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Strategic transparency and electoral pressure

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CFS WORKING PAPER

No. 2012/19

Strategic Transparency and Electoral Pressure

Laura Moretti and Toru Suzuki





Center for Financial Studies

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Strategic Transparency and Electoral Pressure^{*}

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Abstract

This paper investigates how an office-motivated incumbent can use transparency enhancement on public spending to signal his budgetary management ability and win re-election. We show that when the incumbent faces a popular challenger, transparency policy can be an effective signaling device. A more popular challenger can reduce the probability to enhance transparency, while voters can be better off due to a more informative signaling. It is also shown that a higher level of public interest in fiscal issues can increase the probability of enhancing transparency, while voters can be worse off by a less informative signaling.

JEL Classifications: D72, D82

Keywords: Fiscal Transparency, Electoral Pressure, Signaling Game, Perfect Sequential Equilibrium

1 Introduction

Enhancing fiscal transparency has been a central part of attempts to reform public sector governance in many countries since the late 1990s. Both the OECD and the IMF have recently published Codes of Best Practice for Fiscal Transparency to guide countries towards

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more open fiscal accounts and budgetary policy decision processes.¹ It has been recognized that fiscal transparency is crucial for making informed political decisions, keeping politicians accountable and implementing fiscal discipline. The debate over the importance of transparency is not limited to the policy circles, but it has attracted increasing interest of academic researchers.²

Despite the benefits of transparency, it is not clear whether politicians have an incentive to pursue it. In fact, as noted by Alesina and Perotti (1996), politicians benefit from lack of transparency which helps to create confusion and ambiguity on the real state of public finance. However, in some cases politicians enhance transparency spontaneously. The Federal Fund Accountability and Transparency Act³ of 2006 in the USA, for example, requires “full disclosure of all entities and organizations receiving Federal funds”⁴ through a searchable website. Similarly, the British prime minister, David Cameron, launched a website⁵ to track government activity and make the UK’s the “most open and transparent government in the world.”

We focus on the question of whether transparency enhancement on public spending⁶ could be explained by a politician’s intention to demonstrate his budgetary management ability in order to win re-election. In fact, since public spending depends not only on his ability, but also on exogenous economic conditions, it is not clear whether disclosure policy can be an effective signaling device.

To investigate our question we study a signaling game in which an incumbent chooses whether to disclose public spending to win re-election. In the first period he has to decide whether to introduce the transparency policy that would reduce his political rents, broadly defined as extra benefits and corruption. If he introduces the policy, public spending is disclosed at the beginning of the following period. In the second period, after observing the incumbent’s policy choice, each voter casts her vote for either the incumbent or the

¹See www.oecd.org/dataoecd/33/13/1905258.pdf and www.imf.org/external/np/fad/trans/index.htm

²See Ferejohn (1999), Milesi-Ferretti (2004), Gavazza and Lizzeri (2009, 2011) and Prat (2005) for a theoretical analysis; Alt and Lassen (2006a, 2006b), Alt et al. (2002 and 2006) for an empirical investigation of the beneficial effects of transparency.

³The Federal Funding Accountability and Transparency Act (FFATA) was signed on September 26, 2006. The intent is to empower every American with the ability to hold the government accountable for each spending decision. The end result is to reduce wasteful spending in the government. The FFATA legislation requires information on federal awards (federal financial assistance and expenditures) be made available to the public via a single, searchable website, which is www.USASpending.gov. More than 20 states have established some forms of spending database that make it easier for taxpayers to access information on how public funds are used.

⁴From the FFATA (S. 2590).

⁵transparency.number10.gov.uk/

⁶Transparency is a very broad and vague concept and in this paper we focus on transparency of public spending consistently with the conclusions in Gavazza and Lizzeri (2011).

challenger based on all available information. Voters' utility depends on both the budgetary management ability and other political abilities of the elected politician. The incumbent wins if he gets the majority of the votes. The key assumption of the model is that the level of spending depends not only on the incumbent's budgetary management ability, but also on economic conditions which are exogenous. Thus, the incumbent cannot prove his budgetary management ability by simply disclosing public spending.

Our model shows that the level of the electoral pressure is one of the key factors in determining the effectiveness of the transparency policy as a signaling device. When the incumbent faces a moderately popular challenger, the chance that the incumbent can "impress" voters and win re-election by luck is reasonably high. As a result, the incumbent with a low budgetary management ability can take advantage of luck by imitating high ability types. On the other hand, when the challenger is more popular than the incumbent to a great extent, the efficiency of public spending needs to be much higher to win re-election. As a result, the incumbent with a low ability has no incentive to introduce the transparency policy knowing the chance of re-election by luck is too low to cover the cost of the transparency policy. Hence, the incumbent with a high type can credibly signal his ability. When the incumbent is more popular than the challenger, whether high types can credibly signal their ability becomes much more sensitive to parameters. For example, when the level of public spending is a very noisy signal of the budgetary management ability, the incumbent cannot signal his ability by introducing the policy, while it is possible when the challenger is more popular than the incumbent.

Another contribution of this paper is clarifying the trade-off between "supply" and "quality" of the signaling. We show that a higher electoral pressure can increase the probability of transparency enhancement, while the expected payoff of the median voter can decrease. It is also shown that a greater public interest in fiscal issues has the same effects.

1.1 Related Literature

In most existing theoretical studies, (fiscal) transparency is an exogenous structure and the analysis focuses on how it influences economic activities and welfare. For example, Milesi-Ferretti (2004) shows that, with a lack of transparency, fiscal rules can lead to creative accounting. Gavazza and Lizzeri (2009) analyze a model of electoral competition in which transfer policies are imperfectly observable, and compare the equilibrium outcomes under different transparency structures. They show that transparency of spending is beneficial, while transparency of revenues can be harmful because it leads to an increase of wasteful spending. Prat (2005) shows that transparency of "outcome" is always beneficial to voters

because it induces the politician to use information efficiently. However, transparency of “action” can be detrimental because it induces the politician to behave in a conformist manner and to disregard useful private information. Thus, one common message of these papers is that transparency of outcome or spending is always desirable.

Our paper studies whether the incumbent has an incentive to introduce such a socially desirable fiscal transparency. Thus, we treat disclosure on public spending as a strategic variable chosen by an office motivated politician and analyze whether there exists equilibria in which the politician enhances transparency in a simple election game.

Ferejohn (1999) is the only paper, to our knowledge, that treats the level of transparency as an endogenous variable. He formulates the problem as moral hazard and shows that voters induce an office-motivated politician to take more “transparent” actions. On the other hand, we formulate the problem as adverse selection and explain the enhancement of transparency as a signaling equilibrium. In our model, unlike the “uniform” prediction of Ferejohn (1999), whether an office-motivated politician enhances transparency depends on many factors such as the electoral competitive pressure, and the degree of public interest in fiscal issues.

From a game theoretical perspective, this paper belongs to the literature on signaling games and, in particular, since the sender strategically chooses whether to disclose private information, it is similar to persuasion games by Milgrom (1981) and Grossman (1981). However, our model departs from the standard persuasion game in two aspects. First, the sender has two kinds of private information: his budgetary management ability, which cannot be disclosed, and public spending, which can be disclosed. Second, given his budgetary management ability, the sender has to make a disclosure decision before the spending is realized. As other signaling games, our game has multiple equilibria. However, since the cost of disclosure is constant in the sender’s type, the dominance based refinement. e.g., Cho and Kreps (1987), is not effective. Instead, perfect sequential equilibrium by Grossman and Perry (1986) effectively refines the equilibrium set in our signaling game.

The rest of the paper is organized as follows: Section 2 introduces the model; Section 3 analyzes the equilibria; Section 4 provides comparative statics of the informative equilibrium; Section 5 refines the equilibrium set; Section 6 presents an extension of the basic setting. Section 7 discusses the results and Section 8 concludes.

