POLITICAL UNCERTAINTY AND POLICY INNOVATION

First version: December 13, 2001
This version: December 19, 2003

by

Christos Kotsogiannis† and Robert Schwager‡

Abstract: Conventional wisdom has it that outside sources of information enhance the capability of political institutions to separate selfish from benevolent incumbents. This paper investigates, in the presence of innovative public policies whose outcomes are uncertain, the role of outside information and shows that it is more involved than typically thought. While it is true that enhanced information helps in separating politicians, it also creates an externality that reduces the incentives to experiment with innovative public policies.

Keywords: Policy uncertainty; Political uncertainty; Innovation
JEL classification: D72, H1.

†Department of Economics, School of Business and Economics, University of Exeter, Streatham Court, Rennes Drive, Exeter EX4 4PU, England, UK. Tel: +44 (0)1392 264500. E-mail: c.kotsogiannis@exeter.ac.uk

‡Georg-August-Universität Göttingen and Zentrum für Europäische Wirtschaftsforschung Mannheim, Platz der Göttinger Sieben 3, D-37073 Göttingen, Tel: +49 (0) 551 39 7293. E-mail: rschwag@uni-goettingen.de

*Acknowledgements: The comments of two thoughtful referees and the associate editor have helped us clarify various parts of the paper. We are thankful for this. We also thank Tim Besley, Axel Dreher, David de Meza, Bernd Genser, Hans Gersbach, Robert Inman, Miltos Makris, Steve McCorriston, Gordon Myers, Michael Smart, Minas Vlassis, and Barry Weingast for many insightful discussions and suggestions. All remaining errors are of course ours.
1 Introduction

Two quite different approaches, rooted in two contrasting visions of the political markets, have been taken to the analysis of the role of information for the efficiency of political competition vis à vis redistribution outcomes. One strand of literature, frequently associated with the Virginia School of thought, takes it that asymmetric information causes the political markets to operate inefficiently in that voters are exploited by the rent-seeking political actors who select inefficient and disguised methods of redistribution over more transparent methods, Tullock (1983). Voters, the argument goes, rationally remain ignorant about policies in the election: For the cost of gathering information to evaluate policies far exceeds the benefit from doing so. This rational ignorance is exploited by opportunistic political actors. The second approach, frequently attributed to the Chicago School of thought, in contrast, takes the view that political markets work efficiently and are organized in such a way as to promote wealth maximizing outcomes, Stigler (1971), Becker (1985), and Wittman (1989). This approach emphasizes that a voter needs to know very little about the actions of politicians in order to make intelligent decisions in the elections. The proponents of this school so dismiss the argument that lack of information impedes voters from making choices consistent with their preferences in the elections: For it is `sufficient for the voter to find a person or organization(s) with similar preferences and then ask advise on how to vote’, Wittman (1989) p.1400.

The Virginia School view has been criticized as lacking of solid analytical foundation, Becker (1985), and Wittman (1989). That voters remain rationally ignorant is not controversial but it is difficult for one to justify why they have biased beliefs about the effects of the policies and how they can be consistently fooled. In an influential contribution Coate and Morris (1995) have addressed this criticism. They show that with rational, but imperfectly informed, voters Tullock’s (1983) proposition—that inefficient rents may be selected in equilibrium—can be substantiated.

Though intuitively appealing, in that outside sources of information improve the working of the political system, the Chicago School view seems to overemphasize the efficiency enhancing element of such information. This is for two, intimately related, reasons. Firstly, it is difficult for one to be convinced that such sources of information are perfect—in the sense that they perfectly reveal misbehavior—thereby eliminating the inefficiencies of the political system completely. The second reason refers to inefficiencies stemming from the intrinsic characteristic of certain public policies. There are many public policies whose outcome is intrinsically uncertain as it is the case, in particular, with experimental policies. It is the very nature of an experimental policy that one does not know a priori

1 See also Buchanan and Tullock (1962), and Brennan and Buchanan (1980).
whether it is indeed better than an alternative and well known policy. Clearly, then, any outside sources of information do not only affect political incentives but also the incentives to choose experimental policies. The role of outside information seems to be more complex than initially thought. And this is the objective of this paper; to provide a framework within which the effect of outside sources of information on political incentives and experimentation can be investigated and articulated.

A key feature of experimental policies is that they present a natural vehicle for rent-seeking Leviathan political entrepreneurs to appropriate rents without being detected, and consequently punished, in the elections. This is because when faced with an unsatisfactory outcome voters do not know whether the experimental policy has been unsuccessful or whether it was successful but the politician has diverted some of the benefits to herself. This ignorance gives the opportunity to a Leviathan politician to mimic a benevolent one who has chosen the experimental policy but the outcome has been unsuccessful. Clearly, then, this suggests a trade off between the efficient working of the political market, in separating the types of the incumbent in the elections, and the incentives of the incumbents to experiment. A trade off that makes no appearance, for instance, in the Chicago School view.

One needs to go not too far to empirically document that many public policies are intrinsically experimental. Education, for instance, has undergone major reforms round the globe during the latter half of the 20th century. Governments all over the world, anxious to provide better education services—but also to enhance their reelection chances—experiment with new and innovative policies. In the US, to give an example, school vouchers are considered to be one of the most controversial policy reforms in education. In the UK, the Research Assessment Exercise was introduced so as to enable the higher education funding bodies to distribute public funds for research selectively on the basis of quality. This, too, is considered to be both innovative and controversial.

---

2In spite of the vast and fast-growing political economy literature, the interactions between policy experimentation and political incentives have been surprisingly neglected. Even in the well known—and much explored—Downsian model little is understood on whether the incentives of political parties to find solutions that appeal to voters lead to correct incentives for policy experimentation and evaluation, see Besley (2001). Recent work has acknowledged, Besley (2001), and has partly attempted to fill this gap, Le Borgne and Lockwood (2003), and Strumpf (2002). For an overview of how political institutions may affect policy choices see Besley and Case (2003). See also Persson and Tabellini (2000).

3This is reminiscent of the role of information in political agency models, Holmström (1979), and Dewatripont, Jewitt, and Tirole (1999).

4EURYDICE (2000) offers a wealth of examples of innovative reforms in higher education implemented in the EU and EFTA/EEA countries.

5See Peterson and Howell (2003), and Krueger and Zhu (2004).

6For more on this, see RAE Team (2001).
To understand the interactions between experimentation and political incentives, it is necessary to analyze a model in which: (i) incumbents as well as voters do not know the efficacy of the experimental policy \textit{ex ante} but only its payoff distribution, and (ii) there is asymmetric information regarding the type of the incumbent. While incumbents know their type, voters observe a noisy signal consisting of the policy choice of the incumbent and their level of utility. To capture how experimentation and incentives change when there are outside sources of information, we assume that with some probability the efficacy of the experimental policy becomes common knowledge and as a consequence the signal sent to voters by the incumbent improves. The added benefit from modelling outside sources of information in that way is that is allows us to do comparative statics on the equilibrium configurations.

It is not difficult to motivate this comparative statics exercise. To give some sense of the various possibilities consider the following examples:\footnote{Notice that the paper is not concerned with the origins of improved information but rather with its consequences. Thus, it does not explicitly deal with the incentives of political competitors or other bodies capable of publicly transmitting information to voters. This is not because they are unimportant—to the contrary—but because they are, to a great extent, well understood. See, for instance, among others, Austen-Smith (1997), Schultz (1996), Cukierman and Tommasi (1998). For recent contributions to this literature see also Heidhues and Lagerlöf (2003), and Lagerlöf (2003). Instead, the paper analyzes how information release—from whom is capable of doing so and for whatever reasons—affects incumbents’ incentives and therefore policy outcomes.}

Firstly, independent organizations may perform the task of advising the incumbent and voters on the likely effect of a policy.\footnote{Examples of independent institutes abound: Institute of Fiscal Studies (IFS)—‘a research institute which exists to provide top quality economic analysis independent of government, political party or any other vested interest,’ (http://www ifs org uk)—and Centre for European Economic Research (ZEW, http://wwwzew de) to name just two. For a model featuring a similar role of these institutions see Konrad (2003).} Secondly, as explored by Besley and Burgess (2002) and Strömberg (2001a), the information provided by the media may play an important role in enhancing political competition by increasing the scrutiny of policies.\footnote{We thank Tim Besley for bringing this possibility to our attention. See also Besley and Prat (2001), Strömberg (2001b, 2002).} Thirdly, a richer information environment might arise from the contractual approach to political economy which presumes a perfectly benevolent court that checks the chosen policy and reports back to politicians and voters, Laffont (2000).

