博士論文

Essays on Political Agency Problems in Dynamic Environments

(動学的環境下における政治的エージェンシー問題に関する研究)

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Chapter 1

Overall Introduction

The people of England regards itself as free; but it is grossly mistaken; it is free only during the election of members of parliament. As soon as they are elected, slavery overtakes it, and it is nothing. The use it makes of the short moments of liberty it enjoys shows indeed that it deserves to lose them.

Jean-Jacques Rousseau[1]

1.1 Backgrounds

1.1.1 Motivation

In representative democracy, voters delegate decisions on policymaking to elected politicians. Ideally, voters appropriately elect politicians, who choose the policy desirable for the electorate based on their expertise. However, politicians are self-interested, and their policy preferences are usually not aligned with those of voters. That is, conflicts of interest exist between politicians and voters, which induce agency problems. Hence, whether the ideal of representative democracy is achievable is not obvious. This is one of the central questions in the political economics literature.

The most seminal study tackling this question is that by Downs (1957). He considers a static environment in which two parties (or equivalently two politicians) compete with each other. Each party simultaneously announces its own platform in a one-dimensional policy space, and voters then decide which one to vote for. Voters' preferences are assumed to be single-peaked. In this simple framework, it is shown that each party commits to the median voter's ideal policy, that is, the representative democracy perfectly reflects the median voter's policy preference. Because direct democracy yields the same outcome (Black 1948), this result indicates that representative democracy reflects voters' opinions. This property is widely known as *the median voter theorem*.[2] Since Downs (1957)'s work, the literature on electoral competition in such a static environment has been developed. Some of the existing studies show the robustness of the median voter theorem, while others show that policy divergence could arise under different settings (see De Donder and Gallego (2017) for a literature review).

[1] Jean-Jacques Rousseau (1923). *The The Social Contract and Discourses,* London and Toronto: J.M. Dent and Sons (translated by G.D. H. Cole). Book III, Chapter XV.

[2] In his original model, each candidate is assumed to be purely office/vote-seeking. The same result basically holds even if politicians are purely policy-motivated so long as there is no uncertainty about the election.

Although this static electoral competition approach gives us rich insights on representative democracy, there is a shortcoming. In this approach, parties and politicians are assumed to commit to policy platforms before an election. Such a binding contract between principals and agents could be reasonable in economic relationships. However, in politics, politicians do not sign a legal contract with voters. That is, the commitment to policy platforms is not necessarily binding.[3] In reality, once elected, politicians sometimes implement harmful policies that were not promised in the election, such as corruption. Hence, we need to understand how representative democracy works when politicians cannot commit to policies. Nonetheless, the static electoral competition models overlook this issue.

The purpose of the present thesis is to fill this gap. To this end, we emphasize the possibility of replacement (equivalently, the possibility of reelection). The real environment in politics is not static rather dynamic. In the dynamic environment where future elections exist, voters can select a good politician by replacing bad politicians through repeated elections. In addition, voters can discipline the incumbent by using the possibility of reelection as an incentive device. Political thinkers have indeed emphasized the role of reelection in the selection and the control of politicians. For instance, James Madison recognizes the role of reelection as an incentive device:

> [T]he House of Representatives is so constituted as to support in the members an habitual recollection of their dependence on the people. Before the sentiments impressed on their minds by the mode of their elevation can be effaced by the exercise of power, they will be compelled to anticipate the moment when their power is to cease, when their exercise of it is to be reviewed, and when they must descend to the level from which they were raised; there forever to remain unless a faithful discharge of their trust shall have established their title to a renewal of it. (*The Federalist 57*)

Empirical studies have also supported the importance of reelection. Alt, de Mesquita, and Rose (2011) find the selection effect by exploiting variation in U.S. gubernatorial term limits across states and time. In addition, Ferraz and Finan (2011) find the discipline effect by analyzing political corruption in Brazilian local governments. They show that the corruption is significantly lower in municipalities where mayors can get reelected, which indicates that the reelection incentives prevent politicians from corruption.[4] Hence, even if politicians cannot fully commit to the future policies, the responsiveness of democracy is partially maintained through the possibility of reelection. As such, the reelection possibility plays a key role in representative democracy without commitment.

The analysis of the reelection possibility, by its nature, requires us to consider a dynamic rather than a static environment in which the following game is repeated: (i) the incumbent politician implements a policy, and (ii) voters then decide whether to reelect the incumbent or elect a challenger. In this environment, each politician chooses the current policy taking the effect on the reelection probability in the future into account, and voters decide whether to reelect the incumbent by forming the expectation about the future performance of the incumbent based on the politician's past performance. By exploring dynamic environments in which

[3] This is also the essence of the citizen candidate models (Osborne and Slivinski 1996; Besley and Coate 1997).

