbitrator can perfectly infer the parties estimation of the employment relationship. In this type of equilibrium, the arbitrator extracts the maximum possible information from the offers.

Several other studies use a signalling framework similar to that of Spence (1973). Building on Crawford and Sobel's (1982) model of costless signalling, Grossman and Helpman (2001) consider the role of communication by special interest groups to a relatively uniformed public. The purpose of this communication is to sway voter opinion (and thus policy outcomes) in their favour before politicians settle on a final policy. Each of the lobby groups thus has an incentive to exaggerate their claims regarding the impacts of policy on the public at large. The public use a Bayesian mechanism to update their beliefs once messages are received. It is found that provided the messages are not too extreme – that is, do not deviate 'too much' from the prior beliefs of the public, interest groups can effect a

change in beliefs. The issue of costless signalling is also considered by Schultz (1995), who considers the issue of information provided by relatively well informed politicians to a less informed public regarding the workings of the economy. The analysis centres around the circumstances under which the public may or may not learn from these messages. It is found that polarisation of the opposing parties tends to make the public sceptical about their claims and as such, they remain uniformed. It is argued that such societies incur a cost from political polarization because the resultant policy outcomes will be inelastic to exogenous shocks to the economy.

By far the most relevant piece of research to the model presented in this chapter has been undertaken by Yu (2004). Like this chapter, the aim of his paper is to provide a model whereby special interest groups can influence policy by changing public perceptions regarding environmental damage. In his paper, two opposing special interest groups try and influence environmental policy by making political contributions (direct lobbying) to government and/or sending costly messages to an uncertain public regarding the environmental damage which results from polluting activities (indirect lobbying). Direct lobbying is modelled using Grossman and Helpman's (1994) framework, while indirect lobbying is modelled as a signalling game. An important feature of the model is that messages are costly to send, as opposed to the studies discussed previously, which tend to approach the problem as a 'cheap talk game'. Yu's analysis yields some interesting results. First, it is found that where the costs of sending messages are identical for both groups, the party who is more active in direct lobbying will also expend greater effort in indirect lobbying. However, the introduction of asymmetric costs introduces the possibility that one group will hold a comparative advantage in indirect lobbying. In particular, if the cost of sending messages for the

environmental groups is *sufficiently* lower, it will expend more effort in indirect lobbying and the public will believe that environmental damage is higher. This, it is argued, raises the bargaining power of the environmental group with the government which allows it to reduce political contributions. Thus, a substitution effect between direct and indirect lobbying is established.

Yu's (2004) paper establishes a possible explanation for the observation that environmental groups spend so little on political contributions and a large amount on 'public education'. His theory suggests that this may not be due to monetary constraints faced by environmental groups, but instead reflect some sort of comparative advantage in influencing the public. The model presented in this chapter further explores the ability of environmental groups to influence public perceptions by sending messages. For simplicity, we borrow from Yu (2004) the terminology of 'direct lobbying' to describe the making of contributions to the government and 'indirect lobbying' to imply message sending to influence public beliefs regarding damage.

The case of two special interests groups, one representing environmental concerns and the other polluting interests is again considered. Each group is assumed to have perfect information regarding the actual level of environmental damage. The public, however, remains relatively uniformed. As in Yu (2004), the role of both direct and indirect lobbying is considered. There are however, several key differences. First, only the polluting interests lobby the government. Thus, we implicitly assume that for some reason, the environmental group *a priori* chooses not to make political contributions. A second difference in the modelling approaches between Yu (2004) and the current model is that while both consider the case where costs of sending messages differ between the lobbies, this difference is

imposed exogenously in Yu's model. However, it is well worth considering why the costs might be higher for one group as opposed to the other. For example, it may be that less credible messages are more costly to send. This possibility is allowed for in the present model by incorporating a cost structure which makes it more costly to send false messages. Moreover, these costs rise in the *extent* of the lie. Another key difference is that the public update beliefs not based upon the number of messages received from each group (as per Yu's model), but on the credibility of each message. To this end, it is possible to identify separating equilibria under which the public learn the truth regarding environmental damage.

The results suggests that there are circumstances under which the public will accurately determine the level of environmental damage. If environmental damage does occur, it is shown that the public will be more likely to learn of its existence whenever the government is malevolent (values contributions highly compared with aggregate welfare), when the environmental damage is particularly severe and when the public were previously poorly informed about environmental problems. It is also shown that when profits of the firm are large, or the public itself values the production of the polluting good, they tend to be mistrustful or are unwilling to accept messages sent by the lobby representing polluting interests. A further result is that polluting interests may make contributions to the government *and* costly messages to the public. However, such strategic complementarity between these two forms of lobbying is shown to occur under very limited conditions.

The remainder of the chapter is organized as follows. In the following section, the model structure is presented. Section 5.3 considers the equilibrium level of contributions offered by the firm. This is followed by a discussion of the signalling game and the possible equilibria. Section 5.5 considers the special case

where the lower bound of damage is zero. The focus in section is the circumstances under which the public learn true environmental damage. Section 5.6 offers some concluding remarks and suggested directions for future research.

5.2 The Model

5.2.1 Overview

The model describes the setting of an environmental tax (t) in a closed economy. There are two lobby groups.[126] The first is a monopolistic producer (herein called 'the firm') of a single good, the manufacture of which involves the release of emissions that cause environmental damage. Members of this lobby group do not care about the state of the environment. The second is a group of environmentalists, called 'the greens', who are solely interested in the environmental outcomes. As such, the two lobby groups have opposing views regarding pollution and hence the appropriate level of an emissions tax. A third group, called 'the public', derive utility from the consumption of the polluting good but also care about environmental damage. The public are not politically organised.

The actual level of marginal damage (θ) is determined by nature and, for simplicity, is assumed to take on only two values: high (θ_H) or low (θ_L). The true level of marginal damage is known by each of the lobby groups but not the public. Instead, the public rely on messages which may be sent by each of the lobby groups to update their *a priori* belief about environmental damage.

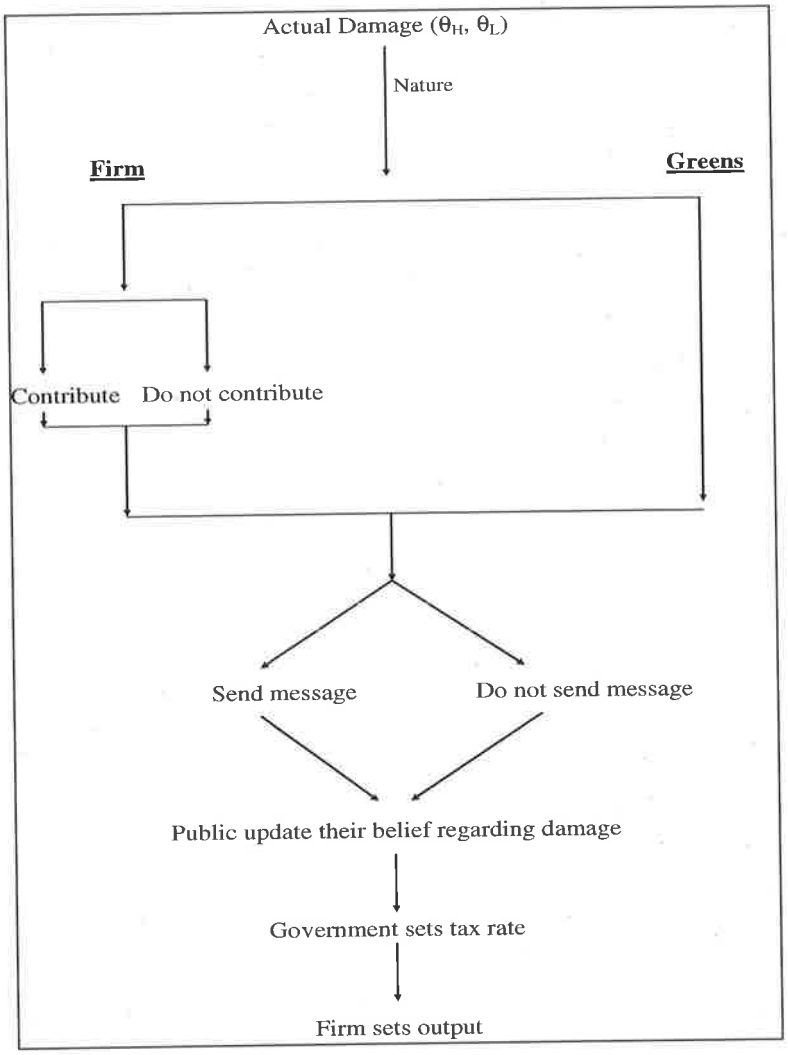
[126] Exactly how these lobby groups form is not discussed here. For an overview of lobby group formation, see Olsen (1965).

Figure 5.1 sets out a basic game tree describing the process. In the first stage, marginal damage from emissions is determined by nature. This is subsequently known by each lobby which chooses an action in order to try to influence the level of the environmental tax (t). The firm can choose one or both of the following methods. The first involves making direct contributions to the government $(S(t))$, which are contingent upon the level of the environmental tax. Contributions are made with a view to securing more lax environmental policy, hence $S'<0$. This type of lobbying (direct lobbying) is modelled following Grossman and Helpman (1994) and Fredriksson (1997a). The second option for the firm is to send a costly message to the public to try and influence their belief regarding expected damage (indirect lobbying). Note, the firm decides on the mix of the two strategies it will use simultaneously. By assumption, the greens do not engage in direct lobbying, but do have the option of sending a message.

Once messages are received by the public, they form a belief regarding the level of damage. The manner in which this belief is formed is discussed later in the paper. The government then sets the tax rate to maximise the sum of aggregate welfare and the contributions received from the firm. An exogenous weight determines the relative importance of each to the government. Once the tax rate is set, the firm chooses some level of output which maximises profits. The model is solved by backward induction.

Summarising, the level of the tax is dependent on contributions made by the firm and by the public's expectations regarding the level of environmental damage, which is a function of the messages they receive. This extends upon Grossman and Helpman (1994) who use a similar framework, but only consider direct lobbying.

Figure 5.1: Overview of the Game



5.2.2 *Utility Functions of the Lobby Groups, The Public, and Government*

We now turn to defining the utility of the agents in the model. The utility of the firm does not depend directly on the level of environmental damage. In particular, the firm does not care about the environmental damage caused, other than by its indirect influence on profits via the level of the emissions tax. Both direct and indirect lobbying impose a cost on the firm. The utility of the firm is thus specified,

$$U_F = \Pi(p) - S(t) - c(m_F \mid \theta_n) \qquad n = (H,L) \qquad (1a)$$

$\Pi(p)$ denotes gross profit from the production of the polluting good contingent on the market price (p). $S(t)$ are direct contributions made to the government in return for more favourable policy, hence $S'<0$. $c(\cdot)$ is the cost of sending a message given the marginal environmental damage, θ_n $(n = H,L)$. Again, the subscript n denotes the actual level of damage as determined by nature.

The green lobby, who are assumed not to consume the good, only care about environmental damage.[127] For simplicity, environmental damage is assumed to be linear in output and equal to the product of total output $(Q(p);\ Q'<0)$ and the marginal level of damage (θ). The greens can also engage in sending messages to the public at a cost of $c(\cdot)$. Disutility of the greens is thus the sum of damage and these costs,

$$U_G = -\theta_n Q(p) - c(m_G \mid \theta_n) \qquad n = (H,L) \qquad (1b)$$

Note the firm and the greens are assumed to know θ_n, the actual level of marginal damage. This is in contrast to the public who are uncertain. This assumption is consistent with Olson's 'rationally ignorant voter' theorem where given the almost zero probability of having a pivotal vote, individual citizens do not find it optional to gather the required information to ascertain the level of environmental damage. On the other hand, both the greens and the firm have a larger stake in the issue and thus have an incentive to acquire the appropriate evidence. The results of this model only require that the firm and the greens have a

[127] As will become evident, this is a major assumption. In reality, green lobbies may have many other motives which influence their behaviour, for example, the raising of revenue from members and indeed the government. The assumption of a completely 'green minded' lobby is made for computational simplicity. Other possible motives are an avenue for future research.

superior knowledge of the facts surrounding environmental damage. Perfect knowledge for these groups is assumed for computational convenience. Despite their relative ignorance, it does seem reasonable to suggest that the public will have some prior notion of whether marginal damage tends towards high or low. This prior, λ, represents the *a priori* belief held by the public that marginal damage is in fact high. When the public receive a message from one or both of the lobbies, they update this belief. Let this posterior belief be denoted by $\mu = prob(\theta_H | m_G, m_F)$, where the subscripts on m denote a message from the greens and the firm respectively. Updating in the model follows a Bayesian mechanism, a more formal definition of which is provided later in the paper.

Thus, after receiving one or more messages, the public will form some view of the probability that damage is high. Defining this belief as

$$\theta_\mu = \mu\theta_H + (1-\mu)\theta_L$$

the utility of the public is,

$$U_P = u(x) - \theta_\mu Q(p) \qquad (1c)$$

Where $u(x)$ is the utility derived from consumption of the polluting good, x, which is approximated by consumer surplus.

Finally, the case of the government is considered. The government is assumed to maximise its political support and therefore values both political contributions and aggregate welfare $W(t)$.[128] Consistent with the approach of Grossman and Helpman (1994), the exact manner in which contributions are used

[128] Aggregate welfare, which is defined more formally later, is simply the sum of all agents utilty.

by the government is not modelled. When induced by contributions to deviate from the welfare maximising policy, the government thus faces a trade off : higher contributions versus lower aggregate welfare.[129] An exogenous weight (β) determines the importance of aggregate welfare relative to contributions to the government. The government's utility function is given by,

$$G(t) = S(t) + \beta W(t) \qquad (1d)$$

5.3 The Game

5.3.1 The Firm's Output and Profit

In solving the model, simple functional forms are adopted. First, the monopolist is assumed to face the following inverse demand curve, $P = a - Q$. For simplicity, the firm is also assumed to face a marginal production cost of zero. Profits are thus defined as $\Pi = (P - t)Q$. Solving the firm's first order conditions yields the familiar results,[130]

$$Q = \frac{a-t}{2} \qquad P = \frac{a+t}{2} \qquad \Pi = \frac{(a-t)^2}{4} \qquad (2)$$

5.3.2 The Political Equilibrium

Having derived equilibrium price, quantity and profits attention can now be turned towards the equilibrium tax rate (t^*). This section follows the menu auction model of Bernheim and Whinston (1986) which is applied to this type of problem by Grossman and Helpman (1994).

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[129] In the absence of any contributions, the government would set policy to maximise aggregate welfare. As contributions lead to less stringent policy, it follows that $W'(t) > 0$.

[130] We are concerned only with an interior solution, thus t < a is required.

The firm offers the government contributions (S) in return for a more favourable policy outcome. As S is contingent on the tax rate chosen, which directly effects the welfare of the firm, the firm will choose S to maximise its utility in (1a). The associated first order condition is,

$$\frac{\partial U_F}{\partial S} = \frac{\partial \Pi}{\partial t}\frac{\partial t}{\partial S} - 1 = 0 \qquad (3)$$

Following proposition 1 in Grossman and Helpman (1994), a subgame perfect Nash equilibrium exists if :

(1) The contribution schedule is feasible,[131] and

(2) The choice of the tax rate (t^*) maximises the government's welfare *(G)*, taking as given the contributions from the firm.

Lemma 2 of Bernheim and Whinston (1986) sets out the following necessary conditions in which such an equilibrium will exist:

$$t^* \in \arg\max\ G(t) = S(t) + \beta W(t) \qquad \text{(BW1)}$$

$$t^* \in \text{Arg max}\ U_F(t) + G(t) \qquad \text{(BW2)}$$

(BW1) implies the equilibrium tax rate is chosen to maximise a weighted sum of contributions and aggregate welfare while condition (BW2) requires that profits of the firm (net of contributions) and the government's welfare are jointly maximised. Using equations (1a) and (1d):

[131] Feasible contributions are those which are non-negative and less than or equal to the lobby group's income.