There is another distinct characteristic of the information release; it gives rise to information externalities that may benefit the incumbents too. This very act of releasing information cannot be hidden away from the incumbent. If the incumbent has chosen the experimental policy the release of information is of no use to her. Information becomes useful, though, if the incumbent has not experimented. This, as we shall see,
shapes the incentives of the incumbents to choose the experimental policy and therefore has profound implications for the equilibrium selection of policies.

Our model suggests that there is a trade off between the incentives to experiment and the efficiency of the political system. Rent-seeking Leviathan politicians can disguise their behavior behind the policy uncertainty, intrinsic in innovative programmes, by mimicking a benevolent politician. The reason is that, when faced with a bad outcome of a policy experiment, citizens may be unable to distinguish between an honest politician who just happened to be unlucky and a selfish politician who diverted part of the return of the successful innovation to herself. The existence of outside sources of information implies that this behavior occurs less often. At the same time it creates an externality that reduces the incentives to innovate. This is because, instead of bearing the cost of innovation, it may be worthwhile to wait and benefit from the outside source of information.

The paper is organized as follows. The next Section places the paper within the literature. Section 3 describes the model. Section 4 analyzes the second period choices, while Section 5 describes the subset of equilibria we focus on. Section 6 analyzes the equilibria of the model and Section 7 presents the comparative statics results. Finally, Section 8 concludes.

2 Related literature

This paper should be contrasted with other work which has sought to identify inefficiencies in policy choices. Our work is related to Coate and Morris (1995) in that we also model asymmetric information between incumbents and voters. Our paper differs, however, from theirs in two important aspects. Firstly, unlike Coate and Morris (1995), incumbents do not have superior information than voters. For in our paper experimentation is central and so assuming superior information on the part of the politicians would render experimentation meaningless. Secondly, our paper introduces outside sources of information which improve the working of the political system creating at the same time learning externalities that shape the incentives of the incumbents to experiment. The present paper also relates to Besley and Smart (2001). Like them, we study political competition between Leviathan and benevolent policy makers in an asymmetric information environment. Unlike us, they focus on the impact of increased economic integration on the working of political competition, modelled as an exogenous increase in the marginal cost of public funds. They also analyze the effects of yardstick competition between
jurisdictions on political outcomes. Contrary to their contribution we focus on the incentives of politicians to experiment.

In two other contributions experimentation, albeit in a different form, is the central theme. Le Borgne and Lockwood (2003) build a career concerns model and investigate the incentives of politicians to experiment when their own type is unknown to them. Thus, experimentation here refers to learning one’s ability and not to finding out, as in our paper, the quality of an innovative policy. Strumpf (2002) considers a model in which benevolent local policy makers decide on an innovative policy. Like Strumpf (2002), we model experimentation as a policy with uncertain payoffs. Specific to Strumpf’s (2002) approach is the assumption that policy experiments are correlated across jurisdictions. Because of this correlation there is a learning externality qualitatively similar to the effect of outside sources of information in our model. As a result decentralized local government decision making typically leads to under-experimentation relative to the social optimum. Unlike Strumpf (2002), we model elections and so focus on the political incentives to innovate in the presence of learning externalities.

3 The model

We study a dynamic two period model which incorporates signaling and an election between both periods, of the general type introduced by Barro (1973) and Ferejohn (1986) and employed latterly by, among others, Coate and Morris (1995). The model features two kinds of uncertainty, policy and political. Policy uncertainty refers to the quality of an innovative policy which ex ante is unknown to both politicians and voters. Political uncertainty refers to the voters’ ignorance of the characteristics of the incumbent policy maker.

In both periods incumbents decide whether to introduce or not a new and innovative public policy, denoted by $n$, whose return is probabilistic. With probability $\theta$ its quality is high, and denoted by $q_h$, and with complementary probability $1 - \theta$ low, $q_l$. Alternatively, they use a public policy denoted by $o$ whose return is certain and given.

---

10 A large literature has spawned around yardstick competition in industrial organization. See, for instance, Sobel (1999), who in a regulatory environment, makes the point that increases in information to a regulator amplifies the hold up problem. We thank a thoughtful referee who brought this literature to our attention. See also Besley and Case (1995), and Belleflamme and Hindriks (2001) who analyze the impact of inter-jurisdictional comparisons on the political system.

11 It has to be noted though that this is not a typical signaling model because the relationship between the sender and the receiver is blurred by the policy uncertainty and external information. Standard equilibrium refinements, hence, do not work in this context. See also the discussion in Coate and Morris (1995).

12 Policies are costly and, without loss of generality, their cost has been suppressed.
by \( q_o \). This policy can be either an old one that has been used in the past or a new policy with a certain return. For needing a convenient label we call this policy old. If the incumbent chooses the new policy she finds out its quality. This implies that in the second period the quality of the new policy will be known to the policy maker. Contrary to that, experimentation does not, at this stage, reveal the new policy’s quality to voters.

The qualities of the policies are ranked according to \( q_h > q_o > q_l > 0 \). In addition, we assume that the high quality of the new policy substantially exceeds the quality of the old policy in the sense that \( q_h \geq 2q_o \). We denote the expected difference in returns of both policies by \( \Delta_q \equiv q_o - \theta q_h - (1 - \theta)q_l \). Central to this paper are the incentives of the incumbents to experiment and so we restrict attention to an innovation which is not from the outset superior to the old policy. We so assume that \( \Delta_q \geq 0 \), and so \( \theta \leq (q_o - q_l)/(q_h - q_l) \equiv \theta^* \). If this restriction did not hold then innovation would provide a short run benefit and be attractive even in the absence of any incentives arising from the dynamic nature of the game that is, the desire of the incumbents to experiment and be reelected. The assumptions \( q_h \geq 2q_o \) and \( \theta \leq \theta^* \) mean that the innovative policy provides a chance for a high return, albeit, at a big risk of failure.

In each period, after having chosen which policy to implement, the incumbent must decide what amount of rents \( \rho \) to divert towards herself. For the citizens such rents are wasteful in the sense that citizens’ utility \( u \) from public policy is reduced one for one by the rent, \( u = q - \rho \), where \( q \in \{q_o, q_l, q_h\} \) is the quality of the implemented policy. If the new policy is chosen the decision on the rent level is taken after the policy’s quality has been realized. The incumbent thus has to commit to the policy choice before policy uncertainty is lifted but she cannot commit to rents at this moment. This timing is quite natural. It is the very essence of costly experimentation that one cannot revise the policy choice after being informed about the policy’s quality, whereas there is no compelling reason why the incumbent should not be able to change her mind about the rents after having obtained this information. The choice of rents is taken to be discrete in the following sense.\(^{13}\) If the quality of the innovative policy is high (low) then the incumbent can appropriate rents \( \rho \in \{q_h, q_h - q_l, 0\} \) (\( \rho \in \{q_l, 0\} \)) whereas if the old policy is chosen we require \( \rho \in \{q_o, 0\} \).

Policy uncertainty can be resolved in two ways: Either via experimentation or through outside sources of information (information release) which are external to the interaction

\(^{13}\)Given the discrete set of policy outcomes restricting rents to a discrete set is innocuous and imposed merely for simplicity. Even with continuous rents the structure of the model together with the beliefs specified below would imply the discrete choice of rents assumed here. This is because any rents which do not produce a utility in the set of possible policy outcomes will be detected by citizens leading to a defeat in the election. Consequently, a further marginal increase in rents raises the Leviathan’s short run benefit without reducing her reelection prospects further.
of incumbent and voters.\footnote{For examples of such sources, see the introduction.} We assume that in period one, after each policy choice, and after the incumbent has made her choice of rents, such communication of information takes place and may, or may not, reveal the innovative policy’s quality. Conditional on the quality being high (low), with probability $\pi$ the information $y = q_h$ ($y = q_l$) is revealed to both citizens and politicians informing them that the quality is high (low). With complementary probability $1 - \pi$ no such information becomes available; this event is denoted by $y = \emptyset$. The role of information $y$ is twofold. Firstly, with $y \neq \emptyset$, even if there was no experiment in the first period, the politician in charge can make an informed policy choice in period two. Secondly, citizens may use $y$ so as to assess what type of incumbent they face.