[4] Other empirical studies confirming the effect of reelection incentives include Besley and Case (1995a), List and Sturm (2006), and de Janvry, Finan, and Sadoulet (2012).

the possibility of reelection arises, we analyze how representative democracy works under the non-commitment assumption.

1.1.2 Existing Literature: Electoral Accountability Models

Clearly, the main question of this thesis, the question about the role of the reelection incentives on the performance of representative democracy in dynamic environments, is not my original one at all. Though the history is relatively new compared with the literature on the static electoral competition models, it has been explored in the literature since Barro (1973) and Ferejohn (1986). The models analyzing this issue are called *the electoral accountability models* (see Ashworth (2012) and Duggan and Martinelli (2017) for a literature review).[5] We start with reviewing this strand of the literature through several basic models (the pure moral hazard model, the adverse selection model, the model on negative effects of reputation concerns, and the infinite-horizon model). By tackling several challenges the existing literature has not sufficiently explored yet, this thesis aims to extend our understanding of political agency problems in dynamic environments.

Pure Moral Hazard Model

Our starting point is the following two-period model with a representative voter (hereafter, the voter).[6]

Period 1: The incumbent politician chooses action $x_1 \in \{0,1\}$, in which politicians prefer $x = 1$ to $x = 0$, while the voter prefers $x = 0$ to $x = 1$.[7] The voter then observes the implemented action and decides whether to vote for the incumbent or the challenger.

Period 2: The elected politician chooses action $x_2 \in \{0,1\}$.

Each politician's payoff when in office in period t is given by $-u(|x_t|) + b$, while that when not in office is given by zero.[8] u is an increasing function and $b > 0$. For simplicity, there is no time-discounting. This model is called *the pure moral hazard model* because there is no uncertainty about politicians' types.[9]

In this model, the voter can perfectly discipline the incumbent in period 1. To observe this, let us solve the game in a backward manner. In period 2, the elected politician always chooses $x_2 = 0$ because the period is the end of the world. Given this, the voter is indifferent between electing the incumbent and electing the challenger at the timing of the election. Hence, any voting strategy can be the voter's equilibrium strategy. As an example, consider the *retrospective voting strategy* such that the voter reelects the incumbent if and only if $x_1 = 1$. Given this

[5] See Ashworth (2012) and Pande (2012) for a literature review of empirical studies on electoral accountability.

[6] In static electoral competition models, voters are assumed to be heterogeneous. On the contrary, in dynamic election models, it is often assumed that voters are homogeneous. This is because the focus is not about how to aggregate preferences but how to resolve conflicts of interest between voters and politicians.

[7] Various interpretations are allowed: x is the effort level so that politicians may shirk; x is the corruption level; x is the policy, and politicians' policy preferences are biased.

[8] An alternative is that the payoff when not in office is $-u(x_t)$. The basically same result is obtained under this setting.

[9] This terminology is based on Ashworth (2012). Although we have no information asymmetry regarding the incumbent's action for simplicity, we can easily introduce it. The result does not change much.

strategy, the incumbent in period 1 chooses $x_1 = 1$ if and only if

$$-u(1)+b \geq -u(0) \Leftrightarrow b \geq u(1)-u(0).$$

Hence, so long as the reelection motivation b is sufficiently large, the voter can discipline the incumbent in period 1. The key for this result is whether the incumbent being is reelected depends on the incumbent's performance. If the incumbent chooses the action undesirable for the voter, they cannot be reelected. Hence, for the reelection, the incumbent has an incentive to choose the voter-optimal action.

This first-generation model reveals the possibility that voters discipline politicians by adopting the retrospective voting strategy.[10] Because of its tractability, this type model has been extensively used. In Chapter 4, we introduce a variant of the two-period pure moral hazard model into the model of international trade.

Adverse Selection Model

However, the pure moral hazard model has an important drawback. To observe this, let us remember the key for the aforementioned optimistic result, the voter's retrospective voting strategy. This creates the incumbent's incentive to choose $x_1 = 1$. However, the retrospective voting strategy can be an equilibrium strategy just because any voting strategy is indifferent for the voter. Hence, such strategy becomes non-optimal once we introduce a slight difference between the incumbent and the challenger (Fearon 1999). For example, assume that the incumbent obtains the ability as the policymaker during the first period such that there is an incumbency advantage. That is, the voter obtains an additional utility $v > 0$ when reelecting the incumbent. Under this setting, for any positive v, it is no longer optimal for the voter to follow the retrospective voting strategy. Instead, the voter always reelects the incumbent. Given this, the incumbent chooses the undesirable action $x = 0$ in period 1.