BW1: $$\frac{\partial G(t)}{\partial t} = \frac{\partial S(t)}{\partial t} + \beta \frac{\partial W(t)}{\partial t} = 0 \qquad (4a)$$

and

BW2: $$\frac{\partial U_F(t)}{\partial t} + \frac{\partial G(t)}{\partial t} = \frac{\partial \Pi(t)}{\partial t} - \frac{\partial S(t)}{\partial t} + \frac{\partial G(t)}{\partial t} = 0 \qquad (4b)$$

As (4a) and (4b) are equal,

$$\frac{\partial S(t)}{\partial t} + \beta \frac{\partial W(t)}{\partial t} = \frac{\partial \Pi(t)}{\partial t} - \frac{\partial S(t)}{\partial t} + \frac{\partial S(t)}{\partial t} + \beta \frac{\partial W(t)}{\partial t} \qquad (4c)$$

Which by simple rearrangement yields,

$$\frac{\partial S(t)}{\partial t} = \frac{\partial \Pi(t)}{\partial t} \qquad (4d)$$

This implies that around the equilibrium point, the change in contributions for a lobby group will be exactly offset by the policy induced change to that groups welfare. Grossman and Helpman (1994) coin such contributions as *locally truthful.* By substituting the right hand side of equation (4d) into the government's first order condition (4a), it becomes evident that the government will choose t^* so as to satisfy the following:

$$\frac{\partial G}{\partial t} = \frac{\partial \Pi}{\partial t} + \beta \frac{\partial W_A}{\partial t} = 0 \qquad (5a)$$

From the firms profits in (2), we obtain,

$$\frac{\partial \Pi}{\partial t} = \frac{t-a}{2} < 0 \quad ; \quad \frac{\partial^2 \Pi}{\partial t^2} = \frac{1}{2} > 0 \qquad (5b)$$

Aggregate welfare is defined as the sum of profits, environmental damage incurred by the public $(\theta_\mu Q)$ and the greens $(\theta_n Q)$, consumer surplus

$\left(\int_0^Q P(dQ) - PQ\right)$, and the cost of sending messages $\left(C\left(m_j \mid \theta_n\right), j=(F,G), n=(H,L)\right)$. Tax revenues collected are assumed not to be redistributed and thus do not appear in the specification of aggregate welfare. Aggregate welfare is thus specified,[132]

$$W_A = \int_0^Q P(dQ) - \left(\theta_n + \theta_\mu\right) Q - c\left(m_j \mid \theta_n\right) \qquad j = (F,G) \qquad n = (H,L) \qquad (5c)$$

Note that the greens know the true state of damage whereas the public are unsure. This implies that both θ_n and θ_μ appear in aggregate welfare.

Using (5b) and (5c), the government's first order condition (5a) is:

$$\frac{\partial G}{\partial t} = \frac{t-a}{2} + b\left(\frac{2\left(\theta_s + \theta_m\right) - a - t}{4}\right) = 0$$

solving for the equilibrium tax rate, t^*

$$t^* = \frac{\beta\left[2\left(\theta_s + \theta_\mu\right) - a\right] - 2a}{\beta - 2} \qquad (6a)$$

Note that if the firm were to make no contributions, the government would set the tax so as to maximise aggregate welfare. In the absence of lobbying, the welfare maximising tax rate $\left(t^w\right)$ is equal to,

$$t^w = 2\left(\theta_n + \theta_\mu\right) - a \qquad (6b)$$

The tax rate under lobbying from the firm can thus be written as

[132] Notice that the weight attached by the government to damage suffered by the greens and the public is equal. This implicitly assumes a normalisation such that there is one green citizen and one public person.

$$t^* = \frac{\beta\, t_w - 2a}{\beta - 2} \qquad (6c)$$

Note the tax rate is increasing in both θ_n and θ_μ and decreasing in the parameter a, which is indicative of the benefits derived from consumption of the polluting good.[133,134] Thus, ceteris paribus, the tax rate will be higher when actual damage and perceived damage are higher, and lower when the value placed on production and consumption of the polluting good by society is greater. In addition, the tax is also increasing in the exogenous weight β (but at a decreasing rate). In the limit, when β approaches infinity, the tax rate approaches that of the welfare maximising rate in (6b).

5.3.3 *Payoffs to the Lobby Groups*

Before embarking on the signalling component of the model, it is useful at this stage to derive the payoffs to each of the lobby groups both when the firm contributes to the government and when it does not. Thus, for this part of the analysis, signalling is ignored.

To begin, assume that the firm does not send any signal and does not lobby. The government sets the tax rate at the welfare maximising level defined in (6b). Welfare of the firm in this situation is found by substituting the equilibrium tax rate into its profit function (2),

$$U_F\left(S=0, m=0\right) = \left(\theta_n + \theta_\mu - a\right)^2 \qquad (7)$$

Where $S=0$ and $M=0$ denote that the firm neither makes contributions to the government nor sends messages to the public respectively. The requirement that

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[133] The requirement that t<a for positive output implies that $\theta_n + \theta_\mu < a$.

[134] Note that for very large a, (6c) can take on a negative value. In this case the firm receives a subsidy on its output.

$\theta_n+\theta_\mu < a$ for positive output implies the welfare of the firm falls as actual and perceived damage increases across the feasible range.

Suppose now that the firm makes contributions to the government. Welfare of the firm is now the profit level under the equilibrium lobbying tax in (6a) minus its contribution. Following Grossman and Helpman, when only one lobby contributes to the government, the lobby contributes an amount which is proportional to the weighted distortion in aggregate welfare caused by its lobbying activity. This is because the lobby must compensate the government for any loss in aggregate welfare from the distortionary policy. Contributions defined in this way are expressed,

$$S_F = \beta\left[W(t_w) - W(t^*)\right] \tag{8a}$$

Clearly, the greater the weight placed on aggregate welfare by the government or the greater the distortion in the equilibrium tax rate under lobbying, the greater are the contributions required to compensate the government.

Calculating aggregate welfare under each level of the tax and substituting into equation (8a) yields

$$S_F = 2\beta\frac{\left(\theta_n - \theta_\mu - a\right)^2}{(\beta-2)^2} \tag{8b}$$

Note that the level of contributions is always positive and thus an interior solution always exists. Further, $S'(\beta)<0$ and $S''(\beta)>0$. Intuitively, as the government increases the weight on aggregate welfare relative to contributions, it values welfare more highly and consequently, the marginal compensation required to change policy increases. Further, examination of equation (5b) reveals that

$\Pi'(t)<0, \quad \Pi''(t)>0$. Thus, as the government becomes more benevolent, environmental stringency increases, resulting in lower firm profits. As profits are decreasing and convex in the rate of tax, the firm has a diminishing marginal return from policy concessions when the tax is relatively high. Nonetheless, as shown in equation (8b), contributions are always positive. The intuition behind this result can be clarified by calculating the utility of the firm when it lobbies directly (net of contributions), which is,

$$U_F(S_F>0, m=0)=\frac{\beta\left(\theta_n+\theta_\mu-a\right)^2}{\beta-2} \tag{9a}$$

By comparing this to equation (7), it is evident that that the firm will do better by lobbying directly to the government for any $\beta > 2$.[135] The intuition behind this is that only when β approaches infinity does the tax rate approach the welfare maximising level. Consistent with this idea, note that (7) and (9a) are equivalent when β approaches infinity. Thus, only when the government cares only about aggregate welfare of its citizens will the firm cease to make contributions.

The disutility of the green lobby is easily derived by calculating the firms profit maximising level of output when $t=t^*$ and substituting this back into the utility function in (1b).

$$U_G(m=0)=\frac{\beta\theta_n\left(\theta_n+\theta_\mu-a\right)}{\beta-2}<0 \tag{9b}$$

Note that unlike the firm, welfare of the greens increases with the weight on aggregate welfare ascribed by the government. This reflects increases in the

[135] For the remainder of this paper it is assumed that β is greater than 2 implying that the firm always does better by lobbying.

stringency in environmental policy under a more benevolent government, resulting in lower environmental damage.

5.4 Signalling

5.4.1 Background

Signalling in the model takes the form of messages regarding the level of damage which are sent by each lobby group. The intuition behind the signalling game is similar to that of Spence (1973).[136]

To begin the discussion, and to ensure that the motivation of the players is made clear, examine the equilibrium lobbying tax rate (equation 6a).

$$t^* = \frac{\beta\left[2\left(\theta_n + \theta_\mu\right) - a\right] - 2a}{\beta - 2} \qquad (6a)$$

Recall the expected level of damage of the public is defined as,

$$\theta_\mu = \mu\theta_H - (1-\mu)\theta_L$$

Where μ is the probability assigned to high damage by the public after they have received messages from the lobby groups. Note that from (6a),

$$\frac{\partial t^*}{\partial \theta_\mu} = \frac{2\beta}{\beta - 2} > 0 \qquad \forall \beta > 2 \qquad (9c)$$

The tax rate is increasing in the level of damage the public believe will occur and implies that the lobby groups have an incentive in trying to manipulate the level of expected damage for this group.

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[136] For a concise overview of the Spence model, see Mas-Colell et al (1995) pp 450-460.

Lemma 1.

No matter what the level of actual damage, the firm will never wish to send a message that damage is high (θ_H) and the greens will never wish to send a message that damage is low(θ_L).

Proof Taking the derivative of the welfare functions of the firm and the greens with respect to (θ_μ) yields,

$$\frac{\partial U_G}{\partial \theta_\mu} = \theta_n \frac{\beta}{\beta - 2} > 0 \qquad (10a)$$

$$\frac{\partial U^f}{\partial \theta_\mu} = \frac{2\beta(\theta_n + \theta_\mu - a)}{\beta - 2} < 0 \qquad (10b)$$

This implies when sending a message, the strategies are $m_G = \theta_L$ and $m_F = \theta_H$ are never optimal. The firm always prefers a lower tax rate and will thus act in a manner which it hopes will achieve this. Whenever environmental damage occurs, the opposite is true for the greens.

We consider Perfect Bayesian Equilibria (PBE). Following Mas-Colell et al (1995, p452), we can state the conditions under which the public's belief (μ) after observing the messages of the lobby groups is a PBE:

C1: The sender's strategies are optimal given the strategy of the public.

C2: The posterior belief function, $\mu(\theta_H \mid m_j)$, $j=g,f$ is derived from the senders' signals using Bayes Law.

Bayesian updating in the model takes the following form,

$$prob(\theta_H \mid \{m_G, m_F\}) = \mu = \frac{prob(\{m_G, m_F\} \mid \theta_H)\lambda}{prob\ (\{m_G, m_F\} \mid \theta_H)\lambda + prob(\{m_G, m_F\} \mid \theta_L)(1-\lambda)} \qquad (11)$$

Where again, λ is the *a priori* belief held by the public regarding marginal environmental damage.

5.4.2 Separating and Pooling Equilibria

We consider two types of equilibria: pooling and separating. In a pooling equilibrium, the public are unable to derive any new information from the messages which are sent by the lobbies and thus remain uncertain regarding the level of actual damage. This occurs when, given values of the exogenous parameters, a given message set will be sent in either state of damage. Formally, for any set of messages $\{m_G, m_F\}$ where $prob(\{m_G, m_F\} | \theta_H) = prob(\{m_G, m_F\} | \theta_L)$, by Bayes' rule (equation 11), it must be that $\mu = \lambda$.

In a separating equilibrium the public learn the truth regarding environmental damage. This implies that the solution for μ must be either zero or unity. To see this, consider the following candidate separating equilibrium where the public correctly infer that damage is high after receiving a set of messages $\{m_G, m_F\}$ (i.e. $\mu = 1$). Examination of equation 11 reveals that this can only occur if the public believe that the message set observed will never be sent when damage is low. Formally, a separating equilibrium requires:

$$\Pr(\theta_n | m_j) = 1 \; and \; \Pr(\theta_{-n} | m_j) = 0 \qquad n = (H, L) \; ; \; j = (F, G))$$

and –n denotes 'not state n'.

Turning our attention back to the equilibrium tax rate we can thus see the effect of each. In a pooling equilibrium, let $\mu = \lambda$ and

$$\theta_\mu = \lambda\theta_H + (1-\lambda)\theta_L \equiv \theta_\lambda$$

and in a separating equilibrium,

$\theta_\mu = \theta_H$ if $\mu = 1$
or
$\theta_\mu = \theta_L$ if $\mu = 0$

5.4.3 *Cost of Sending Messages*

Before examining the payoff functions under both direct lobbying and signalling, we need to explicitly define the costs of sending a message. In this model, costs take the form,

$$c(m_j \mid \theta_n) = 1 + |m_j - \theta_n| \qquad j = (F,G) \qquad n = (H,L) \qquad (12)$$

This implies that the cost of sending a message consistent with the actual state of damage is equal to unity. On the other hand, a lobby group wishing to send a message which is false faces higher costs, which are increasing when the divergence from the true state is greater. As noted earlier, this extends upon Yu (2004) where the costs of sending messages are not a function of parameters of the model.

In a real world context, specification of costs in this manner can be justified on several grounds. While the nature of the message is not considered in the model, if we assume that a message regarding environmental damage requires some scientific evidence, it is reasonable to assume that the search costs associated with finding supporting evidence when the message is untruthful might be higher. For example, the sender may have to fund research to back their position.[137] It is also likely that public will be harder to convince when there is less available evidence. Thus, greater expenditure may be required in order to generate a persuasive

[137] An example of this is that of the tobacco industry which often employed their own researchers to refute the claims of outside parties regarding the damage caused by smoking.

message.[138] Finally, it is likely that the potential costs of the truth being uncovered in some future period might be large for a lobby group who previously sent messages which were false. For example, the group's credibility in future environmental debates may be damaged or it may be subject to litigation. This type of discovery in future periods is beyond the scope of this model, however still warrants consideration in the specification of costs.

5.5 Results

5.5.1 Identifying Possible Equilibria

Attention is now directed to identifying equilibria in the model. For computational convenience, and to minimise the need for numerical simulations, the assumption is made that $\theta_L = 0$. This implies that the polluting activity either causes environmental damage of θ_H or is completely innocuous and causes no environmental degradation. Such an assumption fits quite well with recent debates surrounding global warming. For example, despite being in a minority, some scientists argue that the *effective* damage of greenhouse gas emissions on human activities is zero.[139] This is equivalent in the context of the model presented here of assuming the lower bound on damage to be zero. For future reference, note that $\theta_L = 0$ and $\theta_\mu = \mu\theta_H$.

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[138] As an anecdotal example, *PR Watch* cite a Los Angeles Times article which reveals that in 1997 the *Global Climate Coalition*, an group representing polluting interests spent $US13 million on its anti-Kyoto campaign, which was designed to try and refute increasing scientific evidence of the deleterious effects of global warming. It is noted that this was greater than the entire Greenpeace budget over the same period. For details see: http://www.prwatch.org/improp/gcc.html (accessed 22/3/04).

[139] For a numerous examples of this type of argument, see http://www.globalclimate.org/opinion/scientists.htm.

5.5.2 *Messages from the Green Lobby*

Under what circumstances will the public uncover the truth regarding environmental damage from messages sent by each of the lobbies? In order to answer this question, we need to consider what may occur in either state of damage. To begin, let us first consider the actions of the green group when damage is low (zero). It turns out that the greens will never send a message when damage is low. Incorporating signalling costs into equation and using (9b), it is evident why this is so

$$U_G(m=\theta_H)=\frac{\beta\theta_n(\theta_n+\mu\theta_H-a)}{\beta-2}-(1+\theta_H) \qquad n=(H,L)$$

where $(1+\theta_H)$ are the costs associated with sending a message to the public and $\frac{\beta\theta_n(\cdot)}{\beta-2}$ is the disutility caused by the polluting good.

Recall from Lemma 1, the greens will only ever send a message claiming that damage is high. However, as this group cares only about environmental damage, when there is no damage, they suffer no disutility. It follows that they can gain nothing from influencing public beliefs when $\theta_n=0$, and thus would never incur the costs $(1+\theta_H)$ associated with sending a message when damage is low. Thus,

Lemma 2

When the greens send a message that damage is high, the public will always correctly infer that damage is in fact high.

Proof: The proof of Lemma 2 is undertaken in two parts.

i. When marginal damage is low (zero), disutility of the green lobby falls to zero when it does not send a message $\left((U_G \mid m_G = 0) = 0\right)$. If the greens send a message in these circumstances, they incur signalling costs. Thus, $\left((U_G \mid m_G = \theta_H) = -(1+\theta_H)\right)$. Given this, the greens will clearly be better off by not sending a message.

ii. The public have a knowledge of all exogenous parameters of the problem other than the true state of environmental damage. They are thus aware that if the true marginal rate of damage is low, the green lobby will never find it optimal to send a message. It follows that if the public observe a message from the greens, then they must believe that they are in the high damage state.

Lemma 3

If the greens send a message stating that damage is high, it is never optimal for the firm to counter this message with a claim of low damage.

Proof: Suppose this is not the case and the firm counters the green's claim of high damage with a low damage message. By Lemma 2 the public still believe damage to be high. Thus, the firm's welfare is lower when it sends a message than if it had not done so. Specifically, by sending a message the firm violates condition 1 of a PBE which states that the senders strategy must be optimal given the beliefs of the public. Intuitively, the firm has no capacity to influence the public and will not incur any costs in attempting to do so.