2 Model

The model consists of two periods. There is a continuum of voters who have to choose between two candidates, an incumbent and a challenger, in an election scheduled for the second period. The election is based on majority rule. Each candidate is characterized by

his budgetary management ability $\theta \in \Theta = [0, 1]$, which is private information, and his political ability $\omega \in [0, 1]$, which is observable for the sake of the analysis.⁷ In the model his budgetary management skill, θ , refers to the ability of managing public spending efficiently, while his political skill, ω , refers to a diverse set of complementary political abilities such as mediation, both in domestic and foreign affairs.

In the first period the incumbent has to decide whether to introduce a transparency policy to disclose public spending (the use of tax revenues) or not. If he introduces the transparency policy, $a = Y$, the amount of public spending in period 1, $s \in S = [0, \infty)$, will be disclosed next period and he incurs the cost $c \in (0, 1)$. On the other hand, if he does not introduce the policy in period 1, $a = N$, he incurs no costs and public spending cannot be disclosed next period. We assume that the incumbent can credibly commit to the announced transparency policy.

The cost c is the reduction in political rents that the incumbent has to suffer when deciding to enhance transparency. Hence, in societies in which politicians enjoy personal benefits from their position, the level of the rent reduction is very high, while in societies in which politicians are committed to the common good, the cost of becoming transparent is relatively low.

In our setting, the delay between the adoption of the transparency policy and the actual circulation of information represents the time required to collect detailed data and to make them accessible to the public by setting up, for example, an user-friendly website.⁸

The incumbent was elected to achieve a goal, e.g., public projects, which he tries to accomplish with the lowest possible spending s in period 1. Then, in the period 2 election voters evaluate the incumbent's budgetary management ability θ based on the level of spending s whenever it is available. However, since public spending s depends not only on the incumbent's budgetary management ability θ , but also on some unobservable economic and political shocks⁹, voters cannot pin down the budgetary management ability only from observing spending s . Nevertheless, an incumbent with a higher θ tends to achieve the goal with a lower spending level than an incumbent with a low θ , given a certain economic condition.¹⁰ Formally, let $f(s, \theta)$ be the joint probability density of (s, θ) which is continuous in

⁷It can be unobservable, but the candidates are assumed to have no signaling device for the political ability.

⁸We relax this assumption in Section 6 allowing the incumbent to wait until after the observation of s before committing to the policy.

⁹Another determinant of the noisiness of s is the credibility of its information content. In fact, account manipulation is a common problem in the disclosure of public records and, when the information disclosed is less trustworthy, public spending s is an even noisier signal of the incumbent's ability.

¹⁰Voters do not observe the realization of the economic shocks either, but they know the distribution of the shocks.

each argument and has the following property:

Assumption 1. $\frac{f(s|\theta'')}{f(s|\theta')}$ is strictly decreasing in s for any $\theta' < \theta''$.

Note that $f(s, \theta)$ reflects the incumbent's goal and the state of the economy in period 1. For example, during a recession, the level of spending in social programs might need to be increased in order to achieve the goal. Thus, the level of spending s could be high even when the incumbent has a high budgetary management ability. Hence, when the economy is in a recession, $f(s|\theta)$ may have a high value for a large s even if θ is high. On the other hand, during booms it might be easier to achieve the goal with lower spending even if the incumbent has a low budgetary management ability. Thus, when the economy is booming, $f(s|\theta)$ has a low value for high s if θ is high.

The next is a technical assumption which helps our analysis.

Assumption 2. $\lim_{s \rightarrow \infty} \int \theta f(\theta|s) d\theta = 0$ and $\lim_{s \rightarrow 0} \int \theta f(\theta|s) d\theta = 1$.

The incumbent is office motivated and his payoff is 1 if he is re-elected and 0 if he loses the election. Each voter's payoff from electing a candidate is a linear combination of the elected politician's budgetary management ability θ and his political ability ω with relative weights α and $(1 - \alpha)$ respectively.¹¹ Hence, given (θ, ω) , a voter's payoff from selecting a candidate is $\alpha\theta + (1 - \alpha)\omega$ where $\alpha \in [0, 1]$. α is a taste parameter which characterizes each voter's preference for a politician's budgetary management skill. Thus, a voter characterized by a higher α cares more about the efficiency in government spending than about the candidate's political abilities.¹² For tractability, we assume that the distribution of α in the population is single peaked.

The timing of the game is as follows. In period 1, the incumbent chooses his action a that is either Y or N . In period 2, if the incumbent chooses $a = Y$ in period 1, voters observe public spending s , while s cannot be observed if the incumbent chooses $a = N$. Each voter then chooses whether to vote for the incumbent "I" or the challenger "C" given available information. Thus, the incumbent's strategy¹³ is defined as a mapping $\sigma : \Theta \rightarrow A$. On the other hand, the voter's strategy is defined as a mapping $r : A \times Z \rightarrow \{I, C\}$ where $z \in Z = S \cup \emptyset$ is disclosed information and \emptyset denotes "no available information." For simplicity, we assume that the challenger has no effective signaling device and no effective action to take. It is assumed that the expected value of the challenger's budgetary management

¹¹We can interpret the voter's payoff as her future consumption given the politicians' abilities. Then α is her belief about the effect of the politician's budgetary management ability on her future consumption.

¹²This may be because the voter believes managing public finances efficiently is more important than other political abilities.

¹³We focus on pure strategies since the set of types which use a mixed strategy in any equilibrium is measure zero.

ability, $\theta_0 \in (0, 1)$, and his political ability, $\omega_0 \in (0, 1)$, are both common knowledge between the incumbent and voters. Thus, essentially, our model is a signaling game between the incumbent and voters. We employ *perfect Bayesian equilibrium* to analyze the game.

Remark 1. Since s is the only stochastic variable for all players, our model assumes implicitly that the incumbent always achieves his goal and θ is evaluated only by the level of spending s . Even though this setting is highly stylized, the qualitative results of our paper are preserved even in a setting in which the incumbent can fail to achieve the goal. To see the reason, suppose the level of the incumbent's achievement $y \in [0, \infty)$ is stochastic given his spending, and voters can observe not only the disclosed information but also y at the end of period 1. Then, instead of $f(s, \theta)$, we just need to introduce the joint probability density function $g(s, y, \theta)$ such that, for any $\theta'' > \theta'$, (i) $\frac{g(s|y, \theta'')}{g(s|y, \theta')}$ is decreasing in s given any $y \in [0, \infty)$ and (ii) $\frac{g(y|s, \theta'')}{g(y|s, \theta')}$ is increasing in y given any $s \in [0, \infty)$. In this setting, voting decisions can depend on y but the incumbent's problem is qualitatively the same as in our setting in the sense that, given a strategy, a higher θ still has a higher probability to be re-elected. Hence, our simple setting is sufficient to provide the key insight of the problem.

3 Equilibrium analysis

3.1 Preliminary analysis

Since this is a two-stage game, we start with each voter's optimal decision given a strategy and available information. The difference between a voter's expected payoff from electing the incumbent and that from electing the challenger conditional on (a, z) is

$$\alpha(E[\theta|a, z] - \theta_0) + (1 - \alpha)(\omega - \omega_0).$$

If $E[\theta|a, z] - \theta_0 > \omega - \omega_0$, then, whenever a voter with α prefers the incumbent to the challenger, a voter with $\alpha' > \alpha$ also prefers the incumbent. On the other hand, if $E[\theta|a, z] - \theta_0 < \omega - \omega_0$, then, whenever a voter with α prefers the challenger to the incumbent, a voter with $\alpha' > \alpha$ also prefers the challenger. Then, since the distribution of α in the population is single peaked, the median voter determines the outcome of the election. Let α^* be α of the median voter.