To overcome this disadvantage of the pure moral hazard models, the second-generation models have introduced politicians' types and the information asymmetry about it.[11] They are called *the adverse selection model*.[12] Its workhorse model is developed by Besley (2006).

Here, we present a simplified version of Besley's model. The model is basically the same as the pure moral hazard model except for the information asymmetry regarding the incumbent's type. There are two types of politicians: *the congruent type* and *the non-congruent type*. The congruent type shares the same policy preference as that of the voter and non-strategically chooses the voter-optimal policy. On the contrary, the non-congruent type's payoff is given by

[10]The idea of the retrospective voting goes back to Key (1996). In order to vote retrospectively, voters must know the performance of the politicians. Whether the voters can correctly evaluate the politicians' performance is an empirical issue, and the existing studies reveal a complicated picture (see Healy and Malhotra (2013) for a literature review). Note that theoretically, the ignorance of voters alone may not imply that the retrospective voting does not work. Aytimur and Bruns (2018) show that even if each voter obtains only an imprecise signal about the incumbent's performance, voters can collectively discipline the incumbent because information is successfully aggregated such as in the Condorcet jury theorem.

[11]There is also a strand of the literature in which politicians' type are assumed to be unknown to even the politicians themselves (Persson and Tabellini 2000: Section 4.5). This type models are originally motivated by the career concerns model of Holmström (1999). This setting is natural when politicians' type concerns their competence, while it is not so reasonable when the type concerns politicians' policy preferences.

[12]Since the model has the choice by the incumbent as well as the incumbent's type, this model includes moral hazard as well as adverse selection. Pure adverse selection models, in which a politician's type directly affects voters' payoff, are also examined in the literature (e.g., Besley and Prat 2006).

that in the pure moral hazard model. The prior probability of each politician being the congruent type is denoted by $\pi_0 \in (0,1)$. Note that each politician's type is the private information of the politician.

As in the pure moral hazard model, let us solve the game in a backward manner. In period 2, the congruent type politician chooses $x_2 = 1$, while the non-congruent type chooses $x_2 = 0$. Hence, the voter chooses a politician whose probability of being the congruent type is higher than that of the other politician. Formally, let the probability of the incumbent being the congruent type be conditional on x_1 be $\pi(x_1)$. The voter should reelect the incumbent if $\pi(x_1) > \pi_0$, while the voter should elect the challenger if $\pi(x_1) < \pi_0$. We assume that the voter reelects the incumbent if $\pi(x_1) = \pi_0$.

In this setting, we examine if there is an equilibrium such that the non-congruent type incumbent chooses $x_1 = 1$. Since both types of the incumbent choose $x_1 = 1$ in period 1, $\pi(1) = \pi_0$. As the off-path belief, consider $\pi(0) = 0$.[13] Then, when $b > u(1) - u(0)$, even the non-congruent type politician has an incentive to choose $x_1 = 1$ for reelection.[14] Hence, the voter can discipline the incumbent in period 1. This type of adverse selection model has been extensively used in the literature (e.g., Besley and Case 1995b; Besley and Smart 2007).

One implication of this result is that the retrospective voting can be understood as the prospective voting. In the model, the voting is not retrospective in the sense that the voter tries to select the politician who will perform well in period 2. However, because the bad performance of period 1 serves as a bad signal of the incumbent's type (i.e., the bad future performance of the incumbent), the forward-looking voting coincides with the retrospective voting at least in this model.[15] Indeed, Besley (2006, p.106) highlights that

> One key implication of [the adverse selection model's] approach is that there really is no meaningful distinction between prospective and retrospective voting. It is precisely because there is information content in past actions about future behavior that retrospective voting is rational.

Another implication is that an election creates the selection effect as well as the discipline effect. The moral hazard models indicate that the possibility of reelection enables voters to discipline politicians. This is called the discipline effect. In addition to this, the current model shows the selection effect: elections serve a selection function by screening out low performers. Although we consider the pooling equilibrium in the above for the demonstration, when $b < u(1) - u(0)$ but b does not take a much lower value, we obtain a semi-separating equilibrium in which the non-congruent type mixes policy 0 and policy 1.[16] In this equilibrium, policy 0 is chosen with positive probability, and the voter can exclude some of the

[13] This is natural if a fraction of the non-congruent type has only weak office-seeking motivation and choose policy 0.