Taken together, Lemmas 2 and 3 imply the existence of a candidate separating equilibrium in the high damage state where the public receive a message from the greens, no message from the firm, and correctly infer the true level of damage. To prove the existence of this equilibrium, it remains to show that there

exist some circumstances where it is optimal for the greens to send a message. This can be examined by comparing the difference in green payoffs between sending a message and not (when the actual level of marginal damage is high). Assume that in the case where the greens do not send a message, the posterior belief regarding marginal environmental damage is equal to μ, $\mu<1$.[140] Using (9b), disutility suffered by the greens is:

$$U_G(m=0)=\frac{\beta\theta_H(\theta_H+\mu\theta_H-a)}{\beta-2} \qquad (13a)$$

Alternatively, the greens can send a message and incur a cost of unity. As per lemma 2, this will imply a posterior belief of $\mu=1$. Disutility will thus be:

$$U_G(m=\theta_H)=\frac{\beta\theta_H(2\theta_H-a)}{\beta-2}-1 \qquad (13b)$$

defining $\Omega^G=U^G(m=\theta_H)-U^G(m=0)$, we can derive the change in disutility associated with sending a message for the greens. Subtracting (13a) from (13b) yields,

$$\Omega^G=\frac{\beta(\theta_H^2-\mu\theta_H^2-1)+2}{\beta-2} \qquad (13c)$$

For all $\Omega^G>0$, the greens find it optimal to send and thus a separating equilibrium exists. This obviously depends on the relative values of θ_H, μ, and β. Numerical examples are provided in Appendix C.1 which reveal that message sending by the greens may be optimal, however, there are situations where even though the public

[140] Clearly, if this were not the case it would never be optimal for the greens to send a message. Note that the conditions of a PBE impose no restrictions over off-equilibrium beliefs. For a discussion of this, see Gibbons (1992).

will believe them, the greens do not find it worthwhile to send their 'high damage' message. The overall characteristics of this equilibrium are detailed in the following proposition.

Proposition 1

(a) *In the high damage state, a separating equilibrium exists:* $\{m_G, m_F\} = \{\theta_H, 0\}$ *and,*

$$prob\left(\theta_H \mid \{m_G, m_F\} = \{\theta_H, 0\}\right) = \mu = \frac{prob(\{m_G, m_F\} = \{\theta_H, 0\} \mid \theta_H)\ \lambda}{prob(\{m_G, m_F\} = \{\theta_H, 0\} \mid \theta_H)\ \lambda + prob(\{m_G, m_F\} = \{\theta_H, 0\} \mid \theta_L)(1-\lambda)} = 1$$

(b) *The likelihood of this equilibrium*

i. *Decreases with the weight attached to aggregate welfare by the government* (β).

ii. *Decreases with the publics' (out of equilibrium) posterior belief* (μ).

iii. *Increases with the level of marginal environmental damage* (θ_H).

Proof: (a) The equilibrium satisfies both properties of a PBE. Together, Lemmas 2 and 3 imply that:

$prob(\{m_G, m_F\} = \{\theta_H, 0\} \mid \theta_L)(1-\lambda) = 0$, and thus by Bayes rule, the posterior probability of the public is given as:

$$prob\left(\theta_H \mid \{m_G, m_F\} = \{\theta_H, 0\}\right) = \mu = \frac{prob(\{m_G, m_F\} = \{\theta_H, 0\} \mid \theta_H)\ \lambda}{prob(\{m_G, m_F\} = \{\theta_H, 0\} \mid \theta_H)\ \lambda} = 1 \qquad \forall prob(m_G = \theta_H) > 0$$

Appendix C.1 provides numerical simulations which indicate situations where the greens send a message and the equilibrium is sustained.

(b) Direct differentiation of (13c) yields:

$$\frac{\partial \Omega^G}{\partial \beta} = \frac{-2\theta_H^2 (1-\mu)}{(\beta-2)^2} < 0 \qquad (14a)$$

$$\frac{\partial \Omega^G}{\partial \mu} = \frac{-\beta\theta_H^2}{(\beta-2)} < 0 \qquad \forall(\beta-2)>0 \qquad (14b)$$

$$\frac{\partial \Omega^G}{\partial \theta_H} = \frac{2\beta\theta_H (1-\mu)}{(\beta-2)} > 0 \qquad \forall(\beta-2)>0 \qquad (14c)$$

The intuition for each result is as follows. When the government attaches a high weight to aggregate welfare relative to contributions, the emissions tax is set closer to the welfare maximising rate. This decreases output and subsequent environmental damage, reducing the incentive of the greens to incur costs in sending a message.

Equation (14b) reveals the importance of the publics' off equilibrium beliefs. The motivation of the greens in sending a message is clearly to alter the beliefs of the public. In the event that the public would otherwise believe that damage is relatively high even when the greens do not send, the potential gain of sending a message is lower. Conversely, where the public are sceptical about environmental damage, the gains from sending a message are larger.

When environmental damage is greater, the green lobby's members suffer greater disutility from the firm's production. As such, they stand to gain substantially from more stringent environmental policy. This policy, as shown by (9c), becomes more stringent in the publics' awareness of environmental damage. The incentive to educate the public thus rises when the activities of the firm severely damage the environment.

Finally, note that the green lobby does not consume the polluting good, nor does it capture any profits which arise from production. As such, its sending strategy is independent of the value society places on the good.

It is also instructive to consider the case where the actual state of environmental damage is low. In this situation, it is possible that the public will learn this fact, even when no messages are sent. Specifically,

Corollary 1

If, for given exogenous parameters, it is optimal for the firm to send a message when damage is high, if the public observe the message set $\{0,0\}$, *Bayes' Law implies that they must correctly infer that damage is low. Thus,*

Proposition 2

A separating equilibrium exists such that when the public observe a message set of $\{0,0\}$, *they believe that damage is low* $(\mu = 0)$

Proof: Proposition 1 details conditions under which the green lobby will send a message and thus the public will believe that damage is high. If conditions are such that the greens find it worthwhile to send a message when damage is high, the public must interpret the message set $\{0,0\}$ to imply that they are in the low damage state. Not to do so would violate condition 2 of a PBE.[141] Note also that this equilibrium is characterised by the firm not sending a message. Obviously, given the equilibrium beliefs, it will never be optimal for the firm to send a message claiming damage is low. To do so would incur costs for the firm even though it is impossible to lower the publics' belief any further.

[141] This is contingent on it being optimal for the greens to send when damage is high. There are, as will be shown, occasions where this is not the case and other equilibria are thus possible.

This equilibrium is indicative of the fact that, under certain circumstances, the public look to the greens for information regarding environmental damage. As the greens are always believed, their silence also conveys information to the public. For example, suppose the public know that the upper bound of damage is very high. While they are uncertain as to which state they are in (high or low damage), they are aware that were the activities of the firm really causing damage as per the worst case scenario, the green lobby, which has perfect information, would be outspoken. As such, they are able to correctly identify that they are in the low damage state provided the greens say nothing.

5.5.3 *Messages from the Firm*

Numerical simulations provided in Appendix C.1, show that despite the fact that they will always be believed by the public, it is sometimes not optimal for the greens to send a message. These cases are highlighted by part (b) of Proposition 1. When the greens *do not send*, it follows that their remain two possible message sets: (i) neither party sends a message $\left(\{m_G, m_F\} = \{0,0\}\right)$, and (ii) Only the firm sends a message $\{m_G, m_F\} = \{0, \theta_L\}$. Note, however, that both of these message sets may be feasible in either state of damage.[142] Before describing these equilibria, it is instructive to first consider the general incentives facing the firm when it chooses between sending and not sending a message (given the strategy of the greens).

In either state, define the beliefs of the public as $\bar{\mu}$ when the firm does not send a message and $\tilde{\mu}$ when the firm sends a message claiming that damage is low. Note that the firm will only find it optimal to send a message if it causes the public

[142] Note that under the conditions where Proposition 2 holds, namely that the greens find it optimal to send in the high damage state, the latter message set is not feasible. However, in cases where, even if damage were high, the greens do not send, it is feasible that the firm would send a message in the low damage state.

to believe damage is lower than it would have if no message had been sent. *Ceteris paribus* , it follows that $\bar{\mu} > \tilde{\mu}$.[143] Using (9a), the firms welfare after sending a message is,

$$U_F(m=\theta_L) = \frac{\beta\,(\theta_n + \tilde{\mu}\theta_H - a)^2}{\beta - 2} - (1 + |m_F - \theta_n|) \qquad n = (H, L) \qquad (15a)$$

If it does not send a message, it will save incurring a cost, but the public will adopt a belief of $\bar{\mu}$. The welfare of the firm will thus be:

$$U_F(m=0) = \frac{\beta\,(\theta_n + \bar{\mu}\theta_H - a)^2}{\beta - 2} \qquad n = (H, L) \qquad (15b)$$

Subtracting (15b) from (15a) yields the payoffs from sending for the firm, defined as Ω^F. This will obviously differ depending on the true state of nature:

High damage:

$$\Omega^F = \frac{\beta\,(\theta_H + \tilde{\mu}\theta_H - a)^2}{\beta - 2} - \frac{\beta\,(\theta_H + \bar{\mu}\theta_H - a)^2}{\beta - 2} - (1 + \theta_H) \qquad (15c)$$

Low damage:

$$\Omega^F = \frac{\beta\,(\tilde{\mu}\theta_H - a)^2}{\beta - 2} - \frac{\beta\,(\bar{\mu}\theta_H - a)^2}{\beta - 2} - 1 \qquad when\ \theta_L = 0 \qquad (15d)$$

Again, $\Omega^F > 0$ is a necessary condition for the firm to send a message. We begin by examining when this is likely to occur. The results are summarised in the following proposition:

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[143] Nothing in the conditions for a PBE restrict beliefs in this manner. Essentially, this assumption is made as an equilibrium refinement in order to reduce the number of possible equilibria.

Proposition 3

Given a strategy of not sending by the Greens, the likelihood of the firm sending a message is:

i. *More likely when the weight attached to aggregate welfare by the government (β) is low*
ii. *Ambiguous in the upper bound of marginal environmental damage* (θ_H).
iii. *More likely when the message is sufficiently persuasive* $(low\ \tilde{\mu})$.
iv. *More likely when the public have a predisposition to believe damage to be high* $(high\ \bar{\mu})$.
v. *More likely when the returns from production and consumption (a) are large*

Proof: The results (i) through (v) are obtained by direct differentiation of equation (15c).[144] Each is discussed in turn below.

$$i. \qquad \frac{\partial \Omega^F}{\partial \beta} = 2\theta_H(\tilde{\mu} - \bar{\mu})\frac{(2a - 2\theta_H - \tilde{\mu}\theta_H + \bar{\mu}\theta_H)}{(\beta - 2)^2} < 0 \qquad (16a)$$

The sign is contingent on the assumption that $\bar{\mu} > \tilde{\mu}$, and that for positive output, $a > \theta_n + \theta_\mu$, where $\theta_\mu = \mu\theta_H$ when $\theta_L = 0$.[145] The implication is that the firm is more likely to send a message when the government places a low weight on aggregate welfare. This result may seem counter-intuitive when one considers that under these circumstances, the government tends to ignore the wishes of the public. As such, the beliefs of the public become more irrelevant. However, when the government is responsive to political contributions made by the firm, the productivity of these contributions is high, resulting in lax policy. This puts the

[144] The signs are unchanged using equation (15d), with the exception of the effects of the upper bound of damage. This is discussed in what follows.

[145] In this situation this posterior belief is given by *either* $\bar{\mu}$ or $\tilde{\mu}$.

firm in a position where it stands to lose more from any change in policy.[146] Even though the government is not overly responsive to public perceptions regarding damage, the firm still finds that it is worthwhile to protect its position.[147] This implies that to some extent, direct and indirect lobbying are strategic complements for the firm. Note that taken together with Proposition (1b), which shows that the greens face stronger incentives to lobby when government is less responsive to aggregate welfare, it is shown that indirect lobbying is more likely when the government does not care. This seemingly counter intuitive result may well be explained by the fact that the need for indirect lobbying only arises from government failure in the first place. In the event that government is completely benevolent (and incorruptible), there is no need for the public to be informed.

ii. To examine the effects of the upper bound of damage on the payoffs from sending a message, we need to consider both the high and low damage state. We consider the latter first. Differentiation of (15d) yields

$$\frac{\partial \Omega^F}{\partial \theta_H} = \frac{-2\beta}{(\beta-2)}(\bar{\mu}-\tilde{\mu})(\bar{\mu}\theta_H + \tilde{\mu}\theta_H - a) > 0 \qquad (16b)$$

Where the sign turns upon the afore mentioned assumptions regarding beliefs $(\bar{\mu} > \tilde{\mu})$, and the conditions for positive output. Intuitively, in the low damage state, the firm is able to send a truthful message by incurring a cost of unity. The parameter θ_H represents the 'worst case' scenario for the public. Thus, when this upper bound on damage is very large, the firm stands to gain more from convincing

[146] Consistent with this, note that by equation (9a), the firm's utility is falling in β ($\forall \beta > 2$).
[147] Note of course that as per lemma 3, the firm will never find it optimal to send when the greens have sent a message.

the public that they are closer to the low damage state. Hence, it is more likely that the firm will send a message.

In the high damage state, the costs to the firm of sending a (false) message are higher and this complicates its strategy. This can be seen by differentiation of equation 15(c), which yields:

$$\frac{\partial \Omega^F}{\partial \theta_H} = \frac{2\beta}{(\beta-2)}\left[a(\bar{\mu}-\tilde{\mu}) + \theta_H\left(2(\tilde{\mu}-\bar{\mu}) + (\tilde{\mu}^2-\bar{\mu}^2)\right)\right] - 1 \begin{matrix} > \\ < \end{matrix} 0 \qquad (16c)$$

There are two major components of (16c). The first term in parenthesis, $a(\bar{\mu}-\tilde{\mu})$ represents the gains which accrue to the firm from influencing public perceptions regarding damage. As $\bar{\mu} > \tilde{\mu}$, this term is unambiguously positive. The second term, $\theta_H\left(2(\tilde{\mu}-\bar{\mu}) + (\tilde{\mu}^2-\bar{\mu}^2)\right) < 0$ represents the costs involved with making a false claim regarding damage in order to influence the public. Thus, when the first of these terms is sufficiently large, (16c) is positive. In this case, the gains from influencing the public will outweigh the costs of doing so, and the firm will have an incentive to lie. Note that when the parameter a is large, the stakes will be higher for the firm and this result is more likely. Conversely, when the second effect dominates, the firm will be less likely to send. Intuitively, if the gains from persuading the public are small, but the costs associated with doing so are large, it cannot be optimal for the firm to send a message. Importantly, note that this is more likely as the upper bound of damage (θ_H) increases.

iii. $$\frac{\partial \Omega^F}{\partial \tilde{\mu}} = \frac{2\beta(\theta_H + \tilde{\mu}\theta_H - a)}{\beta-2} < 0 \qquad (16d)$$

$\tilde{\mu}$ is the posterior belief of the public after receiving a low damage message. As such, it is a measure of how well the firm does in influencing beliefs. When $\tilde{\mu}$ is high, it implies that the public believe damage is large even when the firm tries to convince them otherwise. Conversely, the gains from sending a message which accrue to the firm are greater when their message influences the public to a greater extent.

iv. $$\frac{\partial \Omega^F}{\partial \bar{\mu}} = \frac{-2\beta(\theta_H + \bar{\mu}\theta_H - a)}{\beta - 2} > 0 \qquad (16e)$$

When the firm does not send a message, the public assign a posterior probability of $\bar{\mu}$ of damage being high. Where this is high, the firm will stand to lose from the more stringent policy which follows. It thus stands to gain by convincing the public that damage is lower. Note that this effect is strong when the government attaches a high weight to aggregate welfare.

v. $$\frac{\partial \Omega^F}{\partial a} = \frac{2\beta(\bar{\mu} - \tilde{\mu})}{\beta - 2} > 0 \qquad (16f)$$

Finally, the payoffs associated with sending a message for the firm are shown to be increasing in a. Recall that this parameter reflects the gains which accrue to the firm from the production of the good. Intuitively, when the rewards from production are high, so too are the consequences of environmental policy. Hence, the firm acts to protect its position by sending a message in an effort to sway public opinion regarding the environmental effects of its activities. Note that this effect is greater when the firm's message is influential $\left((\bar{\mu} - \tilde{\mu}) \text{ is large}\right)$.

5.5.3.1 Learning from the Firm's Messages

As noted, there are two possible message sets received by the public when the greens do not send: $(\{m_G, m_F\} = \{0,0\})$ and $(\{m_G, m_F\} = \{0, \theta_L\})$. To identify the nature of these equilibria, it is necessary to consider the possible beliefs of the public. We begin by examining the second of the possibilities, where the firm sends a low damage message and the greens do not send.

Upon receipt of $(\{m_G, m_F\} = \{0, \theta_L\})$, let us assume that there are three possible beliefs: $\mu = 1; \mu = 0; \mu = \tilde{\mu}$. The first possibility, that the public believe themselves to be in the high state, would clearly violate condition 1 of a PBE. In particular, were this to be the case, the firm would not bother to incur the costs of sending a message (as the beliefs could not be higher if they did not send). This equilibrium is thus not a feasible one.