There are two types of incumbents: A benevolent who is denoted by the subscript $B$ and a rent-seeking Leviathan denoted by $L$. The benevolent incumbent places maximal weight on the utility $u$ of the citizens whereas the Leviathan is only interested in rents $\rho$. If the incumbent is not reelected in the second period her payoff is zero. Second period payoff for both types of incumbent is discounted by $\delta \in (0, 1)$. The citizens do not observe the type of the incumbent but have to infer it from the signals they receive. Ex ante they attribute a prior probability of $\frac{1}{2}$ to the incumbent being of either type.\footnote{In the absence of a model that features the decision of the citizens to enter the political arena assigning equal probability to either type seems a natural choice. Moreover, this simplification allows us to focus on the main issue which is the interaction of political incentives in the presence (or not) of information release.}

During the first period, citizens observe the record $(p, u)$ consisting of the policy $p \in \{o, n\}$ and utility $u = q - \rho$, and external information $y$. Taking into account this information and the priors they form beliefs about the type that has produced this record. The posterior probability that the incumbent is of the benevolent type, given record $(p, u)$ and external information $y$, is denoted by $\mu(p, u, y)$. At the end of the first period there is an election. Voting is retrospective and citizens reelect the incumbent with probability $\delta$. This rule reflects the fact that citizens are harmed by a Leviathan government and thus should be more inclined to reelect the incumbent the more they believe that the incumbent is benevolent.\footnote{For simplicity we use this behavioral rule instead of modelling an optimal voting decision on the part of the citizens. This rule could be motivated by appealing to a challenger, as in Coate and Morris (1995), whose probability of being benevolent is drawn from a uniform distribution. A randomly chosen challenger is then defeated by the incumbent with probability $\mu$.}

This model defines a signaling game between both types of the incumbent. At the beginning of the game Nature chooses the type of the incumbent from the set $\{B, L\}$. A strategy for each type of incumbent has three components. The first is the policy decision

\footnote{For simplicity we use this behavioral rule instead of modelling an optimal voting decision on the part of the citizens. This rule could be motivated by appealing to a challenger, as in Coate and Morris (1995), whose probability of being benevolent is drawn from a uniform distribution. A randomly chosen challenger is then defeated by the incumbent with probability $\mu$.}
in the first period. The second component is a rule that specifies a rent decision in the
first period for each policy decision and for each realization of the innovative policy’s
quality. The third component is a rule that specifies the policy choice and rent decision
should the incumbent be elected for another term in period two. A perfect Bayesian
equilibrium of this game consists of a strategy for each type of the incumbent and of
citizens’ beliefs satisfying two requirements. Firstly, given the beliefs of the citizens, the
strategy has to be optimal at all information sets where the incumbent is called upon
to decide. Secondly, the beliefs must be consistent with the incumbent’s strategy in the
sense that they are generated, whenever possible, by Bayes’ updating.

4 Second period choices

The game is solved by means of backwards induction. In this Section we start by
analyzing the politician’s choices in the second period after the first period election.
In the second period incumbents have no reelection motives anymore and thus take the
decision which provides them with the highest short run benefit. If the incumbent is of a
Leviathan type and has chosen the new policy, and if the quality of this policy is \( q_h \) (\( q_l \)),
then she takes rents \( \rho = q_h \) (\( \rho = q_l \)) yielding a payoff \( q_h \) (\( q_l \)). If, on the other hand, the
old policy was chosen she takes \( \rho = q_o \) and obtains payoff \( q_o \). The benevolent incumbent
divers no rents.

While the benevolent and the Leviathan incumbents have opposing preferences regarding
the choice of rents they, naturally, both want to choose the policy with the highest quality.
This choice depends on whether uncertainty on the quality of the new policy has been
resolved in the first period. If experimentation of the new policy has taken place the
incumbent is fully informed of the policy’s quality. Both types then opt for the new
policy in the second period if the quality is high, following on \( q_h > q_o \), and the old if the
new policy is of low quality, following on \( q_l < q_o \). In this case the payoff in the second
period of a reelected incumbent, if the quality has been found out to be high (low), is
\( \delta q_h \) (\( \delta q_o \)).

If the old policy was chosen in period one policy uncertainty can still be resolved through
outside sources of information. In the second period the elected politician could thus benefit from informational externalities without having experimented with the new policy herself. With probability \( \theta \pi \) (\((1 - \theta)\pi\)) such information, \( y = q_h (y = q_l) \), becomes available revealing that the innovative policy is of high (low) quality. In these events the policy choice is again clear; the new policy is optimal in the former, and the old policy is optimal in the latter. With probability \( 1 - \pi \) such information is unavailable, \( y = \emptyset \). The politician then must evaluate the expected quality of the new policy and compare it
to the benefit of the old policy $q_o$. Given $\Delta_q \geq 0$, an uninformed politician thus chooses the old policy in period two. It is clear, then, that the old policy is chosen again in period two with probability $(1 - \theta)\pi + 1 - \pi = 1 - \theta\pi$, while the new policy is chosen with probability $\theta\pi$. It then follows that, after a choice of the old policy in period one, the expected discounted second period payoff of both types is

$$\delta[\theta\pi q_h + (1 - \theta\pi)q_o].$$

(1)

5 Innovation equilibria

Given the complex interactions of political and policy uncertainty there is a large number of possible equilibria. Instead of attempting an exhausting, and possibly tedious, characterization of all equilibria we focus on a subset, called innovation equilibria, which most clearly illustrate the incumbents’ incentives to innovate. In this Section we describe the properties of this subset in terms of beliefs and strategies.

There is no property that can pin down the citizens’ beliefs out of equilibrium in any general way. Instead, we restrict attention to beliefs which are based on the following intuitive reasoning.\(^{17}\) Whenever voters can be sure that there were no rents appropriated they believe that the incumbent is of the benevolent type. Voters know the maximal qualities of the policies. Being rational they will calculate, whenever they can, the maximal utility achievable conditional on the policy chosen. Suppose, for instance, that, independently of any information release, they observe a record consisting of $(n; q_h)$. Clearly, then, in this case, they must believe that it is the benevolent type: For a utility level $q_h$ can be only achieved—conditional on the new policy being chosen—if the incumbent has appropriated no rents. Rationally, then, they attach probability 1 to the incumbent being of the benevolent type that is, $\mu(n, q_h, y) = 1$. This is also true for the records $\mu(o, q_o, y) = 1$ for all $y$ and $\mu(n, q_l, q_l) = 1$. Equally, whenever the citizens can figure out that rents were appropriated, they infer it is the Leviathan. This is the case whenever the utility is zero, or whenever there is information release revealing the discrepancy between the utility and the quality of the new policy. This is summarized by $\mu(p, 0, y) = 0$ for all $p$ and $y$, and $\mu(n, q_l, q_h) = 0$. The belief $\mu(n, q_l, 0)$ is the only belief that cannot be fixed by this reasoning and will, from now on, be simply denoted by $\mu$.

The strategies in the set of innovation equilibria have the following properties. The benevolent incumbent always experiments and never appropriates rents, whereas the Leviathan chooses the innovative policy with probability $\sigma \in [0, 1]$ and takes, in all

\(^{17}\)This reasoning is in line with the monotonicity assumption in Coate and Morris (1995).
eventualities, positive rents. The set of innovation equilibria is thus parameterized by the Leviathan’s probability of experimentation $\sigma$. We do not consider equilibria such that the Leviathan disguises her identity by completely forgoing rents. Although this is a feasible strategy for the Leviathan such behavior, arguably, would not be very interesting to analyze. Instead, at the core of the analysis is the possibility for the Leviathan to appropriate rents $q_h - q_l$, once the high quality of the new policy has been realized, and still not to be detected as long as there is no information release from external sources.