[14] Besley (2006) considers the model wherein b is heterogeneous across politicians and follows a continuous distribution. Although we obtain a semi-separating equilibrium in that case, the results do not change much.

[15] Drago, Galbiati, and Sobbrio (2018) analyze the relationship between the crime rate and the incumbent government's electoral performance by exploiting the 2006 Italian collective pardon as a natural experiment. They find that the collective pardon had idiosyncratic effects on the crime rates across municipalities and the incumbent government's electoral performance became worse in municipalities wherein this policy increased the crime rate. Furthermore, this retrospective voting is consistent with the prospective voting because voters in these municipalities held worse beliefs on the incumbent government's ability to control crime.

[16] When b is too small, we have a fully separating equilibrium in which the non-congruent type chooses policy 0. For the details, see the static equilibrium characterization in Chapter 3.

non-congruent type by screening politicians choosing policy 0. The selection effect will be clear in the infinite-horizon models discussed later.[17]

Negative Effect of Reelection Motives

In the adverse selection models, the incumbent politician's reputation π is transformed to the reelection probability. Hence, politicians have reputation concerns stemming from reelection motives. Although such reputation concerns seem to have a positive discipline effect, this is not necessarily the case. In the general context of agency problems, it is known that reputation concerns could induce agents' bad actions (Morris 2001; Ely and Välimäki 2003), and the same is the case for political agency problems.

So far, the congruent type politician has been assumed to have no reputation concerns and to non-strategically choose the voter-optimal policy. However, this may not reflect the reality. Even politicians who have congruent policy preferences are self-interested to some extent and thus have reelection motives. In this case, congruent type politicians may not implement the voter-optimal policy to increase the reelection probability. The literature has revealed that reputation concerns sometimes force congruent politicians to argue for inefficient policies; congruent politicians pander to public opinion and implement bad policies (e.g., Canes-Wrone, Herron and Shotts 2001; Maskin and Tirole 2004; Fox and Shotts 2009; Acemoglu, Egorov, and Sonin 2013; Smart and Sturm 2013).[18]

To observe the idea of the negative effect of reputation concerns, consider the model introduced by Maskin and Tirole (2004). We extend the aforementioned adverse selection model as follows. The voter-optimal policy in period t depends on the state of the world $\omega_t \in \{0,1\}$. Only politicians know the value of ω_t. The congruent type's payoff from policy in period t is $-u(|x_t-\omega_t|)$, while that of the non-congruent type is $-u(|x_t-1|)$ when $\omega_t=0$ and $-u(|x_t|)$ when $\omega_t=1$. That is, the congruent type shares the same policy preference as that of the voter, while the non-congruent type's policy preference is the opposite one. We also assume that a proportion ρ of politicians have only weak office-holding motives (i.e., they non-strategically choose their ideal policy).[19] The existence of these non-strategic politicians allows us to guarantee the uniqueness of the equilibrium. The prior probability of ω_t being one is $p \in (0.5,1]$, and the voter observes only x_1 before the election.

We can then demonstrate that when $b > u(1)-u(0)$, the unique equilibrium is that both types of politicians (except for politicians with weak office-holding motives) choose $x_1 = 1$

[17] Some empirical studies find evidence consistent with the selection effect. For example, Alt, de Mesquita, and Rose (2011) exploit variation in U.S. gubernatorial term limits across states and time. They find that economic growth is higher, and taxes and spending are lower under second-term incumbents than under first-term incumbents, holding term-limits status constant. In the pure moral hazard models, both incumbents are in the last term and they should behave similarly. This indicates that there is a selection through reelection. In addition, using data on U.S. governors, Aruoba, Drazen, and Vlaicu (2019) structurally estimate a career concerns model. They find a significant disciplining effect and a positive but weaker selection effect.

[18] In this thesis, we consider the case in which politicians' policy preferences are private information because our focus is on how to discipline politicians whose policy preferences are not aligned with those of voters. Another source of private information could be politicians' ability (competence). Reputation concerns about their own ability also induce inefficient policies. For example, the literature on political budget cycles has revealed that high ability politicians could inefficiently expand the government budget (e.g., Rogoff 1990). In addition, Daley and Snowberg (2011) also find that high ability politicians could exert too much effort for their campaigns instead of exerting effort for public policies.