Suppose on the other hand, that for some values of the exogenous parameters, the firm were always to send in both states. In this case, the equilibrium would be characterised by $(\{m_G, m_F\} = \{0, \theta_L\}, \mu = \tilde{\mu})$ where $\tilde{\mu} = \lambda$, the publics' prior belief. Intuitively, if conditions are such that the firm would send in either state, it is impossible for the public to learn anything from its messages. The proof of this equilibrium is detailed as follows:

Lemma 4

For any set of beliefs $\{\tilde{\mu}, \overline{\mu}\}$, *where* $\overline{\mu} > \tilde{\mu}$, *if the firm finds it optimal to send a message to the public when damage is high, it will also send when damage is low.*

Proof: Subtracting (15d) from (15c) yields,

$$(\Omega^F \mid \theta_H) - (\Omega^F \mid \theta_L) = \frac{\theta_H \left[2\beta\theta_H (\tilde{\mu} - \bar{\mu}) \right]}{(\beta - 2)} - \theta_H < 0 \qquad \forall \tilde{\mu} \leq \bar{\mu} \tag{17}$$

The negative sign on equation (17) confirms that given parameter values, payoffs from sending a message are always greater in the low damage state. Thus,

Proposition 4

Where the greens do not find it profitable to send a message to the public, and the firm finds it optimal to send a message when damage is high, it will also always send if damage is low. The public can then learn nothing from the messages of the firm and will not update their beliefs. Thus, $\left(\{m_G, m_F\} = \{0, \theta_L\}, \mu = \tilde{\mu} : \tilde{\mu} = \lambda\right)$

Note the conditions under which this equilibrium is possible. First, it must not be optimal for the greens to send, as their message is always believed. Second, the firm must, given the strategy of the greens, find that when damage is high, it is optimal to send a message. Numerical simulations which appear in Appendix C.2 consider these possibilities. There are many possible numerical values which can be placed on the parameters and the purpose of the simulations is solely to demonstrate the possible existence of this type of equilibrium. It is shown that this is most likely when the upper bound of environmental damage is low (i.e. a lower value on θ_H) and the profits of the firm are large. Intuitively, the public know that when profits are large, the firm has a stronger incentive to send a false message in order to protect its position. It follows that given this knowledge, the public will not consider the message to be credible.

Lemma 4, which shows that the firm always does better by sending when damage is low, suggests that there may be an equilibrium in which the firm sends a message only in the low damage state. By Bayes' rule, if the public only observe a message from the firm when damage is low, they must correctly infer the true state

of damage from this message. If it is optimal for the firm to send a message when its activities do not cause environmental damage $(\theta_n = \theta_L)$, it follows that if the public observe no message from the firm, they must believe themselves to be in the high damage state. Thus,

Proposition 5:
For relevant values of the exogenous parameters, if the greens do not send a message and the firm only sends when damage is low:

i. *If the public observe a message from the firm, they believe themselves to be in the low damage state* $\left(\{m_G, m_F\} = \{0, \theta_L\}, \mu = 0\right)$.

ii. *If the public observe no message, they will believe damage to be high* $\left(\{m_G, m_F\} = \{0,0\}, \mu = 1\right)$.

This equilibrium is characterised by the public believing the firm when it sends a message, but inferring damage is high when it does not. Simulations in Appendix C.2 show this tends to occur when the upper bound of damage is high and profits are low. Specifically, if profits are sufficient to make it worthwhile to send a (less costly) truthful message, but are not large enough to justify the expenses associated with making a false claim, the public are able to believe the firm.

A final possibility is that both lobby groups fail to send a message in either state. Again, Bayes' law requires that the public are unable to infer anything from the sending strategies of the firm and the greens. By Propositions 1 and 3, one case where this is likely to occur is when the weight attached to aggregate welfare (β) is high and profits are low. In such cases, both lobbies are less likely to send. Intuitively, when the government is responsive to the needs of citizens, environmental policy will be set closer to the welfare maximising level. The greens will thus have less cause to influence the public. At the same time, if the returns

from production of the polluting good are low, then the firm stands to gain little from changing the public's belief. In this case, the public will remain ignorant about the true level of environmental damage. This is shown to only occur when the level of marginal damage is exceedingly small. Intuitively, if damage is a non-issue, few gains will accrue to either lobby from engaging in indirect lobbying.

5.6 Conclusion

Empirical evidence suggests that lobby groups representing environmental interests are far less likely to make political contributions to politicians. This raises the question, how is it that these groups are able to influence public policy? One possibility is that this is achieved by influencing public opinion. This type of indirect lobbying indeed appears to be a major strategy of most environmental groups.

Building on Yu (2004), this paper examines direct and indirect lobbying in a model where opposing special interest groups representing a polluting industry and environmental concerns vie over the stringency of environmental policy outcomes. The environmental lobby wishes to minimise environmental damage and thus seeks to raise awareness of an uncertain public regarding the damaging effects of the firm's production. As the government pays attention to these beliefs in deciding policy, raising public awareness of environmental damage leads to more stringent policy outcomes. At the same time, the firm, who wishes to minimise the effects of policy, may also try and influence the public. In addition, it can also make direct political contributions, a process modelled as per Grossman and Helpman (1994).

The results of this model yield some interesting results. There are assumed to be two possible states of environmental damage. The production process either

causes some level of environmental damage or it does not. Given this assumption, messages sent by the green lobby are always believed by the public. In these circumstances, it is clearly not in the interests of the firm to engage in indirect lobbying. This reveals a picture of the lobbying process which seems to fit will with the observed behaviour of polluting and environmental interests. Importantly, however, the green lobby will not always find it optimal to inform the public. This may occur when the government is responsive to the welfare of its citizens relative to political contributions. As the government is aware of the truth regarding environmental damage, it will thus set policy accordingly. In addition, if environmental damage is not significant, the green group will be less prone to incur the costs of informing the public.

Situations where the greens do not send messages lead to the possibility of the firm making an attempt to mislead the public. A particularly important result is that when the firm's profits are sufficiently large, the incentives to mislead increase. The public, aware of the incentives facing the firm, are less likely to believe these messages. Conversely, when profits are low, the public will be more likely to take the messages from the firm at face value.

It is also found that when the government is responsive to political contributions, the firm will face stronger incentives to engage direct and indirect lobbying. In this situation, the high marginal productivity of campaign contributions increase the profits of the firm. It is thus protective of these larger returns and thus stands to gain more by influencing the public. Direct and indirect lobbying by the firm thus seem to some extent to be strategic complements. However, given the same circumstances, the green lobby also has a higher propensity to engage in indirect lobbying. This has several strategic benefits for the

greens. First, by nature of the equilibria in the model, their messages are always believed. As such, the firm will not find it optimal to send a message when the greens have done so. Thus, a message sent by the greens has the effect of blocking the firms avenue of lobbying indirectly. A further benefit of this strategy is that as contributions must compensate the government for the political costs of adopting weaker policy, raising public awareness decreases the effectiveness of direct lobbying by the firm. Overall, it may appear to be counter-intuitive that the incentives to engage in indirect lobbying rise with government apathy towards the beliefs of the public. The intuition, however, is one of strategy. The firm is keen to protect its strong position, while the greens, who have the advantage of always sending credible messages can block the firm from influencing the public and simultaneously raise the costs associated with direct lobbying.

This model is an introductory step to explaining a phenomenon which has to a large extent been ignored by the economic literature. As such, several extensions are warranted. A first and obvious extension is to allow the green lobby to make direct contributions to the government in the same manner as polluting interests. The focus on this paper has been on how indirect lobbying can influence the public. However, no explanation is offered as to why environmental groups prefer to use this method. In particular, these groups are restricted from engaging in direct lobbying by assumption. In reality, green groups do make some contributions to the government, however spending in this manner is quite minimal. Extending the model to allow this behaviour may lead to an explanation for the preponderance of indirect over direct methods.

A second extension would be to consider other possible motives for educating the public. In particular, green groups receive funding from the

government and direct from the public. It would seem reasonable to assume that both forms of funding might increase when the public believe environmental issues to be more important. As such, persuasion of may simply be a way of increasing revenues for green groups.

Chapter 6

Conclusion

This thesis considers some important factors which influence how public policy is set and complied with. A major focus is that of environmental policy. This type of policy is particularly important given an increased scientific and public awareness of environmental issues. Economic theory makes reasonably clear prescriptions about most effective and efficient policies by which to combat environmental problems, however the political process rarely delivers policies consistent with these. This is not only true of environmental policy, but also of many other types of policy. Indeed, the Grossman and Helpman (1994) model, upon which much of this thesis is built, has its origins in explaining deviations in observed trade policy from free trade outcomes advocated by most economists.

If environmental problems are to be addressed, we need an understanding of how the process of policy formation takes place. The role and scope special interest groups have in influencing the government decision making process is central to this understanding. Moreover, it is important to identify how public perceptions and the problems associated with non-compliance inter-relate with the policy formation process. The three essays contained in the thesis have attempted to examine some of these issues.

In the first of these, policy contingent contributions made by special interests are considered as a type of corruption – grand corruption. This is justifiable as most developed countries preclude the making of such contributions in return for policy concessions. A second form of corruption – petty corruption – involves the evasion of environmental policy by bribing a low level bureaucrat to make false reports regarding environmental damage. Both petty and grand corruption exist

simultaneously in many countries, yet the literature has tended to ignore the possible relationships between the two. The paper also considers the effect of political competition on both these forms of corruption. This possibility of an inverse relationship between political competition and corruption has previously been suggested (for example, Rose-Ackerman, 1978), however there remains little formal analysis to support this notion.

The results suggest that increasing political competition may not eliminate either form of corruption. In particular, when enforcement is weak, petty corruption may increase as the political system becomes more competitive. In addition, even the most intense political competition may not eradicate grand corruption. By allowing policies to converge, rival parties are shown to be able to continue to garner bribes from polluting interests. Interestingly, this is most likely to occur when the public are very sensitive to environmental damage and when the rents associated with the activity causing this damage are large. The results also call into question traditional measurement of grand corruption, which tends to focus on the amount or frequency of bribes paid. It is suggested that the resultant policy distortions deserve equal attention, though the measurement problems associated with this measure is acknowledged.

Chapter 4 uses World Bank data from 10000 firms in 80 countries to examine empirically the determinants of corruption. The results provide broad support for the theoretical predictions of the model presented in chapter 3. It is found that where the rents associated with avoidance of policy are large, both grand and petty corruption will be greater. Both forms of corruption are also found to be lower when the quality of policing and the judiciary is higher. In the context of political competition, threshold analysis reveals that when these enforcement

mechanisms are weak, political competition may lead to higher levels of petty corruption. Also consistent with the results of chapter 3 is the finding that political competition does not seem to be significantly associated with any reduction in the level of grand corruption.

The final paper explores the effect public beliefs have on environmental policy outcomes. This is important given the uncertainty which surrounds many environmental issues. The model incorporates direct and indirect lobbying and reveals how lobby groups might go about influencing public perceptions and thus policy outcomes. This issue has been largely ignored by the environmental policy literature.

Environmental interests are shown to be able to influence policy outcomes by informing the public when a polluting firms' activities cause environmental damage. This is shown to be more likely to occur when the government is malevolent (puts a low weight on the welfare of citizens and is thus responsive to contributions made by polluting interests), when the activities of the firm are particularly damaging, and when the public were previously uninformed about this damage.

Polluting interests are also shown to have some ability to persuade the public. In particular, when the profits are high, polluters are more likely to try and convince the public that their activity does not cause environmental damage. The public are nonetheless shown to be mistrustful of messages sent under these circumstances. The two forms of lobbying (direct and indirect) may also be strategic complements for the firm. However, this is shown to occur under very limited conditions. In particular, the environmental lobby, which as a result of key assumption in the model is the more credible of the two, is able to block the ability

of polluting interests to use indirect lobbying. This tends to imply that polluting interests rely on monetary contributions made to government when environmental interests actively engage in public education, a result which appears to be consistent with the empirical evidence on the lobbying activities of these groups.

The results presented in this thesis have implications for the formation of public policy. There is strong evidence to show that corruption has the capacity to contribute to environmental degradation. As such, policies which are successful in reducing corruption levels may yield beneficial effects for the environment. Consistent with Congleton (1992) and Neumayer (2002), the results of chapter three suggest that, in a model where agents are potentially corrupt, increasing the level of political competition yields better environmental outcomes. This suggests that in many countries, the implementation of democratic reforms may assist in yielding better environmental outcomes. This may be particularly important if developing (non-democratic) countries are to induced to sign international agreements, such as the much discussed Kyoto Protocol, aimed at reducing environmentally damaging activities. Despite this, the results suggest that corruption itself may not be eliminated by greater political competition. Persistent corruption, as shown by Fredriksson *et al.* (2004) and Scruggs (1998) has the capacity to temper the beneficial environmental effects of political reform. This is particularly the case when enforcement mechanisms are weak. As such, simultaneous reform to the judiciary and policing ability of authorities must also accompany democratic reforms. Experience in transition economies such as Russia have highlighted the potential dangers of not reforming institutions along with the political process.

Corruption in all its forms is difficult to eradicate and presents one of the major environmental challenges faced today. The results presented here highlight

this fact. In cases where corruption is very problematic, the efficiency losses associated with rent seeking and non-compliance may indicate that traditional forms of regulation (for example, the emissions tax used in this thesis) are not worthwhile. Instead, other measures such as voluntary standards may be superior.[148] Such methods will often turn on the public being relatively well informed about environmental issues. The results of this thesis suggest that special interests may well have the motivation and capacity to mislead the public. As such, a role for government in providing education regarding environmental issues may also be indicated.

The papers presented in this thesis combine and extend upon the existing literature relating to lobbying and corruption. Each raises several questions which can be used to motivate future study. Several of these are detailed in what follows.

Chapter 3 provides an explanation for policy convergence which differs from the existing literature. In essence, the result can be likened to that of a Cournot duopoly where total rent dissipation does not occur, despite competition between firms. In the context of political parties, greater competition may not lead to rent (bribe) dissipation, since policy convergence allows parties to garner bribes from firms by setting policies that deviate from the welfare maximising outcome. This is an area which may be fruitful to investigate empirically, in particular, examining the relationship between the sensitivity of the public to policy issues and the stance of rival parties. An obvious limitation to this type of research would be the paucity of data which measure public sentiment.

The nature of political competition has also been ignored somewhat in this paper. Competitiveness in the context of chapter 3 refers to the level of political

[148] I am grateful to an examiner of this thesis for making this observation.

advantage held by the incumbent. This is not unreasonable, however one can consider other dimensions. One possibility would be to consider greater competition as synonomous with more rivals. Alternatively, one could consider the electoral rules which exist in various countries (for example, preferential voting systems versus more direct democracy). The difficulties in generating tractable models may relegate such analysis to empirical investigation.

A further extension would be to consider more explicit competition between interest groups. This has been undertaken in the literature (for example, Fredriksson, 1997a), however not in the context of chapters 3 and 5. Related to this would be modelling negative contributions. In many instances, environmental lobbies actually receive government funding. Explaining why this occurs in the context of the Grossman and Helpman (1994) model has, to the best of my knowledge, not been undertaken.

Should data become available, the results of chapter 5 might also be empirically tested. It would be of particular interest to see which environmental issues are the focus of such 'green' lobby groups. For example, are the targets of environmental awareness campaigns dominated by the (potential) level of damage or by the relative ignorance of the public, or do other motivations, such as generating income from members or the government dominate?

Finally, the empirical analysis undertaken in chapter 4 focuses on the frequency and amount of bribes paid. It may, as noted in chapter 3, be more useful to try and examine the size of policy distortions in order to more accurately gauge the costs of corruption. Again, a major constraint would be the paucity of available data.

APPENDICES

Appendix A (Appendix to Chapter Three)

A.1 The Firm-Inspector Interaction

This section details some useful properties of the equilibrium arising in the firm-inspector interaction.

Beginning with equations (3a) and (3b), we have

$$J_{\hat{e}} = -\mathrm{t} + \lambda \frac{\partial h^T(\theta, v)}{\partial v} - \frac{\partial \lambda}{\partial \hat{e}} h(\theta, v) = 0 \qquad (3a)$$

$$J_e = \frac{\partial \pi}{\partial e} - \lambda \frac{\partial h^T(v, \theta)}{\partial v} = 0 \qquad (3b)$$

where $\frac{d\lambda}{d\hat{e}} = \eta \frac{d\sigma}{d\hat{e}}$

Total differentiation yields

$$\begin{bmatrix} J_{\hat{e}\hat{e}} & J_{\hat{e}e} \\ J_{e\hat{e}} & J_{ee} \end{bmatrix} \begin{bmatrix} d\hat{e} \\ de \end{bmatrix} = -\begin{bmatrix} J_{\hat{e}t} \\ J_{et} \end{bmatrix} dt - \begin{bmatrix} J_{\hat{e}\theta} \\ J_{e\theta} \end{bmatrix} d\theta - \begin{bmatrix} J_{\hat{e}\eta} \\ J_{e\eta} \end{bmatrix} d\eta \qquad (A1.1)$$

where

$$J_{\hat{e}e} = J_{e\hat{e}} = \lambda \frac{\partial^2 h}{\partial v^2} - \frac{\partial \lambda}{\partial \hat{e}} \frac{\partial h}{\partial v} > 0 \qquad (A1.2)$$

$$J_{\hat{e}t} = -1$$

$$J_{\hat{e}\hat{e}} = 2\left(\frac{\partial \lambda}{\partial \hat{e}} \frac{\partial h}{\partial v}\right) - \frac{\partial^2 \lambda}{\partial \hat{e}^2} h(\theta, v) - \lambda \frac{\partial^2 h}{\partial v^2} < 0 \qquad (A1.3)$$

$$J_{ee} = \frac{\partial^2 \pi}{\partial e^2} - \lambda \frac{\partial^2 h}{\partial v^2} < 0$$

$J_{ee} < 0$, $J_{\hat{e}\hat{e}} < 0$, $|J_{ee}| > |J_{e\hat{e}}|$ and $|J_{\hat{e}\hat{e}}| > |J_{e\hat{e}}|$[149], ensuring a unique and stable solution. This ensures the determinant of the coefficient matrix, defined as

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[149] $|J_{ee}| > |J_{\hat{e}e}|$ requires $\left|\partial^2\pi/\partial e^2\right| > \left|\partial\lambda/\partial\hat{e}\,\partial h/\partial v\right|$ which is assumed.