When the median voter observes the incumbent's choice a and disclosed information z , she updates her belief about the incumbent's ability. Concretely, let $\Theta_\sigma(a) = \{\theta : \sigma(\theta) = a\}$. Then, when the incumbent uses strategy σ and his action a is such that $\Theta_\sigma(a) \neq \emptyset$, the consistent posterior belief conditional on (a, z) is

$$\mu(\theta|a, z; \sigma) = \begin{cases} \frac{f(s, \theta)}{\int_{\theta' \in \Theta_\sigma(a)} f(s, \theta') d\theta'} & \text{if } \theta \in \Theta_\sigma(a) \text{ and } z = s \\ \frac{f_\theta(\theta)}{\int_{\theta' \in \Theta_\sigma(a)} f_\theta(\theta') d\theta'} & \text{if } \theta \in \Theta_\sigma(a) \text{ and } z = \emptyset \\ 0 & \text{if } \theta \notin \Theta_\sigma(a) \end{cases}$$

The median voter chooses a candidate whose expected value is higher. Let $v(\alpha^*, \theta, \omega)$ be the payoff of the median voter from electing the incumbent, while $v(\alpha^*, \theta_0, \omega_0)$ be the payoff of the median voter from electing the challenger. The median voter's optimal reaction is then

$$r(a, z; \alpha^*, \sigma) = \begin{cases} I & \text{if } \int_{\theta \in \Theta_\sigma(a)} v(\alpha^*, \theta, \omega) \mu(\theta|a, z; \sigma) d\theta \geq v(\alpha^*, \theta_0, \omega_0) \\ C & \text{if } \int_{\theta \in \Theta_\sigma(a)} v(\alpha^*, \theta, \omega) \mu(\theta|a, z; \sigma) d\theta < v(\alpha^*, \theta_0, \omega_0) \end{cases}.$$

Turning to the incumbent's problem, Assumption 1 and 2 imply that we can always find a spending level $s(\alpha^*, \sigma) \in [0, \infty)$ such that

$$\begin{cases} r(Y, s; \alpha^*, \sigma) = I & \text{if } s \leq s(\alpha^*, \sigma) \\ r(Y, s; \alpha^*, \sigma) = C & \text{if } s > s(\alpha^*, \sigma) \end{cases}.$$

Then, given σ , we can compute the probability of re-election conditional on (a, θ) as follows

$$Q_a(\theta; \sigma) = \begin{cases} F(s(\alpha^*, \sigma)) & \text{if } a = Y \\ 1 & \text{if } a = N \text{ and } \int_{\theta \in \Theta_\sigma(N)} v(\alpha^*, \theta, \omega) \mu(\theta|N, \emptyset; \sigma) d\theta \geq v(\alpha^*, \theta_0, \omega_0) \\ 0 & \text{if } a = N \text{ and } \int_{\theta \in \Theta_\sigma(N)} v(\alpha^*, \theta, \omega) \mu(\theta|N, \emptyset; \sigma) d\theta < v(\alpha^*, \theta_0, \omega_0) \end{cases}$$

Thus, type θ incumbent's expected payoff from a given σ is

$$\begin{cases} Q_Y(\theta; \sigma) - c & \text{if } a = Y \\ Q_N(\theta; \sigma) & \text{if } a = N \end{cases}.$$

3.2 Characterization of Equilibria

Since our model is a signaling game, there are both informative and uninformative equilibria. In an informative equilibrium, the incumbent's policy choice depends on θ . Thus, voters can learn about θ not only from the disclosed information, but also from the policy choice. On the other hand, in an uninformative equilibrium, the incumbent's action is constant in θ and voters have to make their decision based only on disclosed information. We then analyze

under which circumstances the transparency policy can be an effective signaling device.

3.2.1 Uninformative Equilibria

Since there are two possible actions for the incumbent, there are two kinds of pooling strategies. A pooling strategy is **Y-pooling** if all types choose Y , while a pooling strategy is **N-pooling** if all types choose N . Note that in every pooling equilibrium, the policy choice does not reveal any information. In the Y-pooling equilibrium, public spending s is the only available information about θ . On the other hand, in the N-pooling equilibrium voters have to make a decision based only on their priors.

First, it is easy to see that the N-pooling equilibrium always exists when voters interpret off-equilibrium action Y as a “negative signal” about θ . Second, the Y-pooling equilibrium exists if and only if $c \leq F(s(\alpha^*, \sigma_p)|0)$, where σ_p is the Y-pooling strategy. Observe that type θ incumbent’s expected payoff from Y given the Y-pooling strategy is $F(s(\alpha^*, \sigma_p)|\theta) - c$. When the expected payoff is positive for the worst type, i.e., $\theta = 0$, and voters interpret off-equilibrium action N as a “negative signal” about θ , no type has incentive to deviate from Y .

One possible factor that determines the existence of the Y-pooling equilibrium is the precision of s as a statistical signal. When public spending s statistically reflects the budgetary management ability very well, the lowest type’s expected payoff from Y may be negative and no Y-pooling equilibrium may exist.

3.2.2 Informative Equilibria

When an equilibrium strategy is informative, voters can learn about the incumbent’s ability θ not only from the level of spending s , but also from the incumbent’s action a . Since voters can make decisions based on additional information, voters’ ex ante expected payoffs in an informative equilibrium are always higher than in any pooling equilibrium.

First, we introduce a class of strategies which plays a key role in our paper. An incumbent’s strategy is a **cutoff strategy** if there exists $\hat{\theta} \in [0, 1]$ such that whenever $\theta > \hat{\theta}$, the incumbent chooses Y , while whenever $\theta < \hat{\theta}$, the incumbent chooses N . An equilibrium is a **cutoff equilibrium** if the incumbent uses a cutoff strategy in the equilibrium.

The first observation states that, in any equilibrium, the incumbent introduces the transparency policy whenever a lower type incumbent introduces the policy.

Observation 1. *Any equilibrium is a cutoff equilibrium.*¹⁴

¹⁴Note that a pooling strategy is a cutoff strategy whose cutoff type is 0 or 1.

To see the idea of Observation 1, suppose there exists an equilibrium in which $\sigma(\theta') = Y$ and $\sigma(\theta'') = N$ for $\theta' < \theta''$. Then, $Q_Y(\theta'; \sigma) - c \geq Q_N(\theta'; \sigma)$ and $Q_Y(\theta''; \sigma) - c \leq Q_N(\theta''; \sigma)$. Note that $Q_N(\theta'; \sigma) = Q_N(\theta''; \sigma)$. On the other hand, by Assumption 1, $Q_Y(\theta'; \sigma) < Q_Y(\theta''; \sigma)$. This contradicts the hypothesis.

An intuition of the result is as follows. Suppose there exists an equilibrium in which a higher type chooses N , while a lower type chooses Y . Note that by Assumption 1, the expected payoff from Y is higher for the higher type. However, since the expected payoff from N is constant in the type, the higher type always has an incentive to choose Y .

The next observation provides another property of informative equilibrium.

Observation 2. *In any informative equilibrium, the incumbent's expected payoff from N is 0.*

Intuitively, if the incumbent does not disclose spending, there is no stochastic element in his payoff. Thus the outcome has to be either “win” or “lose” for sure. If he can win with certainty without disclosure, every type prefers not to disclose spending. Hence, whenever the incumbent does not disclose in an informative equilibrium, the probability of winning has to be zero. More formally, note that given cutoff strategy $\sigma_{\hat{\theta}}$, action N reveals that the incumbent's type is lower than $\hat{\theta}$. The probability of re-election conditional on N is then

$$Q_N(\theta, \sigma_{\hat{\theta}}) = \begin{cases} 1 & \text{if } \int_{\theta < \hat{\theta}} v(\alpha^*, \theta, \omega) \frac{f_{\theta}(\theta)}{F_{\theta}(\theta)} d\theta \geq v(\alpha^*, \theta_0, \omega_0) \\ 0 & \text{if } \int_{\theta < \hat{\theta}} v(\alpha^*, \theta, \omega) \frac{f_{\theta}(\theta)}{F_{\theta}(\theta)} d\theta < v(\alpha^*, \theta_0, \omega_0) \end{cases}.$$

Thus, the expected payoff from N has to be either 0 or 1 in any informative equilibrium. Since any informative equilibrium is a cutoff equilibrium, given equilibrium cutoff $\hat{\theta}^*$, $Q_Y(\theta, \sigma_{\hat{\theta}^*}) - c > (<) Q_N(\theta, \sigma_{\hat{\theta}^*})$ for any $\theta > (<) \hat{\theta}^*$. Then, since $Q_Y(\theta, \sigma_{\hat{\theta}}) \leq 1$, the inequality can be satisfied only if $Q_N(\theta, \sigma_{\hat{\theta}^*}) = 0$.