[19] Hence, a fraction $\rho\pi$ of politicians always choose the voter-optimal policy, while a fraction $1-\rho$ always choose the opposite of the voter-optimal policy.

irrespective of the voter-optimal policy.[20] That is, pandering to the popular policy arises. When choosing policy 0, which is unlikely to be the voter-optimal one, the voter downwardly updates the probability of the incumbent being the congruent type, and thus the reelection probability becomes low. To avoid this, the congruent type has an incentive to implement policy 1 even if policy 0 is the voter-optimal one.[21]

Although we observed pandering to the policy that voters perceive to be optimal, the opposite can also be the case in different models. In a certain setting, to obtain the high reputation, the congruent type politician implements the policy that is known to be undesirable for voters. Acemoglu, Egorov, and Sonin (2013) show that this phenomenon occurs, and they refer to it as populism because the undesirably extreme policy acquires high popularity.[22] In this equilibrium, the extreme policy chosen by the congruent type serves as a signal of the incumbent being the congruent type. Because of this signaling effect, voters reelect the incumbent who implements the undesirably extreme policy. That is, prospective and retrospective voting sometimes diverge. In Chapter 3, we analyze this phenomenon more in more depth.

One implications of such a bad reputation effect is that incumbency advantage could endogenously arise (Kartik and Van Weelden 2019b). Suppose that politicians are subject to a two-term limit.[23] After reelection, the incumbent politician will not care about their own reputation because there is no reelection opportunity. On the contrary, if elected a new challenger cares a lot about the reputation given the possibility of the reelection. Hence, in the presence of the bad (good) reputation effect, voters prefer the incumbent politician (a new challenger). That is, the bad reputation effect induces incumbency advantage, while the good reputation effect induces incumbency disadvantage.

Infinite-Horizon Model

So far, we have considered two-period models. Although these models are certainly tractable, they may not be realistic due to the existence of a last period. To resolve this problem, we can simply extend the two-period adverse selection model into an infinite-horizon model, which has no last period.[24] The infinite-horizon repeated elections model was pioneered by Duggan (2000).[25] Subsequent works include Banks and Duggan (2008), Bernhard et al. (2009), Bernhard, Câmara, and Squintani (2011), and Câmara and Bernhard (2015).[26]

This class of models is summarized as follows. There are infinite periods $t = 1, 2, \ldots$.

[20] See Proposition A1 in Maskin and Tirole (2004) for the proof.

[21] If voters cannot observe the incumbent's policy choice, this pandering does not occur. In this sense, transparency is not necessarily useful for voters. Prat (2005) introduces a distinction between information on policy consequences and that on actions. Information on policy consequences improves voters' welfare, but that on actions could hurt the welfare due to pandering. Given this result, one may think that rational voters only pay attention to policy consequences to prevent pandering. However, this is not the case: voters rationally allocate most of the attention to politicians' actions and thus pandering cannot be prevented (Trombetta 2018).

[22] Applications of their mechanism include Fox and Stephenson (2015), Matsen, Natvik, and Torvik (2016), Kartik and Van Weelden (2019), and Kasamatsu and Kishishita (2018).

[23] To analyze this situation, we need an infinite-horizon model, which will be discussed later.

[24] Although we focus on adverse selection models, there is also a strand of literature that analyzes repeated elections in which politicians' types are known to voters. Examples include Alesina (1988), Aragonès, Palfrey, and Postlewaite (2007), and Van Weelden (2013).

[25] Banks and Sundaram (1993) also analyze a similar model, but their focus is effort choice by a politician.

[26] Adopting an infinite-horizon model allows us to analyze the effect of term-limits. The works analyzing this issue include Bernhardt, Dubey, and Hughson (2004), Smart and Sturm (2013), Duggan (2017), and Kartik and Van Weelden (2019b).

In each period, there is an incumbent politician and a challenger. Politician i's payoff from policies is given by $-u(|x_t - \beta_i|)$, where $\beta_i \in \mathbb{R}$ is independently drawn from a distribution in which the distribution function G is continuous. In addition, each politician receives $b > 0$ while in office. Once a politician loses an election, they will never come back. The voter's payoff in each period is $-u(|x_t|)$.[27] The voter does not know each politician's value of β and only observes x_t at the end of period t. The discount factor is $\delta \in (0,1)$. Politicians are subject to no term limit.

In this model, there are potentially a lot of equilibria due to the nature of infinite-horizon repeated games (Duggan 2014). In order to analyze the meaningful cases, the literature has focused on the stationary Markov perfect Bayesian equilibrium.[28] This class of equilibria is characterized as follows. The voter reelects the incumbent if and only if $|x_t|$ is lower than or equal to a certain threshold. Politicians are divided into three types: (i) centrists whose policy preferences are close to that of a median voter and who implement their own ideal policy and can be reelected, (ii) moderates who adopt the most extreme policy that allows them to be reelected, and (iii) extremists whose policy preferences are far from that of a median voter and who implement their own ideal policy and cannot be reelected.