$\Delta = J_{\hat{e}\hat{e}} J_{ee} - J_{\hat{e}e}{}^2$ is positive.

$$J_{\hat{e}\theta} = -\frac{\partial \lambda}{\partial \hat{e}} \frac{\partial h}{\partial \theta} + \lambda \frac{\partial^2 h}{\partial v \partial \theta} > 0 \quad ; \quad J_{e\theta} = -\lambda \frac{\partial^2 h}{\partial v \partial \theta} < 0 \qquad \text{(A1.4)}$$

$$J_{\hat{e}\eta} = \sigma(\hat{e}) \frac{\partial h}{\partial v} - \frac{\partial \sigma(\hat{e})}{\partial \hat{e}} h > 0 \quad ; \quad J_{e\eta} = -\sigma(\hat{e}) \frac{\partial h}{\partial v} < 0 \qquad \text{(A1.5)}$$

Property 1

$$\frac{d\hat{e}}{dt} = \frac{-J_{\hat{e}t} J_{ee}}{\Delta} = \frac{J_{ee}}{\Delta} < 0$$

Property 2

$$\frac{de}{dt} = \frac{J_{\hat{e}t} J_{e\hat{e}}}{\Delta} < 0$$

Property 3

$$\frac{dv}{dt} = \frac{de}{dt} - \frac{d\hat{e}}{dt} = \frac{-\left(J_{e\hat{e}} + J_{ee}\right)}{\Delta} > 0$$

Property 4

$$\frac{d\hat{e}}{d\theta} = \frac{J_{e\theta} J_{\hat{e}e} - J_{\hat{e}\theta} J_{ee}}{\Delta} > 0$$

Property 5

$$\frac{de}{d\theta} = \frac{J_{e\hat{e}} J_{\hat{e}\theta} - J_{\hat{e}\hat{e}} J_{e\theta}}{\Delta} < 0$$

It is assumed that $\left|J_{\hat{e}\hat{e}}\right| > \left|J_{e\hat{e}}\right|$ by a sufficient amount to ensure $\left|J_{\hat{e}\hat{e}} J_{e\theta}\right| > \left|J_{e\hat{e}} J_{\hat{e}\theta}\right|$.

Property 6

$$\frac{dv}{d\theta} = \frac{de}{d\theta} - \frac{d\hat{e}}{d\theta} = \frac{J_{\hat{e}\theta}\left(J_{ee} + J_{e\hat{e}}\right) - J_{e\theta}\left(J_{\hat{e}\hat{e}} + J_{\hat{e}e}\right)}{\Delta} < 0$$

which follows directly from the properties (4) and (5)

Property 7

$$\frac{d\hat{e}}{d\eta}=\frac{-J_{\hat{e}\eta}J_{ee}+J_{e\eta}J_{\hat{e}e}}{\Delta}>0$$

Note that from A1.5, $|J_{\hat{e}\eta}|>|J_{e\eta}|$ and by assumption $|J_{ee}|>|J_{\hat{e}e}|$, hence the sign follows.

Property 8

$\frac{de}{d\eta}=\frac{-J_{\hat{e}\hat{e}}J_{e\eta}+J_{e\hat{e}}J_{\hat{e}\eta}}{\Delta}<0$, where it is assumed that $|J_{\hat{e}\hat{e}}|>|J_{e\hat{e}}|$ by a sufficient amount to ensure $|J_{\hat{e}\hat{e}}J_{e\eta}|>|J_{e\hat{e}}J_{\hat{e}\eta}|$.

Property 9

$\frac{dv}{d\eta}=\frac{de}{d\eta}-\frac{d\hat{e}}{d\eta}<0$, which follows directly from Properties 7 and 8.

A.2 The Political Equilibrium

Expanding terms in (8a) and (8b), using (11a, b):

$$Z_i=\Omega\frac{\partial\Pi^i}{\partial\Phi^i}+(1-\alpha)\gamma^i(A+R)+\frac{d\Phi^j}{d\Phi^i}\left[(1-\Omega)\frac{\partial\Pi^j}{\partial\Phi^j}+(1-\alpha)\gamma^jA\right]=0$$

$$\Phi^i=t^i,\theta^i \qquad \text{(A2.1)}$$

$$Z_j=[1-\Omega]\frac{\partial\Pi^j}{\partial\Phi^j}+(1-\alpha)\gamma^j(A-R)+\frac{d\Phi^i}{d\Phi^j}\left[\Omega\frac{\partial\Pi^i}{\partial\Phi^i}+(1-\alpha)\gamma^iA\right]=0$$

$$\Phi^j=t^j,\theta^j \qquad \text{(A2.2)}$$

Totally differentiating the above system of equations yields

$$\begin{bmatrix}Z_{ii}{}^{i} & Z_{ij}{}^{i}\\ Z_{ji}{}^{j} & Z_{jj}{}^{j}\end{bmatrix}\begin{bmatrix}d\Phi^i\\ d\Phi^j\end{bmatrix}=-\begin{bmatrix}Z_{i\alpha}{}^{i}\\ Z_{j\alpha}{}^{j}\end{bmatrix}d\alpha \qquad \Phi^{i,j}=t^{i,j},\theta^{i,j}$$

For the SOCs to hold it is assumed that:
$Z_{ii}{}^{i}<0$, $Z_{jj}{}^{j}<0$; $Z_{ij}=Z_{ji}>0$; $|Z_{ii}{}^{i}|>|Z_{ij}{}^{i}|$, $|Z_{ii}{}^{i}|>|Z_{ji}{}^{j}|$, $|Z_{jj}{}^{j}|>|Z_{ji}{}^{j}|$ and $|Z_{jj}{}^{j}|>|Z_{ij}{}^{i}|$

These conditions also assure that the determinant of the coefficient matrix is positive:

$$\Omega=Z_{ii}{}^{i}Z_{jj}{}^{j}-Z_{ji}{}^{j}Z_{ij}{}^{i}>0$$

Proposition 1a

$$\frac{d\Phi^i}{d\alpha} = \frac{-Z_{i\alpha}{}^{i} Z_{jj}{}^{j} + Z_{j\alpha}{}^{j} Z_{ij}{}^{i}}{\Omega} \qquad \Phi^i = t^i, \theta^i$$

where,

$$Z_{i\alpha}{}^{i} = (1-\rho)\frac{\partial \Pi^i}{\partial \Phi^i} - \gamma^i (A+R) + \frac{d\Phi^j}{d\Phi^i}\left[(\rho-1)\frac{\partial \Pi^j}{\partial \Phi^j} - \gamma^j A\right] < 0 \text{ when R is large.} \tag{A2.3}$$

$$Z_{j\alpha}{}^{j} = -(1-\rho)\frac{\partial \Pi^j}{\partial \Phi^j} - \gamma^j (A-R) + \frac{d\Phi^i}{d\Phi^j}\left[(1-\rho)\frac{\partial \Pi^i}{\partial \Phi^i} - \gamma^j A\right] < 0 \text{ when R is large.} \tag{A2.4}$$

thus,

$$\frac{dt^i}{d\alpha} < 0 \text{ and } \frac{d\theta^i}{d\alpha} < 0$$

Proposition 1b

From properties 2 and 5, in Appendix A $de/dt < 0$ and $de/d\theta < 0$. As $dt/d\alpha < 0$ and $d\theta/d\alpha < 0$, then $\frac{de}{d\alpha} = \frac{dt}{d\alpha}\frac{de}{dt} + \frac{d\theta}{d\alpha}\frac{de}{d\theta} > 0$.

Proposition 1c

a. When political competition increases, the effect on under-reporting is ambiguous: $\frac{dv}{d\alpha} \gtrless 0$

where $\frac{dv}{d\alpha} = \frac{dv}{dt}\frac{dt}{d\alpha} + \frac{dv}{d\theta}\frac{d\theta}{d\alpha}$ (A2.5)

From Proposition 1a, $\frac{d\Phi^i}{d\alpha} < 0$ $\frac{d\Phi^j}{d\alpha} < 0$

Ambiguity in the sign results from Properties 3 and 6 in Appendix A which reveal:

$$\frac{dv}{dt} > 0 \qquad \frac{dv}{d\theta} < 0$$

b. $$\frac{dB}{d\alpha}=\frac{dB}{dt}\frac{dt}{d\alpha}+\frac{dB}{d\theta}\frac{d\theta}{d\alpha}+\frac{dB}{dv}\frac{dv}{d\alpha} \qquad \text{(A2.6)}$$

using Proposition (1a), $\frac{dB}{dt}\frac{dt}{d\alpha}<0$, $\frac{dB}{d\theta}\frac{d\theta}{d\alpha}>0$, *and* $\frac{dB}{dv}\frac{dv}{d\alpha}<0$

Thus, the sign of (A2.6) is ambiguous.

Proposition 1d

1. $$\frac{dv}{d\alpha}=\frac{dv}{dt}\frac{dt}{d\alpha}+\frac{dv}{d\theta}\frac{d\theta}{d\alpha}$$

$\frac{dv}{d\alpha}<0$ if the first term dominates since $\frac{dv}{dt}=\frac{-\left(J_{e\hat{e}}+J_{ee}\right)}{\Delta}>0$
and $\frac{dt}{d\alpha}<0$, while $\frac{dv}{d\theta}=\frac{J_{\hat{e}\theta}\left(J_{ee}+J_{e\hat{e}}\right)-J_{e\theta}\left(J_{\hat{e}\hat{e}}+J_{\hat{e}e}\right)}{\Delta}<0$ and $\frac{d\theta}{d\alpha}<0$

It is evident that $\frac{dv}{d\alpha}<0$ requires that $\left|\frac{dv}{dt}\right|>\left|\frac{dv}{d\theta}\right|$. Expanding these equations reveals that this occurs when $|J_{e\theta}|$ and $|J_{\hat{e}\theta}|$ are very small in size. This occurs when η is small in magnitude.[150] Performing relevant substitutions for $J_{e\hat{e}}$ and J_{ee}, we get,

$$\underset{\eta\to 0}{Lim}\frac{dv}{dt}=-\frac{\partial^2\pi}{\partial e^2}>0 \text{ and also } \underset{\eta\to 0}{Lim}\frac{dv}{d\theta}=0$$

and thus $\underset{\eta\to 0}{Lim}\frac{dv}{d\alpha}<0$.

2. A similar argument establishes that $\frac{dB}{d\alpha}<0$ as $\eta\to 0$ or $C(\theta)$ is sufficiently large:

$$\frac{dB}{d\alpha}=\frac{dB}{dt}\frac{dt}{d\alpha}+\frac{dB}{d\theta}\frac{d\theta}{d\alpha}+\frac{dB}{dv}\frac{dv}{d\alpha}<0$$

However,

$$\underset{\eta\to 0}{Lim}\frac{dB}{d\theta}=\lambda\left(\frac{dh^f}{d\theta}-\frac{dh^m}{d\theta}\right)=0, \quad \underset{\eta\to 0}{Lim}\frac{dB}{dv}=\lambda\left(\frac{dh^f}{dv}-\frac{dh^m}{dv}\right)=0 \text{ and}$$

$$\underset{\eta\to 0}{Lim}\frac{dB}{dt}>0$$

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[150] Note for Proposition 1a to hold, $\eta\neq 0$.

Thus,

$$\lim_{\eta \to 0} \frac{dB}{d\alpha} < 0$$

Lemma 1

The firm's first order conditions in (11a) and (11b) are,

$$F_i = \frac{d\Phi^i}{dS^i}\left[\Omega\frac{\partial \Pi^i}{\partial \Phi^i} + (1-\alpha)\gamma^i A + \frac{d\Phi^j}{d\Phi^i}\left((1-\Omega)\frac{\partial \Pi^j}{\partial \Phi^j} + (1-\alpha)\gamma^j A\right)\right] - 1 = 0$$

$$F_i = \frac{d\Phi^j}{dS^j}\left[(1-\Omega)\frac{\partial \Pi^j}{\partial \Phi^j} + (1-\alpha)\gamma^j A + \frac{d\Phi^i}{d\Phi^j}\left(\Omega\frac{\partial \Pi^i}{\partial \Phi^i} + (1-\alpha)\gamma^j A\right)\right] - 1 = 0$$

Totally differentiating this system of equations and writing in matrix form yields:

$$\begin{bmatrix} F_{ii} & F_{ij} \\ F_{ji} & F_{jj} \end{bmatrix}\begin{bmatrix} dS^i \\ dS^j \end{bmatrix} = -\begin{bmatrix} F_{i\alpha} \\ F_{j\alpha} \end{bmatrix} d\alpha$$

where $F_{ii} < 0, F_{jj} < 0$. It is further assumed that $|F_{ii}| > |F_{ij}|, |F_{jj}| > |F_{ij}|$ and $F_{ij} = F_{ji}$ as such, the determinant $\Gamma = F_{ii}F_{jj} - F_{ji}F_{ij} > 0$.

Thus,

$$\frac{dS^i}{d\alpha} = \frac{-F_{i\alpha}F_{jj} + F_{j\alpha}F_{ij}}{\Gamma} \quad \text{and} \quad \frac{dS^j}{d\alpha} = \frac{-F_{ii}F_{j\alpha} + F_{ji}F_{i\alpha}}{\Gamma}$$

again it is assumed that $|F_{ii}| > |F_{ij}|, |F_{jj}| > |F_{ij}|$ by a sufficient amount such that the first term in each equation dominates. The effect of incumbency advantage on contributions to party *i* and party *j* thus depend on the signs of $F_{i\alpha}$ and $F_{j\alpha}$ respectively.[151] These are given as:

[151] In order to make the discussion more clear, the assumption is made that A>0. This implies that the policies of the incumbent are less stringent than those of the rival.

$$F_{i\alpha} = \underbrace{\frac{\partial \Phi^i}{\partial S^i}}_{(a)} \left[\underbrace{(1-\rho)\partial \Pi^i / \partial \Phi^i - \gamma^i A}_{(b)} + \underbrace{\frac{\partial \Phi^j}{\partial \Phi^i}\left((\rho - 1)\frac{\partial \Pi^j}{\partial \Phi^j} - \gamma^j A \right)}_{(c)} \right] \qquad \text{(A2.7)}$$

The first term, (a) reveals that contributions change the policy settings of party i. Contributions generate less stringent policy for both parties, hence (a)<0. The second term (b) represents the direct benefits which accrue to the firm from changes in the incumbent's policy. This term is unambiguously negative when A>0. The final term (c) shows the indirect effects of the rival's response on both profits and the election. This term is positive. Thus, where the first term in parenthesis dominates (a), $F_{i\alpha} > 0$. This is possible if the rival is unresponsive to contributions. The reverse holds when the second term is sufficiently large.

A similar argument can be made with regard to the effect of incumbency advantage on the contributions made to the rival.

$$F_{j\alpha} = \underbrace{\frac{\partial \Phi^j}{\partial S^j}}_{(d)} \left[\underbrace{(\rho - 1)\partial \Pi^j / \partial \Phi^j - \gamma^j A}_{(e)} + \underbrace{\frac{\partial \Phi^i}{\partial \Phi^j}\left((1-\rho)\frac{\partial \Pi^i}{\partial \Phi^i} - \gamma^i A \right)}_{(f)} \right] \qquad \text{(A2.8)}$$

In this instance, (d) is the direct effect of contributions on the rival's policy, (d)<0. (e) represents the direct effects on profits and the election from a change in the rival's policy, while (f) is the indirect effect of the changes to the incumbent's policy induced by the making of contributions to j.

Proposition 2a
Consider the case where A>0. Rearranging equation (A2.7) provides two effects:

$$\Sigma \equiv \frac{\partial \Phi^i}{\partial S^i}\left[(1-\rho)\left(\frac{\partial \Pi^i}{\partial \Phi^i} - \frac{\partial \Phi^j}{\partial \Phi^i}\frac{\partial \Pi^j}{\partial \Phi^j} \right) \right]$$

$$K \equiv \frac{\partial \Phi^i}{\partial S^i}(-A)\left(\gamma^i + \frac{\partial \Phi^j}{\partial \Phi^i}\gamma^j \right)$$

The first effect captures the direct and indirect effect on profits while the second captures the corresponding political effect. When the rival is very responsive to policy changes of the incumbent, $\left(\partial\Phi^j/\partial\Phi^i \text{ sufficiently large}\right)$,

$\Sigma<0, K<0$ and hence $F_{i\alpha}<0$.