Observation 3. *An informative equilibrium exists only if $\alpha^* > \max \left\{ \frac{\omega_0 - \omega}{\omega_0 - \omega + 1 - \theta_0}, \frac{\omega - \omega_0}{\omega - \omega_0 + \theta_0} \right\}$.*

This observation says that the majority of voters have to be sufficiently interested in fiscal issues in order to have an informative equilibrium. This result is straightforward: when the incumbent cannot win the election even if the median voters believe he has the highest possible θ , i.e., $\alpha^* + (1 - \alpha^*)\omega < \alpha^*\theta_0 + (1 - \alpha^*)\omega_0$, the incumbent never uses the expensive transparency policy in equilibrium. On the other hand, when the incumbent can win even if voters believe that he has the lowest budgetary management ability, he has no reason to enhance transparency. Note that the “minimum level of public interest” can be very small when ω is close to ω_0 .

To state the next observation, let $\theta(\alpha^*, \theta_0, \omega_0) = \theta_0 + \frac{1 - \alpha^*}{\alpha^*}(\omega_0 - \omega)$.

Observation 4. *Suppose α^* satisfies the inequality of Observation 3. Then, the equilibrium cutoff type in any informative equilibrium is strictly lower than $\theta(\alpha^*, \theta_0, \omega_0)$.*

To understand observation 4, suppose that the incumbent uses a cutoff strategy in which the cutoff type is higher or equal to $\theta(\alpha^*, \theta_0, \omega_0)$ in an equilibrium. Note that $\alpha^*\theta(\alpha^*, \theta_0, \omega_0) + (1 - \alpha^*)\omega = \alpha^*\theta_0 + (1 - \alpha^*)\omega_0$. Then, when the incumbent chooses Y , voters know that his type is at least as good as $\theta(\alpha^*, \theta_0, \omega_0)$. The voter's payoff from electing the challenger is then strictly lower than that from selecting the incumbent. As a result, the voter chooses the incumbent irrespective of the level of spending s . However, in such a situation, for a small $\varepsilon > 0$, type $\theta(\alpha^*, \theta_0, \omega_0) - \varepsilon$ has incentive to choose Y pretending his type is higher than $\theta(\alpha^*, \theta_0, \omega_0)$. This contradicts our hypothesis.

Before stating our first result, we define the use of a term that plays an important role in this paper. We say candidate A is **more popular** than B if the majority of voters prefer candidate A to B in period 1. Concretely, the incumbent is more (less) popular than the challenger if $\int v(\alpha^*, \theta, \omega) f_\theta(\theta) d\theta > (<) v(\alpha^*, \theta_0, \omega_0)$.

Now we are ready to characterize the economic environment under which the transparency policy can be an effective signaling device. We consider first a situation in which the challenger is more popular than the incumbent.

Proposition 1. *Suppose the challenger is more popular than the incumbent and $\alpha^* >$*

$$\frac{\omega_0 - \omega}{\omega_0 - \omega + 1 - \theta_0}.$$

(i) *There exists an informative equilibrium if and only if $F(s(\alpha^*, \sigma_p)|0) < c$.*

(ii) *Whenever an informative equilibrium exists, it is unique.*

Proof. See appendix. □

Proposition 1 implies that when the challenger is more popular than the incumbent to a large degree, the transparency policy is an effective signaling device. Recall that there is no Y-pooling equilibrium if $F(s(\alpha^*, \sigma_p)|0) < c$. Hence, when the incumbent faces a popular challenger, an informative equilibrium exists if and only if there is no Y-pooling equilibrium. This is an intuitive result, in fact, when the incumbent faces a popular challenger, only high types, who are confident about their future performance s , can introduce the costly transparency policy. Low types, expecting a poor future performance, avoid a commitment to disclose s .

To state our next result, let $\tilde{\theta}$ be θ' such that $\int_{\theta < \theta'} v(\alpha^*, \theta, \omega) \frac{f_\theta(\theta)}{F_\theta(\theta)} d\theta = v(\alpha^*, \theta_0, \omega_0)$. Obviously, $\tilde{\theta}$ exists whenever the incumbent is more popular than the challenger.

Proposition 2. *Suppose the incumbent is more popular than the incumbent and $\alpha^* >$*

$$\frac{\omega - \omega_0}{\omega - \omega_0 + \theta_0}.$$

- (i) *There exists an informative equilibrium if and only if $F(s(\alpha^*, \sigma_p)|0) < c < F(s(\alpha^*, \sigma_{\tilde{\theta}})|\tilde{\theta})$.*
- (ii) *Whenever an informative equilibrium exists, it is unique.*

Proof. See appendix. □

Proposition 2 states that, when the incumbent is more popular than the challenger, the set of environments that can support an informative equilibrium is strictly smaller. To see this claim, consider two joint distributions, f and \tilde{f} , which are the same in terms of the noisiness of the signal, i.e., $f(s|\theta) = \tilde{f}(s|\theta)$ for any (s, θ) , but the incumbent is more (less) popular than the challenger under \tilde{f} (f), that is $\tilde{F}_\theta(\theta)$ first-order stochastically dominates $F_\theta(\theta)$. Let $s(\alpha^*, \sigma_p|f)$ be the median voter's cutoff signal given a pooling strategy and f . Then, it is easy to see that $s(\alpha^*, \sigma_p|f) < s(\alpha^*, \sigma_p|\tilde{f})$. Hence, $F(s(\alpha^*, \sigma_p|f)|0) < \tilde{F}(s(\alpha^*, \sigma_p|\tilde{f})|0)$. Thus, given the noisiness of s , the set of costs that can support an informative equilibrium is strictly smaller (the lower bound is strictly higher and the upper bound is strictly lower), when the incumbent is more popular than the challenger.

It is easy to show that if public spending s is a sufficiently noisy signal of θ , an informative equilibrium can exist only if the challenger is more popular than the incumbent. To provide an intuition, observe that when the incumbent is less popular, he has to impress voters to win the election. However, since s is very noisy, even the highest ability type loses the election with a high probability if all types introduce the transparency, i.e., the Y-pooling. Thus, in equilibrium, only some high types introduce the costly transparency. Lower types have no incentive to imitate since it is too costly given their poor expectation of s . On the other hand, when the incumbent is more popular than the challenger, he can win the election unless he hurts his popularity to a great extent. In fact, when some high types introduce the costly transparency policy, low types can take advantage of the noisiness of s and their popularity by imitating high types.

4 Comparative statics

This section provides comparative statics of the informative equilibrium. Concretely, we analyze how a change of each parameter affects the median voter's equilibrium payoff. Let $W(c, \alpha^*, \omega_0, \theta_0)$ be the median voter's payoff in the informative equilibrium given $(c, \alpha^*, \omega_0, \theta_0)$.¹⁵

¹⁵When $\omega \neq \omega_0$, voters with high α and voters with low α can have a different preference over candidates. Thus, when the median voter's equilibrium payoff given $(c, \alpha^*, \omega_0, \theta_0)$ is higher than his equilibrium payoff given $(\tilde{c}, \tilde{\alpha}^*, \tilde{\omega}_0, \tilde{\theta})$, some voters' equilibrium payoffs can be lower given $(c, \alpha^*, \omega_0, \theta_0)$. However, by definition, the median voter's preference reflects at least half of the population. Moreover, as $|\omega - \omega_0|$ gets smaller, larger proportion of voters have the same preference and all voters have the same preference when $\omega = \omega_0$. Thus, we use $W(c, \alpha^*, \omega_0, \theta_0)$ as a benchmark to evaluate the desirability of the equilibrium.

Before we provide comparative statics, it is worth explaining the trade-off between “supply” and “quality” of the signaling. Let $P(c, \alpha^*, \theta_0, \omega_0)$ be the ex ante probability that the incumbent chooses Y in the informative equilibrium given $(c, \alpha^*, \theta_0, \omega_0)$. Suppose there exists an informative equilibrium under both $(c, \alpha^*, \theta_0, \omega_0)$ and $(\tilde{c}, \tilde{\alpha}^*, \tilde{\theta}_0, \tilde{\omega}_0)$.