In Chapter 2, we employ a variant of this infinite-horizon repeated elections model.

Beyond Politics

The electoral accountability models have four distinctive features compared with other agency models such as wage contract models in organizational economics. The first feature is that the principal cannot give an agent the incentives smoothly depending on the agent's action. What voters, as the principal, can do in the electoral accountability models is make a discrete choice, that is, whether to reelect the incumbent politician. The second feature is that the principal delegates all the decisions to the agents at least ex-ante. In representative democracy, politicians often have the right to choose any policy so long as the policy is compatible with the existing laws. The third feature is that there is a possibility of replacement for agents. In the electoral accountability models, there is a pool of challengers, and the incumbent politician competes with them. The fourth feature is that there is an information asymmetry in that the agent's type is unknown to the principal.

Various principal-agent relationships in non-political situations also exhibit these features. Hence, the electoral accountability models have a potential to contribute to a more broad view of agency problems. In Chapters 2 and 3, we discuss the applications to non-political issues in addition to the analysis of political phenomena.

1.1.3 Remaining Problems

As discussed, the literature of electoral accountability models has been extensively developed over the decades. However, there are still remaining challenges that have not been explored yet. Among them, we discuss the challengers that will be explored by the following chapters

[27] Although we present the model with a representative voter, voter heterogeneity is allowed. Duggan (2000) demonstrates that the median voter becomes the decisive voter in this framework.

[28] In Chapter 2, we utilize the stationarity of equilibria in order to guarantee the rectanguraity, which is the important condition for the dynamic consistency under ambiguity-averse preferences. We cannot do this by using two-period models, because the stationarity is not preserved.

of this thesis.[29]

Ambiguity (Knightian Uncertainty)

In electoral accountability models, voters face information asymmetries with politicians. In particular, voters do not know the policymaker's type. In the existing studies, such uncertainty voters face is described as *risk* – the uncertainty such that the realized state is unknown, but the probability distribution is known. For instance, in the adverse selection model presented in the previous subsection, voters do not know the incumbent's type, but know the prior probability of the incumbent being the congruent type. However, in reality, it is not necessarily the case that voters know the probability distribution. The opportunities for learning the probability distribution are elections, but they are held only once in several years. Thus, the opportunities for learning are limited. Furthermore, voters are rational-ignorant (Downs 1957). That is, voters have only limited incentives to acquire information costly because of free-riding. Due to these reasons, voters face the severely constrained information environment.

Given this nature, it is important to explore the case in which voters face *ambiguity* (*Knightian uncertainty*) – the uncertainty such that even the probability distribution is unknown (Knight 1921).[30] Nonetheless, there are only a limited number of studies analyzing ambiguity in political economics (see Bade (2013) for a literature review).[31] To make matters worse, the existing studies of ambiguity in political economics are not about the electoral accountability models.

Dynamic Interaction between Public Opinions and Policies

As seen before, there is a negative effect of reelection incentives: politicians might implement bad policies in order to pander to the public opinion. This is not the whole story about what is happening in the real politics. In reality, the policies argued by politicians, in turn, change the public opinion through learning by voters. For instance, it is empirically shown that elite polarization induces polarization among the electorate in the United States (Robison and Mullinix 2016). Hence, there is an interaction between the public opinion and policies. In order to understand the long-run dynamics of the public opinion and policies, it is indispensable to take this interaction into account. For example, without this interaction, we might think that voters eventually learn the true state of the world (i.e., the public opinion reaches to the truth) because a lot of information is accumulated over time. However, it is known that learning by other players' actions (i.e., observational learning) could not work well when each player's action depends on the belief about the state of world (e.g., Banerjee 1992; Bikhchandani, Hirshleifer, and Welch 1992).

In spite of the large number of studies analyzing the negative effects of reputation concerns, there exist only few studies exploring this long-run dynamics between the public opinion and policies. For instance, in infinite-horizon repeated elections models, we typically focus on stationary equilibria so that the change of politicians' behaviors across time is out of the scope.

[29] See Duggan and Martinelli (2017, Section 8) for other remaining challenges.

[30] See Gilboa, Postlewaite, and Schmeidler (2008) and Nishimura and Ozaki (2017) for the developments of the decision theory under ambiguity and its applications.