Thus,

$\frac{\partial S^i}{\partial\alpha}<0$, which implies greater contributions to the incumbent when political competition rises. As contributions to each party are strategic complements,

$\frac{\partial S^j}{\partial\alpha}<0$.

The reverse result holds for cases where the rival is preferred (A<0)

Proposition 2b and Corollary 1

Let political competition be at the maximum (α=0), $S^i>0$, $S^j>0$:

Setting α=0, equation (11a) can be written as,

$$\frac{\partial S^i}{\partial\Phi^i}=\rho\frac{\partial\Pi^i}{\partial\Phi^i}+\gamma^i A+\frac{d\Phi^j}{d\Phi^i}\left[(1-\rho)\frac{\partial\Pi^j}{\partial\Phi^j}+\gamma^j A\right] \qquad \text{(A2.9)}$$

where $A=\Pi^i-\Pi^j$. Further note that from (11a) for an interior solution we require that $\frac{dS^i}{d\Phi^i}<0$. The sign of the RHS of (A2.9) will depend on the sign of A. We therefore begin by considering equilibrium contributions in 3 cases: A = 0, A > 0 and A<0 and show that when γ^i is large, then A=0 and hence that $S^i, S^j>0$.

Note that when A=0, then all remaining terms on the RHS of (A2.9) are negative so that $\frac{dS^i}{d\Phi^i}<0$, implying that an interior solution exists and contributions are always paid. Suppose next that A>0, and let γ^i be sufficiently large, such that $\frac{dS^i}{d\Phi^i}>0$. In this case by the FOC in (A2.9) $S^i=0$. However, when S^i=0, then from equation (7a) (with α=0): $\frac{dG^i}{d\Phi^i}=\gamma^i R=0$ which implies that party i sets policies at the welfare

maximising level denoted : $\Phi^i=\Phi^w$. Furthermore A>0, implies that $\Pi^i - \Pi^j > 0$ which can only occur if $\Phi^j>\Phi^i=\Phi^w$. But since no party has an incentive to set policies which are more stringent than the welfare maximising policies, it follows that $\Phi^j \leq \Phi^w$. This implies that $A \leq 0$, which contradicts the assumption that $A > 0$. Hence $A > 0$ is not feasible when γ^j is sufficiently high. QED.

By an identical argument it also follows that $A < 0$ is not feasible when γ^j is sufficiently high. Hence $A = 0$, which implies that $\Phi^j = \Phi^i$ for sufficiently high γ^j (and γ^j).

When political competition is at a maximum (α=0), and γ^j (γ^j) is sufficiently high, it has been shown that A=0. This implies that the policies of the parties must converge under such circumstances (i.e. A = 0). Moreover when A=0, then the conditions for an interior equilibrium of (A2.9) are satisfied hence $S^i, S^j > 0$.

Appendix B (Appendix to Chapter Four)

B.1 Data Descriptions and Empirical Results

Table B1: Observations for Petty Corruption

Country	Observations
Albania	123
Armenia	64
Azerbaijan	87
Belarus	44
Bolivia	73
Bulgaria	59
Colombia	91
Costa Rica	89
Czech Rep	53
Dominican Republic	99
Ecuador	78
El Salvador	92
Estonia	54
Georgia	53
Guatemala	85
Honduras	88
Hungary	42
Kazakhstan	71
Kyrgyzstan	71
Lithuania	51
Mexico	85
Moldova	66
Poland	96
Romania	79
Russia	253
Slovakia	48
Slovenia	41
Turkey	77
Uzbekistan	74
Argentina	68
Bangladesh	39
Brazil	140
Cambodia	267
Canada	99
Chile	97
France	77
Indonesia	80
Italy	77
Malaysia	61
Nicaragua	90
Panama	89
Peru	86
Philippines	91
Portugal	96
Singapore	100
Spain	97
Sweden	97
Thailand	276
Trinidad&Tobago	94
UK	83
Uruguay	75
US	82
Venezuela	75
Ukraine	127
TOTAL	4849

Table B2: Observations for Grand Corruption

Country	Observations
Albania	111
Armenia	123
Azerbaijan	89
Belarus	106
Bulgaria	91
Czech Rep	97
Estonia	118
Georgia	115
Uzbekistan	100
Hungary	111
Kazakhstan	94
Kyrgyzstan	79
Lithuania	66
Moldova	90
Poland	183
Romania	75
Russia	465
Slovakia	90
Slovenia	115
Turkey	129
Ukraine	164
Total	3311

Table B3: Variable Descriptions – Regressions for Petty Corruption

Variable	Coding	Mean	Std. Dev.	Min.	Max.
Accountability	As described in the chapter 4	0.195	0.733	-1.18	1.65
Polity		5.041	5.262	-9	10
Polyarchy		18.046	11.478	0	43.54
Stringency	1 = no obstacle 2 = minor obstacle 3 = moderate obstacle 4 = major obstacle	2.208	0.644	1	4
Security of property rights	1 = very bad 2 = bad 3 = slightly bad 4 = slightly good 5 = good 6 = very good	3.754	1.426	1	6
Quality of Police	1 = very bad 2 = bad 3 = slightly bad 4 = slightly good 5 = good 6 = very good	3.392	1.358	1	6
AFS (y/n)	1 = y 0 = n	0.618	0.485	0	1
Market Power	1 = y (≤3 competitors) 0 = n (>3 competitors)	0.471	0.499	0	1
Small	1 = y 0 = n	0.402	0.49	0	1
Medium	1 = y 0 = n	0.404	0.491	0	1
Large (default)	1 = y 0 = n	0.194	0.395	0	1
Exporter (y/n)	1 = y 0 = n	0.349	0.477	0	1
De novo	1 = y 0 = n	0.775	0.417	0	1
Privatised	1 = y 0 = n	0.135	0.342	0	1
State owned	1 = y 0 = n	0.052	0.221	0	1
Real GDP/capita	US$/100	44.797	72.941	1.1221	317.21

Table B4: Variable Descriptions – Regressions for Grand Corruption

Variable	Coding	Mean	Std. Dev.	Min.	Max.
Accountability	As described in chapter 4	0.087	0.735	-1.18	1.191
Polity		4.504	5.539	-9	10
Polyarchy		22.279	10.672	0.19	43.54
Stringency	1 = no obstacle 2 = minor obstacle 3 = moderate obstacle 4 = major obstacle	2.083	0.595	1	4
Security of property rights	1 = very bad 2 = bad 3 = slightly bad 4 = slightly good 5 = good 6 = very good	3.457	1.369	1	6
Quality of Police	1 = very bad 2 = bad 3 = slightly bad 4 = slightly good 5 = good 6 = very good	3.337	1.338	1	6
AFS (y/n)	1 = y 0 = n	0.386	0.487	0	1
Market Power	1 = y (≤3 competitors) 0 = n (>3 competitors)	0.221	0.415	0	1
Small	1 = y 0 = n	0.470	0.499	0	1
Medium	1 = y 0 = n	0.449	0.497	0	1
Large	1 = y 0 = n	0.081	0.273	0	1
Exporter (y/n)	1 = y 0 = n	0.260	0.439	0	1
De novo	1 = y 0 = n	0.545	0.498	0	1
Privatised	1 = y 0 = n	0.279	0.448	0	1
State owned	1 = y 0 = n	0.127	0.333	0	1
Time spent with senior officials	1 = up to 1% 2 = 1-5% 3 = 6-10% 4 = 11-25% 5 = 26-50% 6 = more than 50%	2.681	1.405	1	6
Real GDP/capita	US$/100	24.441	22.125	4.536	111.281

Table B5: OLS Regressions – Petty Corruption

	1	2	3	4
Polyarchy	**-0.135** (0.002)	**-0.307** (0.006)	**-0.199** (0.002)	**-0.111** (0.005)
Stringency	**0.347** (0.011)	**0.459** (0.018)	**0.368** (0.047)	**0.289** (0.02)
Security of property rights	**-0.278** (0.002)	**-0.628** (0.006)	**-0.356** (0.004)	**-0.267** (0.001)
Quality of Police	**-0.478** (0.000)	**-0.932** (0.000)	**-0.641** (0.000)	**-0.398** (0.000)
Market Power	**0.066** (0.799)	**0.072** (0.915)	**0.054** (0.880)	**0.022** (0.924)
Small	**0.712** (0.001)	**0.89** (0.009)	**0.718** (0.013)	**0.664** (0.001)
Medium	**0.431** (0.027)	**0.39** (0.041)	**0.449** (0.090)	**0.32** (0.07)
Large				
Real GDP/capita	**-0.019** (0.006)	**-0.038** (0.010)	**-0.027** (0.010)	**-0.0014** (0.034)
RGDP_Crt	**0.0006** (0.337)	**0.0001** (0.535)	**0.0007** (0.439)	**0.0006** (0.315)
RGDP_pol	**0.001** (0.172)	**0.002** (0.369)	**0.0016** (0.132)	**0.0006** (0.34)
R^2	**0.2038**	**0.1256**	**0.1640**	**0.1823**
n	**3625**	**3625**	**3625**	**3625**

a. see table below for assumptions regarding petty corruption
b. p values in parenthesis
c. Country specific effects estimated but not reported
d. p values derived using Huber-White robust standard errors.

Assumptions made regarding petty corruption (dependent variable)`(%)

Category	% Revenues	1*	2	3	4
1	*0*	*0*	*0*	*0*	*0*
2	*<1*	*1*	*1*	*1*	*0.1*
3	*1-1.99*	*2*	*2*	*2*	*1*
4	*2-9.99*	*6*	*10*	*6*	*2*
5	*10-12.99*	*11*	*13*	*11*	*10*
6	*13-25*	*19*	*25*	*25*	*13*
7	*>25*	*25*	*90*	*40*	*25*

* as per Hellman, Jones and Kaufmann (2000)

Table B6: Marginal Effects – Petty Corruption

	Categories of the dependent variable						
	1	2	3	4	5	6	7
Polyarchy	**0.005** (0.033)	**-0.0005** (0.044)	**-0.0012** (0.034)	**-0.002** (0.034)	**-0.0009** (0.037)	**-0.0003** (0.041)	**-0.0001** (0.047)
Stringency	**-0.074** (0.000)	**0.007** (0.000)	**0.0184** (0.000)	**0.028** (0.000)	**0.013** (0.000)	**0.0048** (0.000)	**0.0015** (0.000)
Security of property rights	**0.025** (0.000)	**-0.0062** (0.000)	**-0.0024** (0.002)	**-0.0095** (0.000)	**-0.0045** (0.000)	**-0.0016** (0.000)	**-0.0005** (0.001)
Quality of Police	**0.039** (0.000)	**-0.0038** (0.000)	**-0.0097** (0.000)	**-0.015** (0.000)	**-0.007** (0.000)	**-0.0026** (0.000)	**-0.0008** (0.000)
Market Power*	**-0.021** (0.316)	**0.0022** (0.345)	**0.0054** (0.318)	**0.0082** (0.314)	**0.0039** (0.312)	**0.0014** (0.312)	**0.0004** (0.312)
Small*	**-0.116** (0.000)	**0.0086** (0.000)	**0.029** (0.000)	**0.045** (0.000)	**0.022** (0.000)	**0.0083** (0.000)	**0.0028** (0.000)
Medium*	**-0.09** (0.000)	**0.0072** (0.000)	**0.022** (0.000)	**0.035** (0.000)	**0.017** (0.000)	**0.0063** (0.001)	**0.0021** (0.001)
Large							
Real GDP/capita	**0.0013** (0.000)	**-0.0001** (0.001)	**-0.0003** (0.000)	**-0.0005** (0.000)	**-0.0002** (0.000)	**-0.0001** (0.000)	**-0.00002** (0.001)

a. country specific effects estimated but not reported
b. * indicates discrete change of dummy variable from 0 to 1

Dependent Variable – Petty Corruption

Category	% Revenues
1	*0*
2	*<1*
3	*1-1.99*
4	*2-9.99*
5	*10-12.99*
6	*13-25*
7	*>25*

Table B7: Marginal Effects – Grand Corruption

	Categories of the dependent variable					
	1	2	3	4	5	6
Polyarchy	**-0.006** (0.017)	**-0.0025** (0.021)	**-0.0019** (0.019)	**-0.0007** (0.021)	**-0.0006** (0.025)	**-0.0004** (0.025)
Stringency	**-0.066** (0.000)	**0.027** (0.000)	**0.021** (0.000)	**0.0072** (0.000)	**0.0066** (0.000)	**0.0046** (0.001)
Security of property rights	**0.014** (0.050)	**-0.0058** (0.053)	**-0.0045** (0.051)	**-0.0015** (0.066)	**-0.0014** (0.063)	**-0.0009** (0.078)
Quality of Police	**0.018** (0.011)	**-0.0073** (0.012)	**-0.0056** (0.013)	**-0.0019** (0.022)	**-0.0017** (0.024)	**-0.0013** (0.026)
Small*	**0.035** (0.318)	**-0.014** (0.322)	**-0.011** (0.318)	**-0.0038** (0.322)	**-0.0034** (0.324)	**-0.0024** (0.336)
Medium*	**0.015** (0.632)	**-0.0062** (0.633)	**-0.0048** (0.632)	**-0.0016** (0.632)	**-0.0015** (0.632)	**-0.0011** (0.639)
Large						
Denovo*	**-0.112** (0.000)	**0.045** (0.000)	**0.045** (0.000)	**0.012** (0.002)	**0.012** (0.002)	**0.0081** (0.004)
Privatised*	**-0.071** (0.026)	**0.028** (0.021)	**0.028** (0.021)	**0.008** (0.048)	**0.0075** (0.042)	**0.0056** (0.058)
State Owned						
Time spent with senior officials	**-0.021** (0.003)	**0.0085** (0.003)	**0.0085** (0.003)	**0.0023** (0.009)	**0.0021** (0.009)	**0.0015** (0.014)
Real GDP/capita	**0.0002** (0.689)	**-0.00008** (0.690)	**-0.00008** (0.690)	**-0.00002** (0.689)	**-0.00002** (0.692)	**-0.00002** (0.688)

a. country specific effects estimated but not reported
b. indicates discrete change of dummy variable from 0 to 1

Dependent Variable – Grand Corruption

Category	Frequency
1	*never*
2	*seldom*
3	*sometimes*
4	*frequently*
5	*mostly*
6	*always*

Table B8: Petty Corruption – No Country Specific Effects

	Model 1			Model 2		
Accountability	-0.042			-0.078*		
Polity		-0.02**			0.027**	
Polyarchy			-0.006**			-0.006**
Stringency	0.173**	0.177**	0.174**	0.152**	0.157**	0.151**
Security of property rights	-0.053**	-0.059**	-0.085**	-0.059**	-0.065**	-0.068**
Quality of Police	-0.131**	-0.119**	-0.129**	-0.136**	-0.126**	-0.135**
AFS (y/n)	-0.229**	-0.214**	-0.239**			
Market Power	-0.503**	-0.493**	-0.513**	-0.610**	-0.591**	-0.633**
Small	0.395**	0.382**	0.389**	0.386**	0.371**	0.386**
Medium	0.252**	0.241**	0.254**	0.311**	0.292**	0.318**
Large						
Exporter (y/n)	0.057	0.061	0.055			
De novo	-0.485**	-0.439**	-0.496**			
Privatised	-0.152	-0.133	-0.141			
State owned						
Real GDP/capita	-0.0012	-0.0069	-0.0008	-0.0012	-0.0005	-0.0011
RGDP_crt	-0.0006*	-0.0006*	-0.0006*	-0.0006*	-0.0006*	-0.0006*
RGDP_pol	-0.0001	-0.0002	-0.0001	-0.0001	-0.0001	-0.0001
LL	-4578	-4569	-4575	-5176	-5159	-5174
p>chisq (Wald)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.1117	0.1135	0.1124	0.0972	0.1003	0.0975
n	3249	3249	3249	3625	3625	3625

* significant at p<0.05

** significant at p<0.01

All regressions obtained using Huber-White robust standard errors.

Table B9: Grand Corruption – No Country Specific Effects

	Model 1			Model 2		
Accountability	0.174**			0.158*		
Polity		0.017*			0.016*	
Polyarchy			0.038			0.004
Stringency	0.314**	0.319**	0.310**	0.337**	0.341**	0.333**
Security of property rights	0.029	0.04	0.031	0.030	0.021	0.021
Quality of Police	-0.163**	-0.16**	-0.154**	-0.086**	-0.088**	-0.084**
AFS (y/n)	0.002	-0.003	0.008			
Market Power	0.024	0.015	0.021			
Small	0.015	0.038	0.044	-0.029	-0.014	-0.021
Medium	0.027	0.034	0.027	0.006	-0.006	-0.004
Large						
Exporter (y/n)	0.102	-0.116	0.133			
De novo	0.451**	0.422**	0.432**	0.429**	0.429**	0.421**
Privatised	0.253*	0.234*	0.222	0.239*	0.222*	0.218
State owned						
Time spent with senior officials	0.054*	-0.046	-0.048	0.054**	0.059*	0.054*
Real GDP/capita	-0.009	0.007	0.007	-0.003	-0.002	-0.001
RGDP_crt	-0.002	-0.002	-0.002			
RGDP_pol	0.003*	0.003*	0.003*			
LL	-1155	-1157	-1159	-1218	-1219	-1221
p>chisq (Wald)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.043	0.042	.041	.044	.044	.042
n	1649	1649	1649	1731	1731	1731

* significant at p<0.05

** significant at p<0.01

All regressions obtained using Huber-White robust standard errors.