Observation 5. $P(c, \alpha^*, \theta_0, \omega_0) > P(\tilde{c}, \tilde{\alpha}^*, \tilde{\theta}_0, \tilde{\omega}_0)$ if and only if $W(c, \alpha^*, \theta_0, \omega_0) < W(\tilde{c}, \tilde{\alpha}^*, \tilde{\theta}_0, \tilde{\omega}_0)$.

The proof is provided in the appendix. The basic idea of Observation 5 is as follows. Since any informative equilibrium is a cutoff equilibrium, whenever the ex ante probability of the transparency enhancement is higher, the equilibrium cutoff type becomes lower. From Observation 4, we know that the equilibrium cutoff type is bounded above by the cutoff type with which the voter can perfectly distinguish a better candidate. Thus, higher cutoff type always improves the median voter’s equilibrium payoff. Hence, a higher equilibrium cutoff type decreases the “supply” of transparency and increases the signaling “quality”.

Turning to comparative statics, the following proposition states that higher “demand” of transparency can have a negative effect on voters.

Proposition 3. *Suppose $\tilde{\alpha}^* > \alpha^*$ and an informative equilibrium exists under $(c, \alpha^*, \theta_0, \omega_0)$ and $(c, \tilde{\alpha}^*, \theta_0, \omega_0)$. If $\int \theta f_\theta(\theta) d\theta > \omega$, then $W(c, \alpha^*, \theta_0, \omega_0) > W(c, \tilde{\alpha}^*, \theta_0, \omega_0)$.*

Proof. See appendix. □

The proposition says that a higher demand for transparency can decrease the median voter’s equilibrium payoff when voters consider the incumbent’s budgetary management ability higher than his general political ability ω . An intuition of this result is the following. When $\tilde{\alpha}^*$ is higher, more voters perceive the fiscal condition of the government as their main concern. Thus, the marginal gain from the transparency policy becomes higher for the cutoff type. Then, since the incumbent’s expected payoff from N is 0, the cutoff type who finds Y and N indifferent becomes lower. Hence, higher public interest in transparency induces higher “supply” of transparency and, as we showed in Observation 5, makes it a less informative signal.

When voters do not perceive the incumbent’s budgetary management ability as his strength before the election period, i.e., $\int \theta f_\theta(\theta) d\theta < \omega$, a higher demand decreases the median voter’s equilibrium payoff depending on the parameters. This is because when voters think the incumbent’s strength is his political ability rather than his budgetary management ability, higher public interest in fiscal issues improves the effectiveness of signaling only in a small level. As a result, the equilibrium cutoff type who finds Y and N indifferent could be higher and thus the median voter’s equilibrium payoff can be higher in such a situation.

The next proposition shows that a stronger “obstacle” to enhance transparency always improves the median voter’s equilibrium payoff.

Proposition 4. *Suppose there exists an informative equilibrium under $(c, \alpha^*, \theta_0, \omega_0)$, $(c, \alpha^*, \theta_0, \tilde{\omega}_0)$, $(\tilde{c}, \alpha^*, \theta_0, \omega_0)$, and $(c, \alpha^*, \tilde{\theta}_0, \omega_0)$.*

- (i) *If $c < \tilde{c}$, then $W(c, \alpha^*, \omega_0, \theta_0) < W(\tilde{c}, \alpha^*, \omega_0, \theta_0)$.*
- (ii) *If $\omega_0 < \tilde{\omega}_0$, then $W(c, \alpha^*, \theta_0, \omega_0) < W(c, \alpha^*, \theta_0, \tilde{\omega}_0)$.*
- (iii) *If $\theta_0 < \tilde{\theta}_0$, then $W(c, \alpha^*, \theta_0, \omega_0) < W(c, \alpha^*, \tilde{\theta}_0, \omega_0)$.*

Proof. See appendix. □

Proposition 4 is intuitive: any obstacle that makes transparency more “costly” makes the signaling more “credible”. For example, when the challenger is more popular than the incumbent, the chance that the incumbent can win the election with the signaling becomes lower. Thus, only higher types are confident enough to introduce the transparency policy as signaling. Hence, even though a tough competition discourages the transparency enhancement, the median voter’s payoff is improved by more informative signaling.

Remark 2. There is a caveat when our results are compared to empirical regularities. Note that the comparative statics focuses on the informative equilibrium. Thus, in order to apply our results, we need to assume that, after economic environment changes, (i) an informative equilibrium still exists, and (ii) agents always play the informative equilibrium rather than a pooling equilibrium. Thus, our results may be a reasonable prediction when the economic environment changes to a small degree and the informative equilibrium was played before the change. On the other hand, when the economic environment changes to a large degree, our results might not deliver very good predictions.

For instance, the empirical results of Alt and Lassen (2006) suggest that more competition tends to increase transparency. At first glance, their result is inconsistent with Proposition 4. However, as Proposition 1 and 2 show, the set of costs that can support the informative equilibrium is smaller when the incumbent is more popular than the challenger. Thus, even if an informative equilibrium exists under a strong competitive pressure, i.e., facing a more popular challenger, there can be no informative equilibrium under a weak competitive pressure, i.e., facing a less popular challenger. Moreover, as we will show in the next section, the N-pooling is the only pooling equilibrium that passes our refinement test under a weak competitive pressure. Thus, it is possible that competition increases transparency by shifting the equilibrium from the N-pooling to the informative equilibrium.

5 Refinement

As we showed in the last section, our game has always at least one pooling equilibrium. However, such pooling equilibria often rely on counter-intuitive off-equilibrium beliefs. For instance, in the N-pooling equilibrium, voters believe that the incumbent has a low budgetary management ability when the transparency policy is introduced. On the other hand, in the Y-pooling equilibrium, voters interpret “no disclosure” as a signal of incompetence even if the incumbent has a good reputation about his budgetary management ability.

This section investigates whether such pooling equilibria are reasonable. Concretely, we refine the set of equilibria with **perfect sequential equilibrium (PSE)** introduced by Grossman and Perry (1986). We show that each pooling equilibrium is not always a PSE.

PSE refines the set of perfect Bayesian equilibria (PBE) by restricting off-equilibrium beliefs to be “credible”. That is, once a deviation has occurred, the voter tries to rationalize the deviation by trying to find a set of types $T \subset \Theta$ that would benefit from the deviation if it is thought T deviated, but $\theta \notin T$ loses from the deviation. More precisely, suppose the incumbent chooses an off-equilibrium action. Voters then try to find $T \subset \Theta$ such that, if voters choose the optimal action believing the incumbent’s type is in T , the set of types whose expected payoffs are strictly higher than the equilibrium payoff is exactly T . If such T exists, the **credible updating rule** given off-the-equilibrium action a is

$$\mu(\theta|a, z) = \begin{cases} \frac{f(\theta, s)}{\int_{\theta' \in T} f(\theta', s') d\theta'} & \text{if } \theta \in T \text{ and } a = Y \\ \frac{f_{\theta'}(\theta)}{\int_{\theta' \in T \setminus \Theta} f_{\theta'}(\theta') d\theta'} & \text{if } \theta \in T \setminus \Theta \text{ and } a = N \\ 0 & \text{otherwise} \end{cases}$$

An equilibrium is a PSE if the incumbent has no incentive to deviate under the credible updating rule. In a PSE, the updating rule has to follow Bayes’ rule whenever possible. Thus, whenever there is no off-equilibrium action in a PBE, the equilibrium is always a PSE. Hence, *any informative equilibrium is a PSE* in our model. Our question is therefore whether each pooling equilibrium is a PSE.

The next result states that when the incumbent is less popular than the challenger in period 1, PSE provides us a unique prediction.