[31] Most of the existing studies in this line, including Chapter 2 of this thesis, analyze the effect of ambiguity-aversion. However, some other studies do not assume such aversion, and instead analyze voters' learning about the distribution itself (e.g., Meirowitz and Tucker 2013; Chen and Suen 2017; Kasamatsu and Kishishita 2019).

Economic Policymaking

One of the objectives of analyzing political phenomena for economists is to understand how economic policies are determined in the political arena. For instance, trade protectionism is often prevailing in the real world. In order to understand the mechanism behind this popularity of the protectionism, it is not enough to analyze the normative implication of trade liberalization and protection. We need to take political process into account.

Reflecting this objective, there are a number of attempts to analyze political process of making economic policies.[32] Many of them adopt either direct democracy settings, static electoral competition models, or models of special interest politics. Compared with the number of these studies, the number of studies analyzing electoral accountability models is relatively small.[33] Although the models other than electoral accountability models provide various insights, the role of reelection motives in making economic policies is also important. For instance, Conconi, Facchini, and Zanardi (2014) empirically show that as the remaining term of the incumbent is shorter, the incumbent is less likely to support trade liberalization bills in congressional votes in the U.S. context. The role of reelection motives in making economic policies should be explored more extensively.

1.2 Overview

By tackling each of the aforementioned three challenges, this thesis aims to extend our understanding of political agency problems in dynamic environments.

In various principal-agent relationships, a principal decides the agent to whom to delegate decisions among multiple agents. In this decision, the principal typically faces the choice between informed experts with uncertain bias and uniformed non-experts with no bias. The typical example is electoral competition wherein both elite and non-elite politicians are running for an election. Having the application to political economics in mind, Chapter 2 investigates under what conditions the principal delegates to experts by focusing on the effect of uncertainty. For this purpose, we construct a infinite-horizon delegation model in which an ambiguity-averse principal chooses the delegated agent among experts and non-experts. Ambiguity-averse preferences are modeled by adopting Choquet/Maximin expected utility theory (Schmeidler 1989; Gilboa and Schmeidler 1989). We then investigate the effect of the uncertainty regarding preference heterogeneity among experts. We show that its effect is different depending on the type of the uncertainty. An increase in risk and in ambiguity work in opposite directions with higher ambiguity rather than risk being a source of the delegation to non-experts. The difference between the effects of risk and ambiguity comes from the possibility of replacement – the nature of the dynamic environment. This analysis sheds new lights on the sources of anti-elitism in politics, which is a key aspect of populism.

Chapter 3 is about populist extremism –another aspect of populism. In academic literature as well as the real politics, it has been pointed out that populism might spread across countries like falling dominoes. The purpose of Chapter 3 is to explore the long-run dynamics of the propagation of populist extremism across countries. For this purpose, we construct a multi-

[32] See Persson and Tabellini (2000) for the analysis of taxation politics.

[33] The literature of political budget/economic cycles is an exception. However, studies in this strand of the literature are about fiscal policies, and thus they do not analyze other economic issues such as trade policies.

country model in which each country's politician sequentially implements a policy. Voters learn the incumbent politician's type as well as the desirable policy by observing foreign policies on top of the domestic one. We first establish a preliminary result that populist extremism as the negative effect of reelection motives arises when the public opinion is sufficiently radical. This is a simple extension of the result by Acemoglu, Egorov, and Sonin (2013). We then show that populist extremism is contagious across countries through the novel mechanism: the interaction between the public opinion and implemented policies. This structure yields novel long-run dynamics. First, a single moderate policy could be always enough to stop the domino effect. Second, the persistence of the domino effect depends on the correlation of the desirable policy across countries. In particular, while extremism eventually ends under the perfect correlation, either the convergence towards extremism or cycles of extremism hold when the state of the world follows a Markov process without absorbing states. These results indicate the importance to take into account agency problems when we analyze policy diffusion across countries.

Chapter 4 is devoted to the analysis of the political economy of economic policies (especially trade policies) in the framework of an electoral accountability model.[34] Labor immobility (high adjustment cost) has been regarded as a major obstacle to trade liberalization, and it has been argued that higher labor mobility promotes trade liberalization. Indeed, we straightforwardly obtain this monotonic relationship so long as the median voter theorem holds. However, this is not the case when we take into account conflicts of interests between politicians and voters that are inevitable in representative democracy. To show this, we construct a simple two-period model including both elections and sectoral adjustment, where sectoral adjustment is described by using Blanchard and Willmann (2011)'s model. We then show the non-monotonic relationship between labor mobility and the equilibrium degree of trade liberalization. Higher labor mobility prevents trade liberalization in some cases. This is because the degree of labor mobility endogenously changes whether the partial trade liberalization by the incumbent prevents the reelection. The result highlights the importance to take into account politicians' reelection motives and the associated dynamic structure in the analysis of politics on trade liberalization.