Default categories in italics.

Table B10: Country Specific Effects (Petty Corruption – *Polyarchy* Measure of Political Competition).

Country	Petty 1	Petty 2
Armenia (Default)		
Azerbaijan	-0.2302 (0.314)	-0.2265 (0.318)
Belarus	-1.1439 (0.000)	-1.1471 (0.000)
Bulgaria	-0.3149 (0.047)	-0.3279 (0.034)
Czech Rep	0.0954 (0.589)	0.112 (0.509)
Estonia	-0.23 (0.066)	-0.2595 (0.033)
Georgia	0.1421 (0.385)	0.1171 (0.469)
Hungary	-0.2222 (0.196)	-0.2545 (0.095)
Kazakhstan	-0.4256 (0.102)	-0.4604 (0.072)
Kyrgyzstan	-0.35 (0.13)	-0.3992 (0.073)
Lithuania	-0.3757 (0.027)	-0.398 (0.017)
Moldova	-0.3118 (0.123)	-0.2749 (0.156)
Poland	-0.4263 (0.001)	-0.4333 (0.001)
Romania	-0.1289 (0.397)	-0.1383 (0.359)
Russia	-0.2569 (0.019)	-0.2545 (0.017)
Slovenia	0.1255 (0.378)	0.1275 (0.352)
Ukraine	-0.029 (0.822)	-0.0445 (0.725)
Uzbekistan	-0.2141 (0.424)	-0.258 (0.326)
Albania	-0.5066 (0.012)	-0.5225 (0.008)
Turkey	-0.5626 (0.002)	-0.5563 (0.001)
Bolivia	-0.6824 (0.002)	-0.7263 (0.000)
Columbia	-1.889 (0.000)	-1.9222 (0.000)
Costa Rica	-1.1383 (0.000)	-1.2508 (0.000)
Dom Rep.	-1.1403 (0.000)	-1.2022 (0.000)
Ecuador	-1.1458 (0.000)	-1.1418 (0.000)
El Sal.	-2.2604 (0.000)	-2.3754 (0.000)
Guatemala	-1.5656 (0.000)	-1.5924 (0.000)
Mexico	-1.1197 (0.000)	-1.1625 (0.000)
Nicaragua	-1.2503 (0.000)	-1.2756 (0.000)
Panama	-1.2174 (0.000)	-1.2298 (0.000)
Peru	-0.9781 (0.000)	-1.0141 (0.000)
Trin & Tib	-1.8674 (0.000)	-1.9155 (0.000)
Uruguay	-1.8314 (0.000)	-1.8313 (0.000)
Venezuela	-1.3393 (0.000)	-1.3974 (0.000)
Pakistan	-0.6921 (0.010)	-0.6917 (0.007)
Malaysia	-1.3941 (0.000)	-1.3748 (0.000)
Indonesia	-0.6788 (0.018)	-0.4905 (0.067)
Singapore	-2.3202 (0.000)	-2.1338 (0.000)
Philippines	-1.008 (0.000)	-1.0501 (0.000)
UK	-2.015 (0.000)	-1.8173 (0.000)
France	-0.8699 (0.003)	-0.8689 (0.002)
Germany	-0.3211 (0.307)	-0.2082 (0.448)
Spain	-1.8034 (0.000)	-1.8166 (0.000)
Portugal	-2.004 (0.000)	-1.9599 (0.000)
Italy	-1.039 (0.001)	-1.0097 (0.001)
Sweden	-2.003 (0.000)	-2.0219 (0.000)
Argentina	-0.984 (0.000)	-1.0177 (0.000)
Brazil	-1.683 (0.000)	-1.5467 (0.000)
Canada	-1.805 (0.000)	-1.7946 (0.000)
Chile	-2.01 (0.000)	-1.8926 (0.000)
Bangladesh	-0.7582 (0.010)	-0.6779 (0.011)
Thailand	-0.3167 (0.171)	-0.3492 (0.109)
Cambodia	-0.8114 (0.000)	0.8461 (0.000)
Honduras	-2.548 (0.000)	-2.3189 (0.000)

a. p values in parentheses.
b. Results obtained using *Polyarchy* measure of political competition..

Table B11: Country Specific Effects (Grand Corruption – *Polyarchy* Measure of Political Competition).

Country	Grand 1	Grand 2
Armenia (Default)		
Azerbaijan	1.1943 (0.001)	1.2401 (0.000)
Belarus	-0.4094 (0.364)	-0.3625 (0.414)
Bulgaria	0.1503 (0.619)	0.1545 (0.605)
Czech Rep	-0.549 (0.044)	-0.6033 (0.024)
Estonia	-0.0428 (0.852)	-0.0536 (0.811)
Georgia	0.5244 (0.028)	0.5502 (0.019)
Hungary	-0.5323 (0.084)	-0.4162 (0.138)
Kazakhstan	0.1405 (0.732)	0.2128 (0.600)
Kyrgyzstan	-0.283 (0.503)	-0.2899 (0.493)
Lithuania	0.2839 (0.289)	0.2679 (0.313)
Moldova	0.0542 (0.864)	0.2953 (0.305)
Poland	0.2084 (0.292)	0.2442 (0.207)
Romania	0.2178 (0.414)	0.1939 (0.464)
Russia	-0.1483 (0.395)	-0.1380 (0.414)
Ukraine	-0.1124 (0.614)	-0.1201 (0.581)
Uzbekistan	0.0962 (0.824)	0.1729 (0.687)
Albania	0.8165 (0.005)	0.8403 (0.004)
Turkey	0.3425 (0.199)	0.3819 (0.146)

Table B12: Correlation Matrix (Petty Corruption)

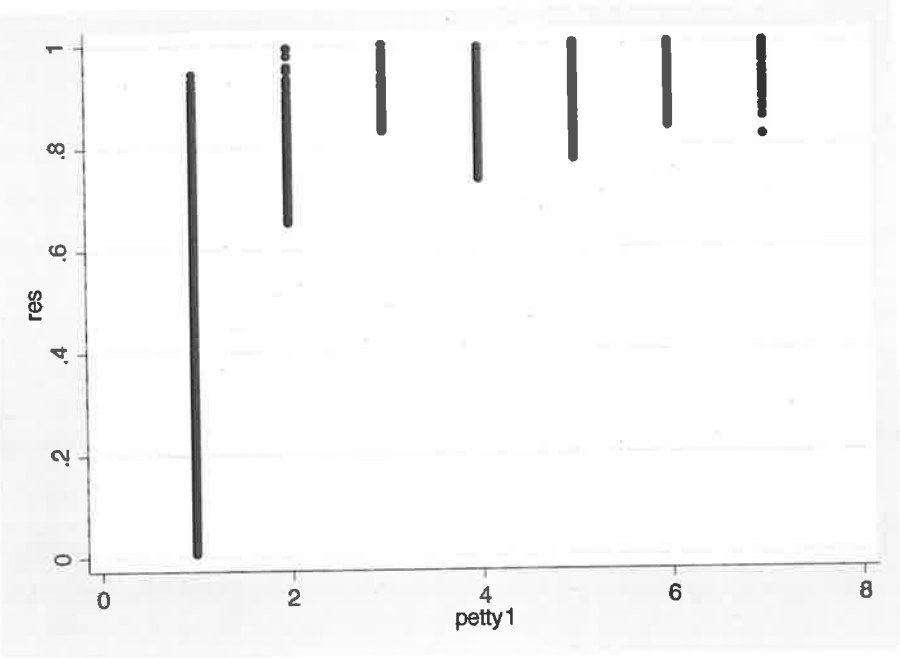
	Account	Polyarchy	Polity	Stringency	Court	Police	AFS	Mkt Power	Small	Medium	Large	Exporter	Denovo	Privatised	RGDP
Account	1														
Polyarchy	0.65	1													
Polity	0.70	0.66	1												
Stringency	-0.008	-0.009	0.02	1											
Court	0.14	-0.05	0.03	-0.15	1										
Police	0.11	0.03	0.07	-0.24	0.31	1									
AFS	0.12	-0.06	0.07	0.07	0.12	0.02	1								
Mkt Pwr	0.24	0.11	0.21	0.11	0.09	0.04	0.17	1							
Small	-0.06	-0.04	-0.03	-0.10	-0.09	-0.02	-0.32	-0.14	1						
Med	0.02	0.06	-0.01	0.06	0.00	0.01	0.12	0.03	-0.66	1					
Large	0.05	-0.02	0.05	0.06	0.11	0.02	0.25	0.13	-0.38	-0.43	1				
Exporter	0.16	0.04	0.07	0.07	0.08	0.04	0.24	0.04	-0.27	0.06	0.25	1			
Denovo	0.05	-0.14	0.05	0.07	0.00	-0.03	-0.01	0.18	0.25	-0.2	-0.05	-0.03	1		
Privatised	-0.05	0.11	-0.06	-0.03	-0.06	0.004	0.02	-0.15	-0.16	0.13	0.03	0.02	-0.73	1	
RGDP	0.54	0.39	0.28	-0.07	0.12	0.23	0.09	0.31	-.04	0.02	0.01	0.09	0.11	-0.04	1

Table B13: Correlation Matrix (Grand Corruption)

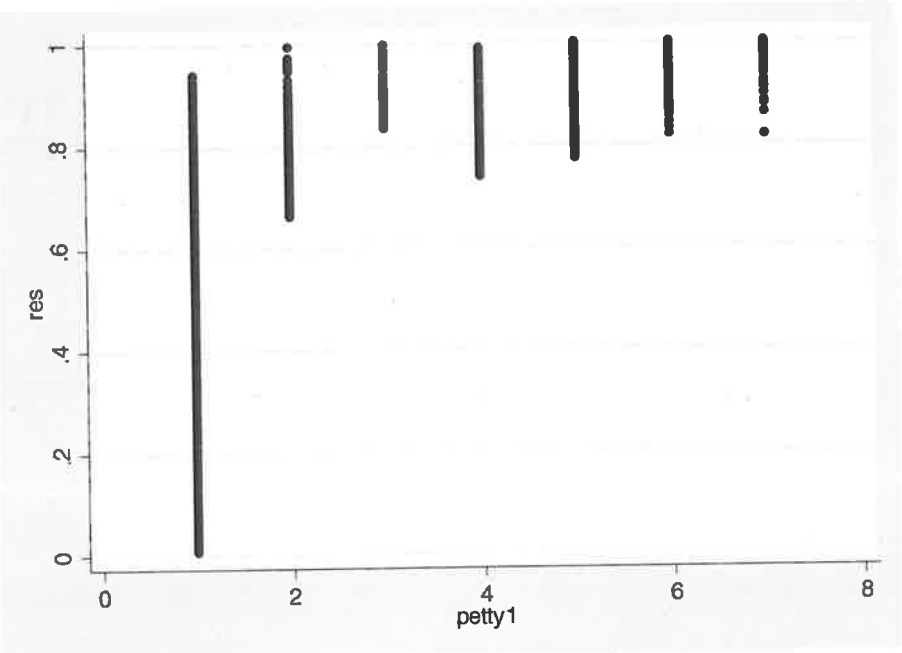
	Account	Polity	String	Polyarchy	Crt	Police	AFS	Mkt pwr	Small	Med	Exporter	Denovo	Priv	TMGMT	RGDP
Account	1														
Polity	0.79	1													
Stringency	-0.07	-0.04	1												
Polyarchy	0.64	0.76	-0.01	1											
Court	0.11	-0.02	-0.18	-0.11	1										
Police	0.15	0.11	-0.18	0.04	0.30	1									
AFS	0.08	0.06	0.01	0.03	0.08	0.12	1								
Mkt Pwr	0.02	0.03	-0.05	0.04	0.06	0.04	0.06	1							
Small	0.05	0.05	-0.04	0.01	-0.09	-0.11	-0.34	-0.16	1						
Med	-0.07	-0.07	0.01	-0.02	0.03	0.07	0.25	0.07	-0.83	1					
Exporter	0.28	0.21	0.06	0.15	0.07	0.12	0.25	0.10	-0.26	0.11	1				
Denovo	0.04	0.09	0.03	0.06	-0.11	-0.09	-0.29	-0.17	0.54	-0.37	-0.13	1			
Privatised	-0.02	-0.04	0.04	0.02	-0.01	0.02	0.25	0.03	-0.33	0.22	0.12	-0.69	1		
TMGMT	-0.16	-0.06	0.10	0.04	-0.12	-0.10	0.08	0.01	-0.11	0.09	-0.02	-0.06	0.04	1	
RGDP	0.60	0.44	-0.07	0.42	0.11	0.23	0.17	0.00	-0.10	0.07	0.31	-0.05	0.09	-0.12	1

B14 – Plotted Pseudo Residuals - Polyarchy

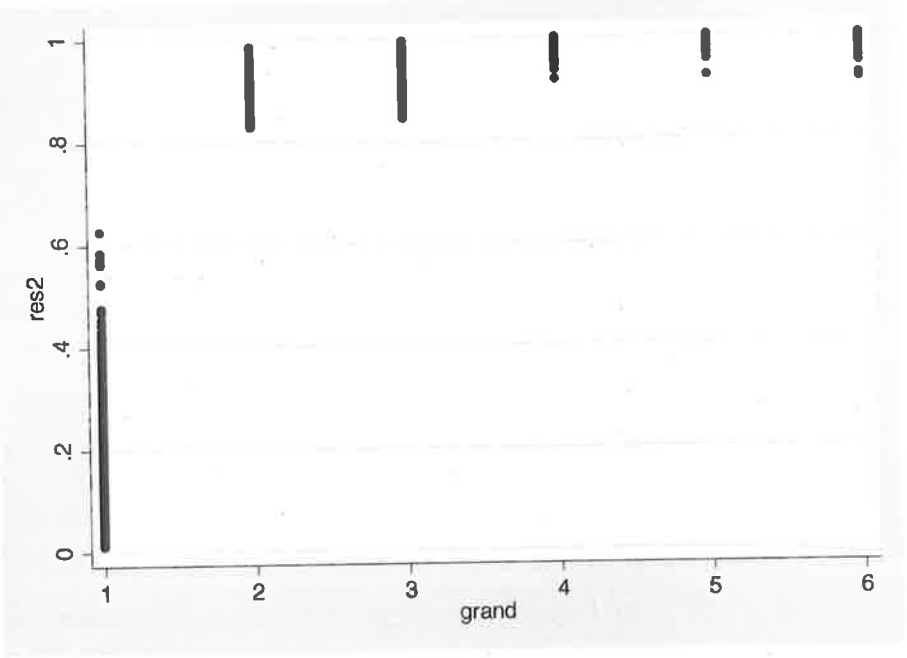
1. Calculated residuals v actual outcomes of DV (Petty Corruption – Model 1)



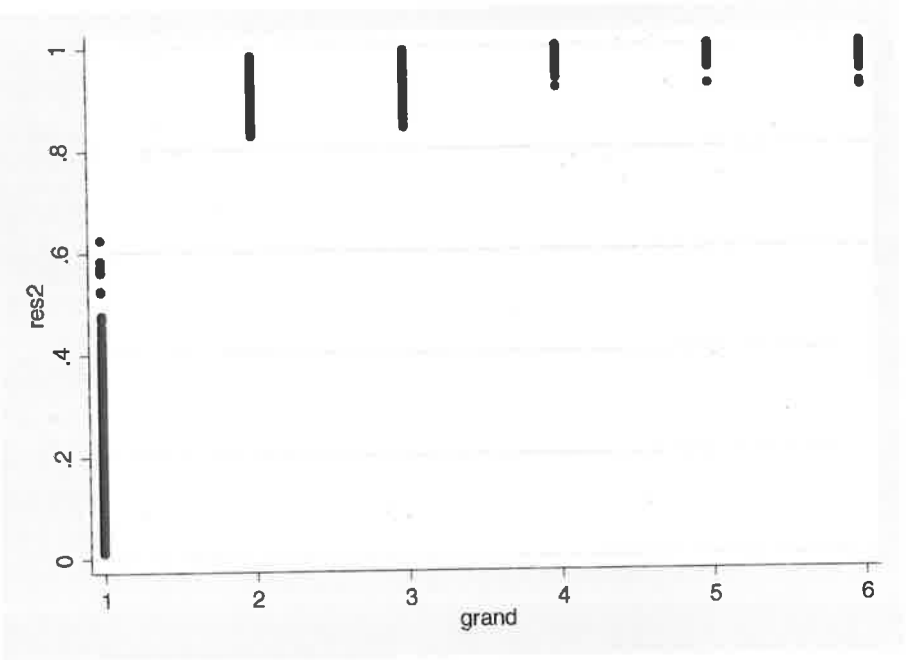
2. Calculated residuals v actual outcomes of DV (Petty Corruption – Model 1)