To see how the belief $\mu$, corresponding to this situation, can be derived by Bayesian updating observe that record $(n, q_l)$ can be reached from two different paths. Firstly, the politician might have been of benevolent type, having chosen the new policy and taken no rents, but Nature drew the bad outcome $q_l$. This possibility occurs with probability $(1/2)(1 - \theta)$. Secondly, the incumbent might have been a Leviathan that has chosen the new policy—followed by a draw of the high quality outcome—and a choice of rents $\rho = q_h - q_l$, which amounts to producing utility $u = q_l$. Given the Leviathan’s strategy, this possibility occurs with probability $(1/2)\sigma\theta$. We so have

$$\mu = \frac{(1 - \theta)}{(1 - \theta) + \sigma\theta}. \quad (2)$$

In an equilibrium where the Leviathan plans to choose the maximal rents $q_h$, after a high quality realization of the innovative policy, we must have $\mu(n, q_l, 0) = 1$. Intuitively, the choice of rents $q_h - q_l$, instead of the maximal rent $q_h$, allows the Leviathan to mimic the benevolent incumbent which had an unlucky draw of the innovative policy’s quality. For needing a convenient label we will, throughout, call these rents ‘mimicking’ rents.

6 Analysis of equilibrium

In order to characterize innovation equilibria, we derive now, in a series of Lemmas, the optimal first period rent choice and policy strategies of either type, conditional on the beliefs.

6.1 Optimal first period choices

We start by the rent choice after the new policy was chosen and has produced a high quality outcome. In this event the rent strategies available to the Leviathan are $\rho \in \{q_h, q_h - q_l, 0\}$. Firstly, consider the maximal rent $\rho = q_h$. In this case citizens obtain a utility of zero and infer that this was the Leviathan politician. Consequently, the incumbent is defeated and just obtains the first period payoff $q_h$. Secondly, she can take the mimicking rent $\rho = q_h - q_l$ and generate the low utility $u = q_l$ for the voters. In this case the voters evict the Leviathan incumbent if there is external information, which
happens with probability $\pi$. They reelect her with probability $\mu$ when such information is not available, which occurs with probability $1 - \pi$. If reelected in the second period she chooses unrestricted rents $q_h$, implying an expected discounted second period payoff $\delta(1 - \pi)\mu q_h$. Altogether the mimicking rent $\rho = q_h - q_l$ yields $q_h - q_l + \delta(1 - \pi)\mu q_h$.

Thirdly, she can take no rents and receive utility zero in the first period. In doing so, she generates the highest possible utility for the voters implying a reelection with certainty. Once in office in period two, the Leviathan chooses $\rho = q_h$ which confers utility $\delta q_h$. In total, utility after $\rho = 0$ is $0 + \delta q_h$. Comparison of the payoffs under the alternative rent strategies, following on $\delta < 1$, implies that $\rho = q_h$ dominates $\rho = 0$ and that $\rho = q_h - q_l$ is weakly preferable to $\rho = q_h$ if and only if $\delta(1 - \pi)\mu q_h \geq q_l$.

Regarding the low quality of the innovative policy one notices the following. The strategy $\rho = q_l$ implies no reelection and, therefore, only the first period payoff $q_l$ for the Leviathan incumbent. With $\rho = 0$ this type behaves exactly as the benevolent incumbent, receiving zero utility in the first period, reaping the benefit of reelection with probability one in the case of information release, and with probability $\mu$ otherwise. In the second period she chooses the old policy, because the new policy is now known to be of low quality, and appropriates rents $\rho = q_o$. This provides her with expected second period payoff $\delta[(1 - \pi)\mu + \pi]q_l$. It, then, follows that for the Leviathan politician the unrestricted rent is optimal if and only if $\delta[(1 - \pi)\mu + \pi]q_o \leq q_l$.

The rent strategies available to the Leviathan under the old policy are $\rho \in \{q_o, 0\}$. If this politician chooses $\rho = q_o$ then she is voted out obtaining zero second period payoff. The first period payoff is $q_o$. If she instead chooses $\rho = 0$ then she behaves like the benevolent politician and is voted in with expected second period payoff given by (1). It so follows that this politician is willing to choose the unrestricted rents if and only if $\delta[\theta\pi q_h + (1 - \theta\pi)q_o] \leq q_o$.

Solving the critical inequalities for $\delta$ we can now summarize:

\textbf{Lemma 1 (Rent choices by the Leviathan).}

1. If the new policy is of high quality the mimicking rent $q_h - q_l$ (the maximal rent $q_h$) is optimal iff
   \[ \delta \geq (\leq) \delta_h(\theta, \pi, \mu) \overset{\text{def}}{=} \frac{q_l}{\mu(1 - \pi)q_h}. \]  

2. With the quality of the new policy being low the maximal rent $q_l$ is optimal iff
   \[ \delta \leq \delta_l(\theta, \pi, \mu) \overset{\text{def}}{=} \frac{q_l}{(1 - \pi)\mu + \pi]q_o}. \]  

\[ ]^{18}\text{The optimal strategies in Lemmas 1 through 3 are unique if the critical inequalities are strict. For the sake of brevity we do not state this fact explicitly.}
3. After the old policy is chosen, the maximal rent $q_o$ is optimal iff

$$\delta \leq \delta_o(\theta, \pi) \overset{\text{def}}{=} \frac{q_o}{\theta \pi q_h + (1 - \theta \pi)q_o}. \quad (5)$$

We now analyze the policy choice of the Leviathan, anticipating that, according to the properties of an innovation equilibrium, positive rents are planned in all events. While this implies the maximal rent after the old policy, and after the low quality realization of the innovative policy, there are two possibilities after the high quality of the new policy has occurred. If also in this event, the Leviathan takes the maximal rent $q_h$, then she is always voted out of office. Hence, in this instance, only the first period payoffs matter and so she weakly prefers the old policy whenever the probability of the new policy being of high quality is sufficiently low that is, $\theta \leq \theta^*$. Consider instead the possibility that the Leviathan anticipates to play the mimicking rent $q_h - q_l$ once the high quality of the innovative policy is realized. With probability $\theta$ the first period payoff is then $q_h - q_l$. With probability $1 - \theta$ the policy is of low quality giving payoff $q_l$. It is clear, then, that the expected first period payoff is $\theta(q_h - q_l) + (1 - \theta)q_l$. Given the rent strategies the incumbent is voted out if the quality of the new policy is low. She is voted in with probability $\mu$ if the quality is high and there is no external information. Hence, the total probability of reelection is $\theta(1 - \pi)\mu$. If reelected she obtains $q_h$ in the second period since the new policy is then known to be of high quality. Therefore, the expected payoff, after choosing the new policy, is $\theta(q_h - q_l) + (1 - \theta)q_l + \delta \theta(1 - \pi)\mu q_h$. The old policy, on the other hand, provides a payoff of $q_o$ in the first period and no chance of reelection. Altogether the Leviathan’s expected payoff, from choosing the new policy with probability $\sigma$, is $\sigma \{\theta(q_h - q_l) + (1 - \theta)q_l + \delta \theta q_h (1 - \pi)\mu\} + (1 - \sigma)q_o$.

Denoting now by $Z_L(\theta, \pi, \mu) \equiv \theta(q_h - q_l) + (1 - \theta)q_l - q_o + \delta \theta q_h (1 - \pi)\mu$ the gain in payoff for the Leviathan from switching from the old to the new policy, the optimal $\sigma$ must satisfy $\sigma = 1$ if $Z_L(\theta, \pi, \mu) > 0$ and $\sigma = 0$ if $Z_L(\theta, \pi, \mu) < 0$. If $Z_L(\theta, \pi, \mu) = 0$, then all $\sigma \in [0, 1]$ are optimal. Solving again for $\delta$ we summarize the Leviathan’s policy choice in the following Lemma:

**Lemma 2 (Policy choices by the Leviathan).**

1. Anticipating to take the maximal rent $q_h$, after the high quality of the innovative policy is realized, it is optimal for the Leviathan to choose the old policy iff $\theta \leq \theta^*$.