Proposition 5. *Suppose $\int_{\theta} v(\alpha^*, \theta, \omega) f_{\theta}(\theta) d\theta < v(\alpha^*, \theta_0, \omega_0)$. The informative equilibrium is the unique PSE whenever it exists.*

Proof. See appendix. □

To show Proposition 5, we need to prove that the N-pooling cannot be a PSE when

the incumbent is less popular than the challenger. To provide an intuition, suppose that the incumbent has a bad reputation about his budgetary management ability. Then, in the N-pooling equilibrium, when voters observe deviation Y , voters might interpret it as an “attempt to demonstrate his budgetary management ability.” In other words, voters might think that the incumbent that deviates could have a high budgetary management ability. In fact, if the informative equilibrium with cutoff type $\hat{\theta}^*$ exists and voters believe that the deviated incumbent belongs to the set $[\hat{\theta}^*, 1]$, the incumbent has an incentive to deviate only if his type belongs to the set $[\hat{\theta}^*, 1]$. That is, the deviation can credibly signal that his type is higher than $\hat{\theta}^*$.

The next proposition states that when the incumbent is more popular than the challenger, the Y-pooling cannot be a PSE.

Proposition 6. *Suppose $\int_{\theta} v(\alpha^*, \theta, \omega) f_{\theta}(\theta) d\theta > v(\alpha^*, \theta_0, \omega_0)$. Then, any PSE is either the N-pooling equilibrium or the informative equilibrium.*

Proof. See appendix. □

To provide an intuition of the result, suppose the incumbent deviates from the Y-pooling equilibrium. When the incumbent has a good reputation about his budgetary management ability, voters might think that the incumbent has nothing to prove and the purpose of the deviation is to save the cost of the transparency policy. Note that if voters believe that the deviated incumbent can be any type in Θ , all types have an incentive to deviate.

6 Extension: Endogenous timing

In the basic setting, the incumbent has to decide whether to introduce the transparency policy in period 1 as a once-and-for-all decision. This section investigates the robustness of our basic results when the incumbent can choose the timing of introduction of the transparency policy.

To investigate our question, we extend the model as follows: in period 1 the incumbent decides whether to introduce the transparency policy. If he chooses $a_1 = Y$, he credibly commits to his policy and discloses spending s in period 2. On the other hand, if he chooses $a_1 = N$, he waits until he observes spending s in period 2 and chooses either $a_2 = Y$, “disclosure,” or $a_2 = N$, “no disclosure.” As the basic setting, the incumbent loses c in rent-reduction if he discloses s . Formally, the incumbent’s strategy is defined as $\tilde{\sigma} = (\sigma_1(\theta), \sigma_2(\theta, s))$ where

$$\sigma_1 : \Theta \rightarrow \{Y, N\}$$

and

$$\sigma_2 : \Theta \times S \times \{Y, N\} \rightarrow \{Y, N\}$$

such that $\sigma_2(\theta, s, Y) = Y$ for any (θ, s) .¹⁶

Voters observe the incumbent actions (a_1, a_2) and, if the incumbent chooses Y at period 1 or 2, voters also observe spending s . Hence, each voter's strategy is defined as a mapping

$$a : H \times Z \rightarrow \{C, I\}$$

where $H = \{\{Y, Y\}, \{N, Y\}, \{N, N\}\}$ and $Z = S \cup \{\emptyset\}$. The payoff function of each player is the same as the basic setting.

As the basic setting, a pooling equilibrium where all types choose N for both periods always exists. Moreover, if c is sufficiently small, there exists a pooling equilibrium where all types choose Y for both periods. Off-equilibrium beliefs in both pooling equilibria are similar to those of pooling equilibria in the basic setting.

On the other hand, since the incumbent can make a decision based on s , there is another class of strategies which does not depend on θ . A strategy is **spontaneous disclosure** if

$$\sigma_1(\theta) = N \text{ for all } \theta,$$

$$\sigma_2(\theta, s, N) = \begin{cases} Y & \text{if } s > k \\ N & \text{if } s < k \end{cases} \text{ for any } \theta.$$

In this strategy, the incumbent avoids commitment and discloses the spending only if the level of the spending is sufficiently low. Not surprisingly, the following proposition claims that a spontaneous disclosure is an equilibrium strategy whenever the outcome of the election is uncertain at period 1.

Proposition 7. *If $\alpha^* > \max \left\{ \frac{\omega_0 - \omega}{\omega_0 - \omega + 1 - \theta_0}, \frac{\omega - \omega_0}{\omega - \omega_0 + \theta_0} \right\}$, there exists an equilibrium where the incumbent uses a spontaneous disclosure strategy.*

Proof. See appendix. □

Obviously, voters prefer the spontaneous disclosure equilibrium to the N-pooling equilibrium. On the other hand, since the spontaneous disclosure is independent of θ , voters always prefer the Y-pooling equilibrium to the spontaneous disclosure equilibrium.

The next question is whether there is an equilibrium in which the incumbent voluntarily commits to the transparency policy. Let $\tilde{\sigma}_\theta$ be a strategy such that

¹⁶Note that if the incumbent chooses $a_1 = Y$, he credibly commits to $a_2 = Y$.

$$\sigma_1(\theta) = \begin{cases} Y & \text{if } \theta > \hat{\theta} \\ N & \text{if } \theta < \hat{\theta} \end{cases}$$

$$\sigma_2(\theta, s, N) = N \text{ for all } (\theta, s).$$

We call this class of strategies **commitment signaling**.

Proposition 8. *Suppose there exists a cutoff equilibrium with cutoff type $\hat{\theta}$ in the basic setting. Then, commitment signaling $\tilde{\sigma}_{\hat{\theta}}$ is an equilibrium strategy. Moreover, the commitment signaling equilibrium is a PSE.*

Proof. See appendix. □

This is an intuitive result: the incumbent with a high budgetary management skill can credibly signal his ability by committing to the transparency policy before spending s is realized. Note that the cutoff equilibrium with $\hat{\theta}$ in the basic setting and the commitment signaling equilibrium with $\hat{\theta}$ have exactly the same outcome. Thus, the cutoff equilibrium in the basic setting is consistent with an equilibrium in the endogenous timing setting. Moreover, since the commitment signaling always passes a stringent refinement test, i.e. PSE, it can be a reasonable equilibrium prediction.

7 Discussion

It is tempting to impose transparency as a rule, believing it improves welfare. However, our results suggest that rule-based transparency can be optimal only in some circumstances. In fact, when transparency becomes a rule, voters receive the same level of information as in the Y-pooling equilibrium. Instead, when the incumbent enhances transparency voluntarily, voters obtain information not only from the disclosed reports (spending s), but also from the signaling. Since any informative equilibrium, when the challenger is sufficiently more popular than the incumbent, is a PSE, voters may be better off by leaving the choice of the transparency policy to the incumbent. On the other hand, when the incumbent is more popular than the challenger, the N-pooling equilibrium is always a PSE. Then, since the existence of an informative equilibrium is more sensitive to parameters when the incumbent is more popular than the incumbent, voters may be better off by rule-based transparency that guarantees disclosure.

Our model provides relevant insights into politicians' incentives to enhance transparency, but there are some caveats to be taken into account when interpreting the results. We

assume, in fact, that each voter follows a Bayesian reasoning and that she is characterized by a taste parameter α that measures the relative importance of budgetary management ability. Hence, our analysis excludes the cases of naive voters, who do not try to infer the politician's ability from his policy choice, and of partisan voters, who choose a candidate simply based on political party (or ideology). If the proportion of partisan or naive voters is sufficiently large, the office-motivated incumbent may have no incentives to enhance transparency.

In the paper, the incumbent cannot choose the degree of transparency. However, the key insights of our model remain the same even if we allow for this possibility. In fact, we can construct an informative equilibrium with each level of transparency whenever the conditions in proposition 1 and 2 are satisfied. However, such an extension expands the set of equilibria that cannot be refined by the standard refinement tools.

8 Conclusions

The aim of this paper is to analyze how fiscal transparency can endogenously emerge in equilibrium and how it can be a valid signaling device of the incumbent's budgetary management ability contributing to his re-election.

We show that the transparency policy can be an effective signaling device when the majority of voters is sufficiently interested in fiscal issues and the incumbent faces a sufficiently popular challenger.