3. Calculated residuals v actual outcomes of DV (Grand Corruption – Model 1)



4. Calculated residuals v actual outcomes of DV (Grand Corruption – Model 1)



B.2 Stata Coding for Bootstrap Regressions

B.2.1 Stata Do File for Generating Polyarchy Confidence Intervals

```
postfile john4 cdif1 cdif2 cdif3 cdif4 cdif5 chigh1 chigh2 chigh3
chigh4 chigh5 clow1 clow2 clow3 clow4 clow5 using
coeffpolyid2,replace

scalar ccc=1
while ccc<1001 {

drop _all
do open
gen clow1=.
gen clow2=.
gen clow3=.
gen clow4=.
gen clow5=.
gen chigh1=.
gen chigh2=.
gen chigh3=.
gen chigh4=.
gen chigh5=.
gen cdif1=.
gen cdif2=.
gen cdif3=.
gen cdif4=.
gen cdif5=.

set more off
global model "quietly oprobit petty1 polyid stringency police small
medium rgdp"
drop if crt_prghts==.
drop if petty1==.

bsample

$model if crt_prghts<2, robust
replace clow1=_b[polyid]
$model if crt_prghts>=2 , robust
replace chigh1=_b[polyid]
replace cdif1=chigh1-clow1

$model if crt_prghts<3, robust
replace clow2=_b[polyid]
$model if crt_prghts>=3 , robust
replace chigh2=_b[polyid]
replace cdif2=chigh2-clow2

$model if crt_prghts<4, robust
replace clow3=_b[polyid]
$model if crt_prghts>=4 , robust
replace chigh3=_b[polyid]
replace cdif3=chigh3-clow3

$model if crt_prghts<5, robust
replace clow4=_b[polyid]
$model if crt_prghts>=5 , robust
```

```
replace chigh4=_b[polyid]
replace cdif4=chigh4-clow4

$model if crt_prghts<6, robust
replace clow5=_b[polyid]
$model if crt_prghts==6, robust
replace chigh5=_b[polyid]
replace cdif5=chigh5-clow5

post john4 (cdif1) (cdif2) (cdif3) (cdif4) (cdif5) (chigh1)
(chigh2) (chigh3) (chigh4) (chigh5) (clow1) (clow2) (clow3) (clow4)
(clow5)
scalar list ccc
scalar ccc=ccc+1
}
postclose john4
```

B.2.2 Stata Do Files for LR Critical Value

Setup of Bootstrap

```
oprobit petty1 polyid stringency police small medium rgdp if
crt_prghts<7, robust
predict p1 p2 p3 p4 p5 p6 p7
gen randnum=uniform()
gen pr1=p1
gen pr2=p1+p2
gen pr3=p1+p2+p3
gen pr4=p1+p2+p3+p4
gen pr5=p1+p2+p3+p4+p5
gen pr6=p1+p2+p3+p4+p5+p6
gen pr7=p1+p2+p3+p4+p5+p6+p7
gen pettybs=0
```

Bootstrap

```
set more off
postfile john lr thresh using out1,replace
scalar ccc=1
while ccc<10001 {

replace randnum=uniform()
replace pettybs=.
replace pettybs=1 if randnum<pr1 & pettybs==.
replace pettybs=2 if randnum<pr2 & pettybs==.
replace pettybs=3 if randnum<pr3 & pettybs==.
replace pettybs=4 if randnum<pr4 & pettybs==.
replace pettybs=5 if randnum<pr5 & pettybs==.
replace pettybs=6 if randnum<pr6 & pettybs==.
replace pettybs=7 if randnum<pr7 & pettybs==.
replace pettybs=. if petty1==.


global model "quietly oprobit pettybs polyid stringency police
small medium rgdp"

$model if crt_prghts<2, robust
scalar liklow=e(ll)
$model if crt_prghts>=2 & crt_prghts<., robust
scalar likhigh=e(ll)
scalar lik1=liklow+likhigh

$model if crt_prghts<3, robust
scalar liklow=e(ll)
$model if crt_prghts>=3 & crt_prghts<., robust
scalar likhigh=e(ll)
scalar lik2=liklow+likhigh

$model if crt_prghts<4, robust
scalar liklow=e(ll)
$model if crt_prghts>=4 & crt_prghts<., robust
scalar likhigh=e(ll)
scalar lik3=liklow+likhigh

$model if crt_prghts<5, robust
```

```
scalar liklow=e(ll)
$model if crt_prghts>=5 & crt_prghts<., robust
scalar likhigh=e(ll)
scalar lik4=liklow+likhigh

$model if crt_prghts<6, robust
scalar liklow=e(ll)
$model if crt_prghts==6, robust
scalar likhigh=e(ll)
scalar lik5=liklow+likhigh

scalar likmax=max(lik1,lik2,lik3,lik4,lik5)

$model if crt_prghts<=6, robust
scalar liktot=e(ll)
if likmax==lik1 {
scalar thresh=1
}
if likmax==lik2 {
scalar thresh=2
}
if likmax==lik3 {
scalar thresh=3
}
if likmax==lik4 {
scalar thresh=4
}
if likmax==lik5 {
scalar thresh=5
}

scalar lr=2*(likmax-liktot)

post john (lr) (thresh)
scalar list ccc
scalar ccc=ccc+1
}

postclose john
```

B.2.2 Stata Do Files for generating 'Pseudo Errors'

```
set more off
xi: oprobit grand polyid stringency crt_prghts police small medium
denovo privatised t_smgt rgdp100 i.country
predict float p1 p2 p3 p4 p5 p6, p
replace res2=.
gen prob1=1-pr1
gen prob2=1-pr2
gen prob3=1-pr3
gen prob4=1-pr4
gen prob5=1-pr5
gen prob6=1-pr6
replace res=prob1 if grand==1 & res2==.
replace res=prob2 if grand==2 & res2==.
replace res=prob3 if grand==3 & res2==.
replace res=prob4 if grand==4 & res2==.
replace res=prob5 if grand==5 & res2==.
replace res=prob6 if grand==6 & res2==.
scatter res grand

bysort grand: sum res2
sfrancia res2
```

Nb. This example is for a Grand corruption model. All Coding is identical for other dependent variables and other specifications of the model.

Appendix C (Appendix to Chapter Five)

C.1 Sending by the Green Lobby

As per Lemma 2, when the green lobby sends a message, the public will always believe it to be true. Thus a separating equilibrium exists such that: $\{m_G, m_F\} = \{\theta_H, 0\}; \mu = 1$. Numerical simulations below show conditions under which the green lobby will find it optimal to send a message. By Proposition 1, this is most likely when: (i) β is small, (ii) the upper bound of environmental damage θ_H is large, and when the public would otherwise believe damage to be very low. The effect of these variables on the payoffs from sending a message for the greens are examined below. Data in the tables reveal the net gain from sending a message, given exogenous parameter values. Negative values obviously imply that it is not optimal to send a message.

$\bar{\mu} \equiv$ posterior belief of public when greens do not send

$\beta \equiv$ weight attached to aggregate welfare by government

$\theta_H \equiv$ upper bound of environmental damage

Case 1: $\beta = 5; \quad \bar{\mu} = 0, 0.9; \quad \theta_H = 0.5, 1, ..., 5$

θ_H	$\bar{\mu} = 0$	$\bar{\mu} = 0.9$
0.5	-0.58	-0.96
1	0.67	-0.83
1.5	2.75	-0.63
2	5.67	-0.33
2.5	9.42	0.04
3	14	0.5
3.5	19.4	1.04
4	25.6	1.67
4.5	32.8	2.38
5	40.6	3.7

Case 2: $\beta = 3, 20; \quad \bar{\mu} = 0, 0.5, 0.9, 1; \quad \theta_H = 1$

$\bar{\mu}$	$\beta = 2.2$	$\beta = 3$	$\beta = 20$
0	*10*	*2*	*0.1*
0.5	*4.5*	*0.5*	*-0.4*
0.9	*0.1*	*-0.7*	*-0.9*
1	*-1*	*-1*	*-1*

Case 3: $\bar{\mu} = 0.9; \quad \theta_H = 2, 5$

β	$\theta_H = 2$	$\theta_H = 5$
2.2	*3.4*	*26.5*
3	*0.2*	*6.5*
5	*-0.33*	*3.2*
10	*-0.5*	*2.1*
50	*-0.6*	*1.6*

C.2 Sending by the Firm.

For message sending to be optimal for the firm, it must be the case that the green lobby does not send a message. We thus begin by considering the green's strategy first. From proposition 1, it is evident that when β is large, or the upper bound of damage is low, it is less likely that the green lobby will send. The simulations below reveal the greens will not send under these conditions. For this, it is assumed that the beliefs of the public when the green do not send $\bar{\mu}$ are zero. In terms of off-equilibrium beliefs, this provides the strongest incentives for the greens to send. For any parameter values where the greens do not send when $\bar{\mu} = 0$, it is also the case that the greens will not send for any $\bar{\mu} > 0$.

Consider the following parameter values:

$\beta = 4, 6, ..., 20$

$\theta_H = 0.8$

$\bar{\mu} = 0$ (Belief of the public when greens do not send)

Table C2.1 Payoffs for Greens (high damage state)

β	Ω^G
4	0.28
6	-0.04
8	-0.15
10	-0.2
12	-0.23
14	-0.25
16	-0.27
18	-0.28
20	-0.29

Thus, for all cases other than $\beta = 4$, it is not optimal for the greens to send.

Having identified cases where the greens do not send, we turn to the incentives facing the firm. Suppose that given these conditions, the firm were to find it optimal to send a message in the low damage state. In this situation, when actual damage is high, the firm can either send a message, in which case a pooling equilibrium occurs (Proposition 4), or it can not send. Note that if it follows the 'no send' option, the public will infer that damage is high (Proposition 5). This is because they expect to see a message from the firm when damage is low. The absence of a message would thus imply that damage is high. The possibilities can be examined using the following numerical example.

Consider first the incentives facing the firm in the low damage state. Assume that the public have a prior belief regarding damage such that $\lambda = 0.8$, and that this belief is retained if they do not observe a message from the firm. Note once again that this is an off equilibrium belief, on which there are no restrictions. We will also assume that sending a message reduces this belief to 0.6. It is also assumed that a takes on a value of either 5 or 10. All other values remain the same as in table C2.1.

Simulations yield:

Table C2.2 Payoffs for the Firm (Low Damage State)

β	Ω^F (a=5)	Ω^F (a=10)
6	1.13	3.53
8	0.89	3.03
10	0.78	2.78
12	0.71	2.62
14	0.66	2.52
16	0.62	2.45
18	0.60	2.39
20	0.58	2.35

The results confirm that even if beliefs are only reduced to 0.6, the firm finds it optimal to send. Now consider the corresponding possibilities in the high damage state. If the firm does not send, then we have a separating equilibrium where the public believe that a message from the firm implies zero damage and that the absence of a message implies that they are in the high damage state.[4] On the other hand, if the firm does send, then a pooling equilibrium exists where the posterior belief is equal to the publics' prior. Thus,

$\bar{\mu} \equiv$ *posterior beliefs when the firm does not send* $= 1$

$\tilde{\mu} \equiv$ *posterior beliefs when the firm does send* $= \lambda = 0.8$

Again, numerical simulations are carried out. Given the importance of profits to the firm in devising its sending strategy, we again consider two levels: a=5 and a=10. The results appear in the table below.

[4] Note than in Table A2.2, we have assumed that the public believe that the probability of high damage is 0.6 upon receiving a message from the firm. A posterior belief such that μ=0, will not violate the optimality of sending for the firm.

Table C2.3 Payoffs for the firm (high damage state)

β	Ω^F (a=5)	Ω^F (a=10)
6	-0.13	2.27
8	-0.32	1.82
10	-0.4	1.59
12	-0.46	1.46
14	-0.5	1.36
16	-0.53	1.3
18	-0.55	1.25
20	-0.56	1.22

These results demonstrate that both a pooling and separating equilibrium as described in Propositions 4 and 5 exist, given the parameters assumed. Other equilibria are surely possible, however the focus of this appendix is solely to prove existence. Note that the pooling equilibrium becomes more likely when profits are high (higher value for a). Indeed, where a=5, the firm does not find it optimal to send in the high damage state, despite the fact that the public will take this to mean that damage is indeed high. Intuitively, the firm stands to gain more from influencing environmental policy under these circumstances and is thus prepared to incur the costs of deceiving the public. Note however, that knowing the strategy of the firm, the public place no weight on the messages.

Another interesting feature of this equilibrium is that the firm will only lie provided damage is not too large. This is not really due to the costs associated with sending a message, although these do rise in damage. However, it is always feasible that a will be sufficiently large to make sending optimal. However, the greens sending strategy is, as shown in Appendix C.1, very sensitive to damage. If damage is large, the greens send and in doing so, effectively block the firm from engaging in indirect lobbying.

C.3 Pooling Equilibrium with No Messages.

This equilibrium exists provided neither group is prepared to send in either state of damage. By Propositions 1 and 3, this would seem likely when damage is relatively low, the government places a large weight on aggregate welfare, and the profits earned by the firm are low. In short, these conditions imply that neither of then lobby groups stand to gain sufficiently by influencing the public to incur the costs of sending a message. We consider the case where:

$\theta_H = 0.1, 0.2, ..., 1$

$\beta = 100$

To conduct simulations, it is assumed that the prior belief of the public is 0.8. Thus, if no lobby sends, regardless of the true state of damage, the public will retain this belief. At the same time, the green lobby knows that if it sends a message, it will be believed. Thus, for the greens $\tilde{\mu} = 1$ and $\bar{\mu} = 0.8$.[5] Ω^G is thus given as:

Table C3.1 Payoffs for Greens

θ_H	Ω^G
0.1	-0.998
0.2	-0.992
0.3	-0.982
0.4	-0.967
0.5	-0.949
0.6	-0.927
0.7	-0.9
0.8	-0.869
0.9	-0.835
1.0	-0.796

This reveals that given the high weighting attached to aggregate welfare by the government $(\beta = 100)$ and the relatively low levels of environmental damage, the greens do not find it optimal to send, even though their message would be believed.

We now consider the incentives facing the firm. In addition to not sending in both states, the firm may choose to send only in the low damage state, inducing a

[5] Note that in this case we are considering an equilibrium where no group sends. Thus $\tilde{\mu}$, the belief when a message sent is the off-equilibrium belief on which there are no restrictions.

separating equilibrium as described in Appendix C.2. Again, we consider the incentives facing the firm in low damage first. On the equilibrium path, the posterior belief must be equal to the publics' prior of 0.8. Off the equilibrium path, it is assumed that the public would believe that damage is 0.6. Again, to highlight the importance of the firm's profits, two values for the parameter a are considered.

Table C3.2 Payoffs for the firm (low damage state)

θ_H	Ω^F (a=5)	Ω^F (a=10)
0.1	*-0.80*	*-0.60*
0.2	*-0.60*	*-0.20*
0.3	*-0.41*	*0.20*
0.4	*-0.23*	*0.59*
0.5	*-0.05*	*0.97*
0.6	*0.12*	*1.35*
0.7	*0.29*	*1.72*
0.8	*0.45*	*2.08*
0.9	*0.61*	*2.44*
1.0	*0.76*	*2.79*

These results reveal that given the set parameter values, the firm will not find it optimal to send in the low damage state for any level of damage lower than 0.6 when a=5. Intuitively, if the highest level of damage the public can believe to exist is very low, the gains from influencing them are low. Note also that if it is not optimal to send when damage is low, by Lemma 4, it is not optimal to send when damage is high. As such, the existence of a pooling equilibrium where no lobby sends a message is demonstrated. Note that a pooling equilibrium is far less likely when profits are higher. In particular, sending remains a viable strategy when a=10 for all values on the upper bound of damage greater than 0.2.

For interest, we can examine the strategy of the firm in the cases where the firm did send in the low damage state. As in Appendix C.2, when damage is in reality high, the firm can either send, and a pooling equilibrium exists, or not send and a separating equilibrium exists. This implies that,

$\bar{\mu} \equiv$ *posterior beliefs when the firm does not send* $= 1$

$\tilde{\mu} \equiv$ *posterior beliefs when the firm does send* $= \lambda = 0.8$

Numerical simulations involving these beliefs yield the following:

Table C3.3 Payoffs for the firm (high damage state)

θ_H	Ω^F (a=5)	Ω^F (a=10)
0.1	*-0.9*	*-0.7*
0.2	*-0.82*	*-0.42*
0.3	*-0.76*	*-0.15*
0.4	*-0.71*	*0.11*
0.5	*-0.67*	*0.35*
0.6	*-0.65*	*0.57*
0.7	*-0.65*	*0.78*
0.8	*-0.66*	*0.97*
0.9	*-0.69*	*1.15*
1.0	*-0.74*	*1.31*

Again, where profits are lower, the firm does not send, as indicated by the negative values in column 2. However, as profits rise, the firm is more willing to send in both states, even though it invokes a pooling equilibrium as described in Proposition 4.

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