2. Anticipating to take the mimicking rent $q_h - q_l$, after the high quality of the innovative policy is realized, it is optimal for the Leviathan to choose the new policy with
\begin{equation}
\delta_L(\theta, \pi, \mu) \equiv \frac{\theta q_I + \Delta_q}{\theta q_h (1 - \pi) \mu}.
\end{equation}

The first part of Lemma 2 shows that, for $\theta < \theta^*$, no innovation equilibrium exists where the Leviathan chooses the innovative policy with positive probability and in the same time plans to choose the maximal rent after the high quality materializes. This is intuitive: For with $\theta < \theta^*$ the only motivation to innovate comes from second period payoffs. Opting for the maximal rent, however, eliminates any chance of her reelection thereby reducing all second period payoffs to zero and making the new policy unattractive. Conversely, all innovation equilibria where also the Leviathan experiments with positive probability must be based on her choosing the mimicking rent. Thus, experimentation on the part of the selfish politician is only possible if the political uncertainty is not fully resolved.

The benevolent politician, having experimented with the new policy, is reelected with certainty if the policy turned out to be of high quality. This gives her expected discounted second period utility $\theta \delta q_h$. If now the realization of the quality is low then the information release matters. If such information is available, which occurs with probability $\pi$, she is reelected. Otherwise, with probability $1 - \pi$, she is reelected only with probability $\mu$. If reelected, in the second period she returns to the old policy with payoff $q_o$ because she has learned that the new policy is of low quality. Altogether, the discounted expected second period payoff from choosing the new policy in period one is $\delta \{ \theta q_h + (1 - \theta) [\pi + (1 - \pi) \mu] q_o \}$. If now she chooses the old policy in the first period she is reelected with certainty. From (1) it, then, follows that she obtains an expected discounted second period payoff $\delta [\theta \pi q_h + (1 - \theta \pi) q_o]$. Subtracting now the second period payoff which results from choosing the old policy in the first period from the second period payoff after choosing the new policy in period 1, and simplifying the resulting expression, yields the second period gain from being innovative in the first period $\delta (1 - \pi) \{ \theta q_h + q_o [(1 - \theta) \mu - 1] \}$. Using the assumption $q_h \geq 2q_o$ and observing, from (2), that $\mu \geq 1 - \theta$ one notes that this gain is positive. The innovative policy is then preferable if its first period disadvantage $\Delta_q$ is less than its second period advantage that is, $\Delta_q \leq \delta (1 - \pi) \{ \theta q_h + q_o [(1 - \theta) \mu - 1] \}$. Solving for $\delta$ one arrives at:

**Lemma 3 (Policy choice by the benevolent incumbent).** It is optimal for the benevolent incumbent to choose the innovative policy iff

\begin{equation}
\delta \geq \delta_B(\theta, \pi, \mu) \equiv \frac{\Delta_q}{\{ \theta q_h + q_o [(1 - \theta) \mu - 1] \} (1 - \pi)}.
\end{equation}
An innovation equilibrium characterized by $\sigma$ exists for given parameter values $\pi$, $\theta$, and $\delta$ if the conditions stated in Lemmas 1 to 3 are satisfied, with the belief $\mu$ being given by (2).

To prepare for the characterization of innovation equilibria we first show that not all of these conditions are binding. Compare first the conditions for the mimicking rent choice after the high quality realization of the new policy, and the policy choice by the Leviathan, as stated in (3) and (6). Computing, for any $\pi$ and $\mu$, the ratio

$$\frac{\delta_h(\theta, \pi, \mu)}{\delta_L(\theta, \pi, \mu)} = \frac{\theta q_l}{\theta (2q_l - q_h) + (q_o - q_l)},$$

it follows that $\delta_h/\delta_L < (=) 1$ if and only if $\theta < (=) \theta^*$. Consequently, $\delta \geq \delta_L$ implies $\delta \geq \delta_h$. Thus, following (3), the condition for the mimicking rent $q_h - q_l$ to be optimal is not binding whenever we consider an innovation equilibrium where the Leviathan is to choose the new policy with positive probability.

Similarly, as shown in Appendix A, following from (5), the condition for the rent choice after the old policy is not binding. That is, $\delta_o(\theta, \pi) \geq \delta_l(\theta, \pi, \mu)$ for all $\theta \leq \theta^*$ and $\pi \in [0, 1]$ as well as all $\mu$ generated, according to (2), by $\sigma \in [0, 1]$.

As a last preliminary step we consider the pairwise intersections between the three remaining lines $\delta_l, \delta_L$ and $\delta_B$. We define $\theta_{B,l}(\pi, \sigma)$ to be a value $\theta \in [0, \theta^*]$ satisfying $\delta_B(\theta, \pi, \mu) = \delta_l(\theta, \pi, \mu)$, where $\sigma$, according to (2), determines $\mu$. Similarly, $\theta_{L,l}(\pi, \sigma)$ is a $\theta$ satisfying $\delta_l(\theta, \pi, \mu) = \delta_l(\theta, \pi, \mu)$, and $\theta_{L,B}(\pi, \sigma)$ is a $\theta$ satisfying $\delta_L(\theta, \pi, \mu) = \delta_B(\theta, \pi, \mu)$. It is shown, in Appendices B and C, that the intersections $\theta_{B,l}(\pi, \sigma)$ and $\theta_{L,B}(\pi, \sigma)$ exist and are unique in the interval $\theta \in [0, \theta^*]$, and that the same holds true for the intersection $\theta_{L,l}(\pi, \sigma)$ if $\pi$ is small enough.

6.2 Results

We start the characterization of innovation equilibria by looking at the set of mixed equilibria where the benevolent incumbent chooses the innovative policy and the Leviathan chooses the new policy with any probability $\sigma \in [0, 1]$ and takes mimicking rents after the high quality outcome of the new policy. For this purpose define

$$\pi = \frac{(q_h - q_o)\mu}{(q_h - q_o)\mu + q_o} < 1,$$

and recall, from (2), that $\mu$ is a function of $\sigma$. Then we have:

**Proposition 1** For any $\sigma \in [0, 1]$ consider a mixed equilibrium where the benevolent incumbent chooses the innovative policy and the Leviathan chooses the new policy with probability $\sigma$ appropriating rents $q_h - q_l$ if the new policy is of high quality. Such an
Proof of Proposition 1  For these equilibria to exist the ‘≥’ sign in (3), as well as (4) and (5), must hold. In addition, the third line of (6) and the inequality (7) must be satisfied.

As shown above (3) and (5) are not binding. To verify the rent choice after the low quality of the new policy observe that $l(\pi, \theta, \mu) = L(\pi, \theta, \mu)$. Since $l$ is decreasing and $L$ is increasing in $\pi$ it follows that, for all $\pi \leq \pi$, we have $\delta_l(\theta^*, \pi, \mu) \geq \delta_L(\theta^*, \pi, \mu)$. Since the intersection $\theta_{L,l}(\pi, \sigma)$ is unique it follows that, for all $\pi \leq \pi$ and $\theta \in (\theta_{L,l}(\pi, \sigma), \theta^*)$, $\delta_l(\theta, \pi, \mu) \geq \delta_L(\theta, \pi, \mu)$. Thus, since $\delta = \delta_L(\theta, \pi, \mu)$ the condition (4), is satisfied.

Turning to the policy choices, we first notice, from the requirement $\delta = \delta_L(\theta, \pi, \mu)$, that the Leviathan’s choice is obviously optimal. We also have $\delta_B(\theta^*, \pi, \mu) = 0$ and $\delta_L(\theta^*, \pi, \mu) = q_l/[q_h(1 - \pi)] > 0$. Consequently, since the intersection $\theta_{L,B}(\pi, \sigma)$ is unique, it follows, as required in (7), that $\delta = \delta_L(\theta, \pi, \mu) > \delta_B(\theta, \pi, \mu)$ for any $\theta \in (\theta_{L,B}(\pi, \sigma), \theta^*)$. □

A limiting case of the mixed equilibria analyzed in Proposition 1 is the pure strategy equilibrium where both incumbents choose the innovative policy. This satisfies the same conditions as the mixed equilibria with the exception of equation (6) where now the first line is relevant. In this equilibrium $\sigma = 1$ and so the belief $\mu = 1 - \theta$. In the following Proposition we characterize the space of parameters $\delta, \theta$, for various $\pi$, for which a pooling equilibrium on the new policy exists.