This paper provides some useful insights into the factors that affect the choice of transparency. We show that a higher "demand" for transparency can increase the probability of adopting the policy, but can reduce the informativeness of the signal. Moreover, a higher rent reduction or a higher degree of political competition, in the form of a more popular challenger, decreases the probability that transparency is enhanced. This might explain the resistance to transparency in societies characterized by high levels of corruption of elected officials, by nepotism, or low level of turnover, especially if those politicians tend to have a low budgetary management ability. Moreover, we show that our results are robust even if the timing of commitment to the transparency policy is endogenous. However, the assumption that the incumbent can fully commit to the announced transparency policy remains crucial.

Even though our model is highly stylized it provides some useful insights on how and when the incumbent has an incentive to enhance transparency as a signaling device.

9 Appendix

This appendix provides the omitted mathematical proofs.

9.1 Proof of Proposition 1

If $\int v(\alpha^*, \theta, \omega) f_\theta(\theta) d\theta < v(\alpha^*, \theta_0, \omega_0)$, then $Q_N(\hat{\theta}; \sigma_{\hat{\theta}}) = 0$ for any $\hat{\theta} \in \Theta$. On the other hand, since $\alpha^* > \frac{\omega_0 - \omega}{\omega_0 - \omega + 1 - \theta_0}$, $\lim_{\hat{\theta} \rightarrow 1} Q_Y(\hat{\theta}; \sigma_{\hat{\theta}}) = 1$ and $\lim_{\hat{\theta} \rightarrow 0} Q_Y(\hat{\theta}; \sigma_{\hat{\theta}}) = F(s_p(\alpha^*, \sigma_p)|0)$. Then, since $Q_Y(\hat{\theta}; \sigma_{\hat{\theta}})$ is continuous and strictly increasing in $\hat{\theta}$, there exists a unique $\hat{\theta}$ such that $F(s(\alpha^*, \sigma_{\hat{\theta}})) - c = 0$ if and only if $F(s_p(\alpha^*, \sigma_p)|0) < c$. By Assumption 1, $Q_Y(\theta; \sigma_{\hat{\theta}^*}) - c - Q_N(\theta; \sigma_{\hat{\theta}^*})$ is strictly increasing in θ given $\sigma_{\hat{\theta}^*}$. Thus, given strategy $\sigma_{\hat{\theta}^*}$, there is no incentive to deviate for any type. Since any informative equilibrium is a cutoff equilibrium, this is the only informative equilibrium. Q.E.D.

9.2 Proof of Proposition 2

“If” part: Observe that if $\int v(\alpha^*, \theta, \omega) f_\theta(\theta) d\theta > v(\alpha^*, \theta_0, \omega_0)$, by construction of $\tilde{\theta}$, $Q_N(\theta, \sigma_{\tilde{\theta}}) = 0$ for any θ whenever $\hat{\theta} < \tilde{\theta}$. On the other hand, $Q_Y(\hat{\theta}, \sigma_{\hat{\theta}})$ is continuous and strictly increasing in $\hat{\theta}$. Hence, if $F(s(\alpha^*, \sigma_p)|0) < c < F(s(\alpha^*, \sigma_{\tilde{\theta}})|\tilde{\theta})$, there exists a unique $\hat{\theta}' < \tilde{\theta}$ such that $Q_Y(\hat{\theta}', \sigma_{\hat{\theta}'}) - c = Q_N(\hat{\theta}', \sigma_{\hat{\theta}'}) = 0$. Then, we claim that the cutoff strategy with $\hat{\theta}'$ is an equilibrium strategy. Note that $Q_Y(\theta, \sigma_{\hat{\theta}'}) - c$ is increasing in θ , while $Q_N(\theta, \sigma_{\hat{\theta}'}) = 0$ for all θ . Hence, $Q_Y(\theta, \sigma_{\hat{\theta}'}) > (<)c$ if $\theta > (<)\hat{\theta}'$, that is, the incumbent has no incentive to deviate.

“Only if” part: Recall that we already showed that the expected payoff from N in any informative equilibrium is 0. Moreover, any informative equilibrium is a cutoff equilibrium. The rest of the proof consists of two steps.

Step 1: There is no cutoff equilibrium if $F(s(\alpha^*, \sigma_p)|0) > c$.

Note that $Q_Y(\hat{\theta}, \sigma_{\hat{\theta}})$ is continuous and strictly increasing in $\hat{\theta}$ and $\lim_{\hat{\theta} \rightarrow 0} Q_Y(\hat{\theta}, \sigma_{\hat{\theta}}) = F(s(\alpha^*, \sigma_p)|0)$. Thus, if $F(s(\alpha^*, \sigma_p)|0) > c$, $Q_Y(\hat{\theta}, \sigma_{\hat{\theta}}) - c > 0$ for any $\hat{\theta}$ and thus there is no cutoff type which satisfies $Q_Y(\hat{\theta}, \sigma_{\hat{\theta}}) - c = 0$. Hence, there is no cutoff equilibrium.

Step 2: There is no cutoff equilibrium if $c > F(s(\alpha^*, \sigma_{\tilde{\theta}})|\tilde{\theta})$.

Since $Q_Y(\hat{\theta}, \sigma_{\hat{\theta}})$ is continuous and strictly increasing in $\hat{\theta}$, there exists a unique cutoff type $\hat{\theta}''$ which solves $F(s(\alpha^*, \sigma_{\hat{\theta}''})|\hat{\theta}'') - c = 0$ and $\hat{\theta}'' > \tilde{\theta}$ if $c > F(s(\alpha^*, \sigma_{\tilde{\theta}})|\tilde{\theta})$. Thus, the cutoff strategy with $\hat{\theta}''$ is the only strategy which satisfies the necessary condition for the informative equilibrium strategy. Then, suppose the cutoff strategy with $\hat{\theta}''$ is the equilibrium strategy. Note that, by construction of $\tilde{\theta}$, $Q_N(\theta, \sigma_{\hat{\theta}''}) = 1$ if $\theta, \hat{\theta}'' > \tilde{\theta}$. Thus, any type $\theta > \hat{\theta}''$ has incentive to deviate from Y , a contradiction. Q.E.D.

9.3 Proof of Observation 5

From observation 1, we know that any informative equilibrium is a cutoff equilibrium. Thus, $P(c, \alpha^*, \omega_0, \theta_0) > P(\tilde{c}, \tilde{\alpha}^*, \tilde{\omega}_0, \tilde{\theta}_0)$ if and only if the equilibrium cutoff type under $(c, \alpha^*, \omega_0, \theta_0)$ is lower than that in $(\tilde{c}, \tilde{\alpha}^*, \tilde{\omega}_0, \tilde{\theta}_0)$.

From Observation 4, the equilibrium cutoff type is always smaller than $\theta(\alpha^*, \theta_0, \omega_0)$. Hence, whenever the incumbent chooses N , the voter knows that $\theta < \theta(\alpha^*, \theta_0, \omega_0)$ and, by construction of $\theta(\alpha^*, \theta_0, \omega_0)$, the payoff from selecting the incumbent is lower than that from selecting the challenger with probability 1. Thus, if the incumbent chooses N , the cutoff type level does not affect the median voter's decision and his payoff.

Note that, by construction of $\theta(\alpha^*, \theta_0, \omega_0)$, the median voter should choose the challenger if the incumbent's type is $\theta \in (\hat{\theta}, \theta(\alpha^*, \theta_0, \omega_0))$, where $\hat{\theta}$ is the cutoff (see section 3.2.1). However, by Observation 4, when the incumbent chooses Y in an informative equilibrium, the probability that the voter chooses the incumbent with $\theta \in (\hat{\theta}, \theta(\alpha^*, \theta_0, \omega_0))$ is positive. We claim that a higher equilibrium cutoff level increases the median voter's expected payoff as long as the cutoff level is lower than $\theta(\alpha^*, \theta_0, \omega_0)$. To see the claim, consider two equilibrium cutoffs $\hat{\theta}', \hat{\theta}$ such that $\hat{\theta}' > \hat{\theta}$. When $a = Y$, the voter knows $\theta \in [\hat{\theta}, 1]$ under $\sigma_{\hat{\theta}}$, while $\theta \in [\hat{\theta}', 1]$ under $\sigma_{\hat{\theta}'}$. Suppose the voter uses the cutoff signal $s(\alpha^*, \sigma_{\hat{\theta}})$ for her voting decision that is optimal under $\sigma_{\hat{\theta}}$, while suboptimal under $\sigma_{\hat{\theta}'}$. Since the probability that $\theta < \theta(\alpha^*, \theta_0, \omega_0)$ is lower under $\sigma_{\hat{\theta}'}$, the probability that the voter chooses the incumbent with $\theta \in (\hat{\theta}, \theta(\alpha^*, \theta_0, \omega_0))$ is also lower under $\sigma_{\hat{\theta}'}$. Then, since the voter can improve his payoff by using the optimal cutoff signal under $\sigma_{\hat{\theta}'}$, his equilibrium expected payoff is higher under $\sigma_{\hat{\theta}'}$.