Proposition 2  Consider a pooling equilibrium where both types of incumbent choose the innovative policy and the Leviathan incumbent appropriates rents $q_h - q_l$ if the new policy is of high quality. Such an equilibrium exists for any $(\pi, \theta, \delta)$ such that $\pi \leq \pi$, $\theta \in [\max\{\theta_{B,l}(\pi, 1), \theta_{L,l}(\pi, 1)\}, \theta^*], \delta \in [\max\{\delta_L(\theta, \pi, 1 - \theta), \delta_B(\theta, \pi, 1 - \theta)\}, \delta_l(\theta, \pi, 1 - \theta)]$.

Proof of Proposition 2  The proof of this Proposition makes use of the same arguments as the proof of Proposition 1 and is so omitted. □

At the other end of the scale we have another limiting case in which the Leviathan chooses the old policy that is, $\sigma = 0$, and the benevolent politician experiments with the new policy. Since now the policy choice reveals the Leviathan’s type, the probability of reelection after the utility $u = q_l$ is $\mu = 1$. The Leviathan plans to take unlimited rents after the old policy and for the event that the low quality outcome of the new policy
occurs. In the event where $q_h$ materializes she either opts, depending on which inequality in (3) holds, for rents $q_h$ or $q_h - q_l$. So we arrive at:

**Proposition 3** Consider a separating equilibrium where the benevolent incumbent chooses the innovative policy whereas the Leviathan incumbent chooses the old policy. Such an equilibrium exists for any $(\pi, \theta, \delta)$ such that $\pi \in [0, 1]$, $\theta \in [\max\{\theta_{B,1}(\pi,0),\theta_{L,B}(\pi,0)\}, \theta^*]$ and $\delta \in [\delta_B(\theta, \pi, 1), \min\{q_l/q_o, \delta_L(\theta, \pi, 1)\}]$.

**Proof of Proposition 3** Making use of $\delta_i(\theta, \pi, 1) = q_l/q_o$ the proof of this Proposition follows the proof of Proposition 1 and is so omitted. \[\square\]

We now provide some intuition, for the set of parameters $(\theta, \delta)$, for which each of the equilibria described in Propositions 1-3 exists. For this purpose consider Figure 1.

Insert Figure 1 here.

In this Figure, we have depicted, for $\pi = 0$, each of the lines $\delta_l$, $\delta_L$, and $\delta_B$ for the beliefs resulting from the extreme policy choices by the Leviathan, $\sigma = 0$ and $\sigma = 1$. Starting, for convenience, with Proposition 2 we notice that the pooling equilibrium exists in the area delimited by the points $\{a, b, c, d\}$. To understand why this equilibrium requires a rather high discount factor $\delta$, recall that the expected one-period payoff of the innovative policy falls short of the quality of the old policy. Therefore, both types of incumbent need to obtain a second period benefit so as to be willing to choose innovation. In addition, this second period benefit has to be sufficiently important in the politician’s objective to outweigh the first period cost of innovation that is, the discount factor $\delta$ must be high.

For the benevolent incumbent, the second period payoff from innovating in period one comes from the balance of a cost and a benefit in the second period. The cost consists of the risk of being mimicked by the Leviathan and voted out of office. The benefit comes from the information on the quality of the new policy gathered by experimentation. Thus, the tradeoff in the second period payoffs is between the political risk of being mimicked and the risk of a mistake in policy choice. However, the disutility of being mimicked is less than the disutility of not knowing the quality of the new policy in the second period. The reason for this is that, on the one hand, with $\theta$ rather low, citizens do not penalize the occurrence of the low quality outcome $q_l$ very heavily, as implied by the belief $\mu = 1 - \theta$. Therefore, the good politician is still reelected with a high probability even if she was unlucky. On the other hand, since $q_h$ is high relative to $q_o$, there is a large cost in not knowing if the new policy is of high quality.
The Leviathan, after having chosen the old policy in the first period, does not care about being uninformed. This is because the risk of a mistake in policy due to non-experimentation is not present for her: For in this case she takes the unrestricted rents, reveals herself, and consequently she is voted out of office. However, this politician, too, finds the new policy attractive. The reason is simply that the new policy allows her, in the eventuality in which the high quality is realized, to mimic the good politician. If this happens she is reelected with positive probability, determined again by the belief $\mu = 1 - \theta$, although she has appropriated rents. Clearly, then, second period effects are in favor of the new policy.

The parameter space supporting the separating equilibrium of Proposition 3 is the region $\{e, f, g\}$. Here $\delta$ is low so that the Leviathan will not choose to innovate anymore. Notice, however, that, as long as $\theta$ is close to $\theta^*$, the experimentation motive is still large enough for the benevolent incumbent to choose the innovative policy even for very low discount factors. For such parameter values one can thus have two attractive features of the political system at the same time. Firstly, the political system works well enough to induce the Leviathan to reveal her type instead of mimicking the benevolent type. Secondly, the benevolent incumbent has sufficient incentives to experiment with the new policy. For her it is worthwhile to learn its quality by trying out the new policy rather than free riding on the information gathered elsewhere.

A mixed equilibrium where the Leviathan chooses the innovative policy with probability $0 < \sigma < 1$ requires her to be indifferent between both policy choices. Graphically, this means that the pair $(\theta, \delta)$ has to be on the $\delta_L$-line drawn using the belief resulting from this strategy $\sigma$. For interior values of $\sigma$ the $\delta_L$-line passes between the two lines drawn for the extreme values $\sigma = 0$ and $\sigma = 1$. In an innovation equilibrium the benevolent incumbent has to opt for the new policy. Therefore, such an equilibrium requires to have a $(\theta, \delta)$ combination on, or above, the $\delta_B$-line where both policy choices are equivalent from the benevolent type’s point of view. This line, too, shifts as $\sigma$ changes since it, too, depends on the belief $\mu$. For any given $\sigma$ the equilibrium now exists for parameters which are on that portion of the $\delta_L$-curve induced by this $\sigma$ which lies above the $\delta_B$-curve produced by the same $\sigma$. The union of all these line segments is the area $\{c, d, e, f\}$. This is the space of parameters such that a mixed equilibrium exists.

Having analyzed the set of innovation equilibria we now turn to the effect of outside sources of information on those equilibria.
Enhanced information release

To investigate the effect of external information on political uncertainty and policy innovation we now perform comparative statics with respect to $\pi$. In doing so, we arrive at:

**Proposition 4** For $0 < \theta < \theta^*$, an increase in the information parameter $\pi$ weakly decreases $\delta_l$ and strictly increases $\delta_B$ and $\delta_L$.

**Proof of Proposition 4** The proof follows from differentiating the functions (4), (6), and (7), and making use of, from $\theta < \theta^*$, $\Delta_q > 0$ and the fact that, from $q_h - 2q_o \geq 0$, the denominator of $\delta_B$ is positive. This yields

$$\frac{\partial \delta_l(\theta, \pi)}{\partial \pi} = \frac{-q_l(1 - \mu)}{q_o[(1 - \pi)\mu + \pi]^{\frac{1}{2}}} \leq 0,$$

$$\frac{\partial \delta_L(\theta, \pi)}{\partial \pi} = \frac{\Delta_q + \theta q_l}{\theta q_h(1 - \pi)^{\frac{1}{2}}\mu} > 0,$$

$$\frac{\partial \delta_B(\theta, \pi)}{\partial \pi} = \frac{\Delta_q}{\{\theta q_h + q_o[(1 - \theta)\mu - 1]\}(1 - \pi)^{\frac{1}{2}}} > 0.$$

To illustrate the effect of enhanced information on the parameter space supporting the pooling equilibrium, stated in Proposition 2, consider Figure 2.

![Insert Figure 2 here.](image)

Panel (a) shows the situation, as also depicted in Figure 1, for $\pi = 0$. As $\pi$ increases, as shown in panel (b), this space shrinks monotonically since the upper bound $\delta_l$ decreases and the lower bound—composed of $\delta_B$ and $\delta_L$—increases. Finally, as can be seen from panel (c), for $\pi = \pi$, the space has contracted to a single point. Further increases in external information destroy the equilibrium.