9.4 Proof of Proposition 3

Note that the median voter's expected payoff from selecting the incumbent conditional on (s, Y) given $\sigma_{\hat{\theta}}$ is

$$\int_{\theta > \hat{\theta}} v(\alpha^*, \theta, \omega) \mu(\theta | Y, s; \sigma_{\hat{\theta}}) d\theta,$$

that is strictly increasing in $\hat{\theta}$. Then, since $\int \theta f_{\theta}(\theta) d\theta > \omega$, if $\tilde{\alpha}^* > \alpha^*$,

$$\int_{\theta > \hat{\theta}} v(\tilde{\alpha}^*, \theta, \omega) \mu(\theta | Y, s; \sigma_{\hat{\theta}}) d\theta > \int_{\theta > \hat{\theta}} v(\alpha^*, \theta, \omega) \mu(\theta | Y, s; \sigma_{\hat{\theta}}) d\theta$$

for any $\hat{\theta}$.

Thus, the optimal cutoff signal given $\sigma_{\hat{\theta}}$ is $s(\alpha^*, \sigma_{\hat{\theta}}) < s(\tilde{\alpha}^*, \sigma_{\hat{\theta}})$. Hence, $F(s(\tilde{\alpha}^*, \sigma_{\hat{\theta}}) | \hat{\theta}) > F(s(\alpha^*, \sigma_{\hat{\theta}}) | \hat{\theta})$ for any $\hat{\theta} \in \Theta$. Thus, $\hat{\theta}$ such that $F(s(\tilde{\alpha}^*, \sigma_{\hat{\theta}}) | \hat{\theta}) = 0$ is always smaller than $\hat{\theta}'$ such that $F(s(\alpha^*, \sigma_{\hat{\theta}'}) | \hat{\theta}') = 0$. Q.E.D.

9.5 Proof of Proposition 4

It is easy to see that the cutoff signal $s(\alpha^*, \sigma_{\hat{\theta}})$ is decreasing in $v(\alpha^*, \theta_0, \omega_0)$. Thus, $Q_Y(\alpha^*, \sigma_{\hat{\theta}})$ is also decreasing in $v(\alpha^*, \theta_0, \omega_0)$ given cutoff strategy $\sigma_{\hat{\theta}}$. Then, since $Q_Y(\alpha^*, \sigma_{\hat{\theta}})$ is strictly increasing in $\hat{\theta}$, the solution of $Q_Y(\alpha^*, \sigma_{\hat{\theta}}) = c$ is higher when $v(\alpha^*, \theta_0, \omega_0)$ is higher. Since $v(\alpha^*, \theta_0, \omega_0)$ is increasing in each θ_0 and ω_0 , higher θ_0 or ω_0 increases the equilibrium cutoff type. An analogous argument holds when c is increased given parameters that determine the value of $Q_Y(\alpha^*, \sigma_{\hat{\theta}})$.

9.6 Proof of Proposition 5

Consider the N-pooling equilibrium. Let $\hat{\theta}^*$ be the cutoff type in an informative equilibrium. We claim that if voters believe that the set of types who could deviate to Y is $[\hat{\theta}^*, 1]$, this is a credible updating rule. Observe that if $\int_{\hat{\theta}^*}^1 v(\alpha^*, \theta, \omega) f_{\theta}(\theta) d\theta < v(\alpha^*, \theta_0, \omega_0)$, the incumbent's payoff in the N-pooling equilibrium is 0. On the other hand, by Observation 2, we know that the expected payoff from N in the cutoff equilibrium is also 0. On the other hand, by the property of the equilibrium cutoff type $\hat{\theta}^*$ and Assumption 1, the expected payoff from Y for $\theta > \hat{\theta}^*$ is guaranteed to be strictly positive. Hence, the incumbent has incentive to choose Y if and only if voters believe that $\theta > \hat{\theta}^*$. That is, the updating rule is credible.

9.7 Proof of Proposition 6

Consider the Y-pooling equilibrium. In this equilibrium, type θ incumbent's expected payoff is $F(s(\alpha, \sigma_p)|\theta) - c$. Suppose that voters believe that the incumbent's type is in Θ when he deviates to N . Then, if $\int v(\alpha^*, \theta, \omega) f_{\theta}(\theta) d\theta > v(\alpha^*, \theta_0, \omega_0)$, the incumbent's expected payoff is strictly higher for all types since the probability of re-election is 1, while there is no cost from N . Then, if $T = \Theta$, it is profitable for all types to deviate. That is, the updating rule with $T = \Theta$ is credible. Since the expected payoff in the N-pooling equilibrium is the highest possible payoff, this is obviously a PSE.

9.8 Proof of Proposition 7

If $\alpha^* > \max \left\{ \frac{\omega_0 - \omega}{\omega_0 - \omega + 1 - \theta_0}, \frac{\omega - \omega_0}{\omega - \omega_0 + \theta_0} \right\}$, then there exists $k^* \in S$ such that $\int v(\alpha^*, \theta, \omega) f(\theta|k^*) d\theta = v(\alpha^*, \theta_0, \omega_0)$. We claim that the spontaneous disclosure strategy with $k = k^*$ is an equilibrium strategy. Given the spontaneous disclosure strategy, the voter's consistent belief conditional on $((N, Y), s)$ is $\mu(\theta|(N, Y), s) = f(\theta|s)$. Then, by construction of k^* , the incumbent with $s > k^*$ always wins the election by playing (Y, Y) . On the other hand, when the incumbent chooses (N, N) , by construction of k^* , he never wins the election, and thus the payoff is 0.

Then, no type has incentive to deviate if the off-equilibrium belief for (Y, Y) has sufficiently large mass over low θ .

9.9 Proof of Proposition 8

For the first part, note that, given the commitment signaling strategy with cutoff type $\hat{\theta}$, the incumbent's expected payoff from $a_1 = Y$ is the same as that from $a = Y$ given cutoff strategy $\hat{\theta}$ in the basic setting. On the other hand, the incumbent's expected payoff from (N, N) is the same as that from $a = N$ given cutoff strategy with $\hat{\theta}$ in the basic setting. Thus, if there exists a cutoff equilibrium with $\hat{\theta}$, the incumbent with $\hat{\theta}$ should find Y and (N, N) indifferent given the commitment signaling strategy with cutoff type $\hat{\theta}$. Then, by Assumption 1, $\theta > \hat{\theta}$ strictly prefers Y to (N, N) and $\theta < \hat{\theta}$ strictly prefers (N, N) to Y . Now we claim that $\theta < \hat{\theta}$ has no incentive to play (N, Y) . This is because by construction of the equilibrium cutoff $\hat{\theta}$, the voter always prefers the challenger to the incumbent whose type is $\hat{\theta}$. Thus, the incumbent's expected payoff from (N, Y) is always $-c$. Note that the incumbent chooses his action based on s and thus there is no uncertainty.

To show the commitment signaling equilibrium is always a PSE. Observe that (N, Y) is the only off-equilibrium actions in the commitment signaling equilibrium. Then, suppose voters believe that the deviated incumbent is in $T \subset [0, 1]$ when the incumbent deviates to (N, Y) and spending is s' . If this is a credible updating rule, his payoff from this deviation should be $1 - c$ since the payoff from this deviation is obviously either 0 or $1 - c$. Then, the incumbent with $\theta \notin T$ with spending s' is strictly better off by deviating to (N, Y) , a contradiction.

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