Proposition 4 reveals how the incentives of the two types of politicians change as more information becomes available. While first period payoffs are unaffected by enhanced information release the incentives induced by second period payoffs, identified in the discussion of Propositions 1 to 3, are less marked as $\pi$ increases. For the Leviathan the payoff of the mimicking option is reduced because her behavior is revealed more often. Hence, this type of politician is less inclined to choose the new policy and so for her a
higher discount factor $\delta$ is needed to support the equilibrium. For the benevolent politician there are two countervailing effects. On the one hand, after choosing the old policy, the benevolent politician enjoys the opportunity to free ride on the information provided by the external source thereby reducing the cost of forgoing experimentation. On the other hand, since also voters benefit from the same information externality, they detect the mimicking behavior more often. For the benevolent politician this implies that the cost of being mimicked decreases with $\pi$. Thus, the decrease in policy uncertainty makes the old policy more attractive while reducing political uncertainty raises the payoff of innovation. Nevertheless, given that, initially, the benefit of experimentation outweighs the cost of being mimicked, a reduction in both kinds of costs reduces the attractiveness of the new policy relatively more such that, on balance, the old policy becomes more desirable. For the equilibrium to still exist for the benevolent politician, after an increase in $\pi$, a higher discount factor $\delta$ is needed, too.

Clearly, then, Proposition 4 illustrates two interesting but conflicting features of the politico-economic environment. On the one hand, performance evaluation by means of information release is desirable because the Leviathan increasingly reveals herself, but, on the other hand, it is bad because the benevolent type, by free riding on the information externality, experiments with the new policy less frequently.

8 Concluding remarks

A major issue in political economics is the extent to which political institutions are capable of separating selfish from benevolent incumbents. It has been advocated that outside sources of information, such as, among others, independent research institutions, media, and courts, perform this task by perfectly revealing misbehavior. This paper has shown that, in the presence of policies which are intrinsically uncertain, the role of outside information is more involved. While it is true that enhanced information helps in separating politicians, it, too, creates an externality that reduces the incentives to experiment with innovative public policies.

Our framework shows that selfish politicians can disguise their behavior behind the policy uncertainty intrinsic in innovative programs by mimicking a benevolent politician. The reason is that, when faced with a bad outcome of a policy experiment, citizens may be unable to distinguish between an honest politician, who just happened to be unlucky, and a selfish politician, who diverted part of the return of the successful innovation to herself. It was shown that this behavior occurs less often if there is information release concerning the true result of the policy experiment. Since the same information becomes available to politicians, they have an incentive to free ride on the outside source of information.
rather than bearing the cost of experimentation.

The paper suggests two lines of future research. A natural step would be to shift the focus towards examples where information release is inherently strategic. It might be worthwhile, for instance, to explicitly model the choice of political competitors, as in the Downsian framework, to provide or not external information. Here, an interesting feature would be to analyze how citizens assess the credibility of such information given the incentives of a political challenger to downplay any success of the incumbent.

It would also be interesting to empirically test the predictions of the model. For this purpose, one would need data representing the key variables of the model such as the intensity of information release, political accountability, and policy innovation. Information release could, for instance, be proxied by the freedom of press. According to the predictions of our model this should increase political accountability measured, for example, by a decrease in the probability of reelection.\textsuperscript{19} Moreover, one would expect to observe fewer policy experiments which might, for instance, be quantified by the amount of new legislation passed in a given period of time.

There remains much scope for the analysis of experimentation in richer models of political competition. We hope to have shown that the task is worthwhile and that the conclusions can be instructive.

\textsuperscript{19}Some empirical research has been carried out along these lines. Dreher (2004), for instance, shows that the conclusion of an IMF arrangement affects political outcomes by signalling the incumbent’s incompetence.
Figure 1: Equilibria of the model for $\pi = 0$.

Pooling on innovative policy, $\sigma = 1$: Region \{a, b, c, d\}
Mixed equilibria, $\sigma \in [0, 1]$: Region \{c, d, e, f\}
Separating equilibrium, $\sigma = 0$: Region \{e, f, g\}
Figure 2: Equilibria of the model for different values of $\pi$. 

2.a: Region $\{a, b, c, d\}$

2.b: Region $\{a, b, d\}$

2.c: Region $\{a\}$
Appendix A: Proof that the inequality in (5) is not binding.

We claim that $\delta_o(\theta, \pi) \geq \delta_l(\theta, \pi, \mu)$. This is equivalent to

$$q_o^2(1 - \pi\mu + \pi) \geq \theta\pi q_l(q_h - q_o) + q q_o.$$  \hfill (A.1)

Close inspection of (A.1) reveals that it is satisfied for all $0 \leq \theta \leq \theta^*$ if it holds with the minimum $\mu$ on the left hand side and the maximum $\theta = \theta^*$ on the right hand side. From (2), $\sigma \leq 1$, and $\theta \leq \theta^*$, it follows that $\mu$ takes its minimum value at $\theta = \theta^*$ and $\sigma = 1$. Upon substitution of $\theta = \theta^*$ and $\mu = 1 - \theta^*$ into (A.1), and collecting the terms involving $\pi$, one obtains

$$q_o^2(1 - \theta^*) - q q_o \geq \pi\theta^*[q_l(q_h - q_o) - q_o^2].$$ \hfill (A.2)

Inserting $\theta^* = (q_o - q_l)/(q_h - q_l)$ and multiplying both sides of (A.2) by $(q_h - q_l)$ gives

$$q_o[q_o(q_h - q_o) - q_l(q_h - q_l)] \geq \pi(q_o - q_l)[q_l(q_h - q_o) - q_o^2].$$ \hfill (A.3)

Adding and subtracting $q_o q_l$, the square brackets on the left hand side of (A.3) can be written as $(q_o - q_l)(q_h - q_o - q_l)$. Hence (A.2) is equivalent to

$$q_o(q_h - q_o - q_l) \geq \pi[q_l(q_h - q_o) - q_o^2].$$ \hfill (A.4)

Now since the right hand side of (A.4) is linear in $\pi$ it is maximized either by $\pi = 0$ or $\pi = 1$. Suppose $\pi = 0$. Then (A.4) is equivalent to $q_h - q_o - q_l \geq 0$ which, given the assumption $q_h \geq 2q_o$ and $q_o \geq q_l$, is true. If now $\pi = 1$ then (A.4) is equivalent to $q_o \geq q_l$ which again is true. \hfill $\Box$

Appendix B: Existence and uniqueness of the values $\theta$ solving $\delta_L = \delta_l$ and $\delta_B = \delta_l$ in the interval $\theta \in [0, \theta^*]$. 

The proof follows first on noticing that as $\theta \to 0$, following from (2), $\mu \to 0$ and thus, following from (4), (6), and (7), $\delta_l(\theta, \pi, \mu) = q_l/q_o < \infty$, $\delta_L(\theta, \pi, \mu) \to \infty$, and $\delta_B(\theta, \pi, \mu) \to \infty$. It then follows that for $\theta \to 0$, we have $\delta_l < \delta_B, \delta_L$. Moreover, for
\[ \theta = \theta^* \text{ one has } \Delta_q = 0 \text{ and thus} \]
\[ \delta_{L}(\theta^*, \pi, \mu) = \frac{q_l}{(1 - \pi)\mu + \pi q_o} > 0, \quad (B.1) \]
\[ \delta_{L}(\theta^*, \pi, \mu) = \frac{q_l}{(1 - \pi)\mu q_h} > 0, \quad (B.2) \]
\[ \delta_{B}(\theta^*, \pi, \mu) = 0. \quad (B.3) \]

Simple comparison of (B.1)–(B.3) reveals that at \( \theta^* \), \( \delta_{L} > \delta_{B} \), and, following from \( q_h > q_o \), we have that \( \delta_{L} > \delta_{L} \) holds for small \( \pi \). Hence, there are intersections \( \theta_{B,L} \) and \( \theta_{L,L} \) in the interval \([0, \theta^*]\).

To show uniqueness, we compute the derivatives of the functions \( \delta_{L} \), \( \delta_{L} \) and \( \delta_{B} \) with respect to \( \theta \).

To prepare for this first observe that
\[ \frac{\partial \mu}{\partial \theta} = -\frac{\sigma}{(1 - \theta + \sigma \theta)^2} \leq 0, \quad (B.4) \]
with the strict inequality following whenever \( \sigma > 0 \). Notice also that \( \sigma, \theta \leq 1 \) implies
\[ -\frac{\partial \mu \theta}{\partial \theta} = \frac{\sigma \theta}{(1 - \theta + \sigma \theta)(1 - \theta)} \leq \frac{\theta}{1 - \theta}. \quad (B.5) \]

We turn now to the derivatives of the functions \( \delta_{L} \), \( \delta_{L} \) and \( \delta_{B} \).

From (4), after using (B.4), it follows that
\[ \frac{\partial \delta_{L}(\theta, \pi, \mu)}{\partial \theta} = -\frac{q_l(1 - \pi)}{q_o(1 - \pi)\mu + \pi^2} \frac{\partial \mu}{\partial \theta} \geq 0, \quad (B.6) \]
where the strict inequality follows when \( \pi < 1 \) and \( \sigma > 0 \).

From (6), we have that
\[ \frac{\partial \delta_{L}(\theta, \pi, \mu)}{\partial \theta} = \frac{\theta(2q_l - q_h) - \left(1 + \frac{\partial \mu \theta}{\partial \theta} \right) (\theta q_l + \Delta_q)}{\theta^2 q_h(1 - \pi)\mu} < 0. \quad (B.7) \]
The strict inequality in (B.7) follows after observing that the first term in the numerator of (B.7) is, following from \( 2q_l < 2q_o \leq q_h \), negative. From \( q_h \geq 2q_o \) now one notices that
\[ \theta \leq \theta^* = (q_o - q_l)/(q_h - q_l) \leq (q_o - q_l)/(2q_o - q_l) \leq 1/2. \quad (B.8) \]

(B.8), together with (B.5), implies \(-\frac{\partial \mu}{\partial \theta}(\theta/\mu) \leq 1 \). Hence, the second term in the numerator of (B.7) is non-positive.
Finally, from (7), we compute
\[
\frac{\partial \delta_B(\theta, \pi, \mu)}{\partial \theta} = (q_l - q_h) \{ \theta q_h + q_o[(1 - \theta)\mu] - 1 \} - \Delta_q \left( q_h + \mu q_o \left[ \frac{\partial \mu}{\partial \theta} \frac{(1 - \theta)}{\mu} - 1 \right] \right) < 0. \tag{B.9}
\]
In (B.9), the first term in the numerator is negative since the denominator of \( \delta_B \) is positive and \( q_l < q_h \). Observe also that (B.5) implies \(- (\partial \mu/\partial \theta)(1 - \theta)/\mu \leq 1 \). Thus the second term is less than or equal to \(- \Delta_q(q_h - 2\mu q_o)\). This, however, following from, \( \mu \leq 1 \) and \( q_h \geq 2q_o \), is non-positive.

To summarize, \( \delta_l \) in (B.6) is increasing while \( \delta_B \) in (B.9) and \( \delta_L \) in (B.7) are both decreasing in \( \theta \). Hence, the intersections are unique as claimed.

Appendix C: Existence and uniqueness of the value \( \theta \) solving \( \delta_L = \delta_B \) in the interval \( \theta \in [0, \theta^*] \).

We prove this by means of two claims. Firstly, we show, in claim 1, that there is an odd number of intersections between the lines \( \delta_L \) and \( \delta_B \) in the mentioned interval. Secondly, in claim 2, we show that there are at most two such intersections. Since there is only one odd number between 0 and 2 these two claims together complete the proof.

**Claim 1.** We have at \( \theta = \theta^* \) that \( \delta_L(\theta^*, \pi, \mu) = q_l/[q_h(1 - \pi)\mu] > 0 \) and \( \delta_B(\theta^*, \pi, \mu) = 0 \). Hence, \( \delta_L(\theta^*, \pi, \mu) > \delta_B(\theta^*, \pi, \mu) \), that is, the \( \delta_L \)-line passes above the \( \delta_B \)-line at \( \theta^* \). Consider now \( \theta \) close to zero. For \( \theta > 0 \), after some straightforward manipulation, we have
\[
\frac{\delta_L(\theta, \pi, \mu)}{\delta_B(\theta, \pi, \mu)} = \left( 1 + \frac{\theta q_l}{\Delta_q} \right) \left[ \frac{q_h - \mu q_o}{\mu q_h} \frac{(1 - \mu)}{\theta \mu} \right]. \tag{C.1}
\]
Turning now to equation (2), after some manipulation, one obtains
\[
\frac{1 - \mu}{\theta \mu} = \frac{\sigma}{1 - \theta}. \tag{C.2}
\]
Taking limits, as \( \theta \to 0 \), of \( \Delta_q \), (2), \( \theta q_l \), and (C.2), one obtains, respectively
\[
\lim_{\theta \to 0} \Delta_q = q_o - q_l > 0, \tag{C.3}
\]
\[
\lim_{\theta \to 0} \mu = 1, \tag{C.4}
\]
\[
\lim_{\theta \to 0} q_l = 0, \tag{C.5}
\]
\[
\lim_{\theta \to 0} \frac{\sigma}{1 - \theta} = \sigma. \tag{C.6}
\]
25
Inserting these limits in (C.1), one obtains

\[
\lim_{\theta \to 0^+} \frac{\delta_L(\theta, \pi, \mu)}{\delta_B(\theta, \pi, \mu)} = 1 - \frac{q_o(1 + \sigma)}{q_h}. 
\]

(C.7)

Close inspection of (C.7) reveals that—following on \(\sigma \geq 0\) and \(q_o > 0\)—\(\lim_{\theta \to 0^+} \delta_L/\delta_B < 1\), whereas—following from \(\sigma \leq 1\) and \(q_h \geq 2q_o\)—\(\lim_{\theta \to 0^+} \delta_L/\delta_B \geq 0\). Consequently, for \(\theta > 0\), but close to 0, \(\delta_L(\theta, \pi, \mu) < \delta_B(\theta, \pi, \mu)\), and so the \(\delta_B\)-line passes above the \(\delta_L\)-line. Given that both functions are continuous there must be an odd number of intersections on the interval \([0, \theta^*]\).

Claim 2. Equating (6) and (7), inserting \(\mu\) from (2) and solving for \(\theta\), one obtains the following three roots\(^{20}\) as functions of \(\sigma\).

\[
\theta_{L,B}^{1}(\sigma) = -\frac{1}{-1 + \sigma}, \quad (C.8)
\]

\[
\theta_{L,B}^{2,3}(\sigma) = \frac{\beta \pm \sqrt{\beta^2 - 4\alpha \gamma}}{2\alpha}, \quad (C.9)
\]

where

\[
\beta \equiv q_o^2 + q_h q_l - 3q_h q_o + q_h q_o - (q_h q_h + 2q_h q_o - 2q_h q_o) \sigma,
\]

\[
\beta^2 - 4\alpha \gamma \equiv (-2q_h q_o q_o - 10q_h q_h q_o^2 + 6q_h q_h q_o - 2q_h q_o^2 + 4q_o q_o + 4q_l^2 q_o^2) \sigma
+ (-4q_o^2 q_h q_o + q_h^2 q_o^2 + 4q_l^2 q_o^2) \sigma^2 + q_h^4 + 2q_h^2 q_l q_o + 2q_h^2 q_l + q_l^2 q_o^2
- 2q_h q_o^3 + q_h^2 q_l^2 + q_h^2 q_o^2 - 4q_h q_l q_o^2 - 2q_h q_l^2 q_o,
\]

\[
\alpha \equiv (-2q_h q_o + q_h^2) + q_h^2 q_l - 2q_h q_o + q_h q_o.
\]

Since \(\sigma \in [0, 1]\) the first root is greater than or equal to one and hence is eliminated. So there are now at most two roots in the interval \([0, \theta^*]\). \(\square\)

\(^{20}\)These roots have been computed with MAPLE 7.


BELLEFLAME, P., and J. HINDRIKS (2001) Yardstick competition and political agency problems, Department of Economics Working Paper No. 441, Queen Mary University of London.