[34] As the survey of the literature of the political economy of trade policies, see Rodrik (1995) for the theoretical literature and Gawande and Krishna (2003) for the empirical literature.

Chapter 2

(Not) Delegating Decisions to Experts: The Effect of Uncertainty*

2.1 Introduction

In various principal-agent relationships, a principal decides the agent to whom to delegate decisions among multiple agents. In this decision, the agents are often not homogeneous. In particular, the principal typically faces the choice between the two types of agents with different multidimensional characteristics as seen in the following examples.

The first example is electoral competition. Suppose that both elite and non-elite politicians are running for an election. Elites are experts of politics, but their preferences might not be aligned with voters. On the contrary, non-elites lack knowledge, but instead their preferences are aligned. Facing this trade-off, voters elect the policymaker. This is the relevant decision problem given ant-elitism sentiments that are widespread in today's political landscape.

Another one is a multinational firm's decision. As the manager of a foreign subsidiary, the headquarter of the firm has two options: internally promoting an employee of the local subsidiary or sending a staff of the headquarter. Local employees are familiar with the local market condition, but they might not take into account coordination with other divisions of the firm, which creates misalignment of interests.[2] On the contrary, staffs of the headquarter might be unfamiliar with the local market environments, but instead they seek the globally optimal policy. Facing this trade-off, the firm chooses the manager.

These examples have two common structures. First, the principal faces the trade-off between informed experts with uncertain bias and uninformed non-experts with no bias. The

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[2] In multidivisional organizations, coordination across divisions as well as adapting to local conditions in each division are important (Alonso, Dessein, and Matouschek 2008). Even if external experts are familiar with local conditions, they might not implement the firm-optimal policy because they do not take coordination into account. Note that for such division-level decision-making, incentive design based on monetary transfers are often not applicable, and thus the problem can be regarded as a delegation problem.

principal lacks the information about the state of the world on which the optimal policy depends. Experts are informed so that this problem is resolved by delegating to the experts. However, delegating to the experts creates another uncertainty: the principal faces the uncertainty about how misaligned each expert's interest is. On the contrary, there is no preference misalignment with non-experts, but instead the non-experts might not be able to observe the state of the world. The principal faces the trade-off between these two agents. Second, the relationship between the principal and agents is dynamic. In both cases, the principal can replace the delegatee by a new one if the agent's performance is bad. This dynamic nature of the delegation can limit or magnify the advantages and disadvantages of experts and non-experts.

Motivated from these two features of delegation, the present study aims to analyze the principal's decision about whether to delegate to experts or not in a dynamic environment wherein the agent can be replaced by another one. To this end, we develop a dynamic delegation model in which agents are divided into experts and non-experts. The principal does not know the own optimal policy because of imperfect information on a state of the world. The degree of bias of an expert's policy preference is drawn from a distribution, and its value is unobservable to the principal. In other words, the principal faces uncertainty about an expert's degree of bias. The principal chooses the policymaker among the experts and non-experts in each period.

In this environment, we explore the effect of uncertainty about preference misalignment, because it is one of the key determinants of the principal's decision. The concern about the preference misalignment with experts pushes the principal toward choosing a non-expert. One potential source that increases such concern is the uncertainty about experts' biases because the principal does not prefer uncertainty. To examine this possibility, we derive the condition for which the principal delegates to experts and analyze the effect of the uncertainty on the parameter region in which this condition holds.

The distinction between two types of the uncertainty is important. The first type is the uncertainty about each individual expert's preference, which is called *risk*. This uncertainty increases when the distribution of biases changes from one to another in the sense of a mean-preserving spread. The second type is the uncertainty about the group of experts. In reality, the distribution of experts' biases itself is unknown, creating *ambiguity* (*Knightian uncertainty*).[3] That said, there is uncertainty about the group of experts itself in addition to that about an individual expert's bias. We analyze both types by employing Choquet expected utility with a convex capacity (Schmeidler 1989) (a variant of Maxmin expected utility [Gilboa and Schmeidler 1989]), meaning that the principal has a set of priors about an expert's degree of bias and maximizes the worst payoff.

We show that the effect of uncertainty differs depending on which type of the uncertainty is involved. When the principal has less confidence about the distribution itself (i.e., ambiguity increases),[4] the principal is more likely to stop delegating to experts. In contrast, when the variance in the distribution increases (i.e., risk increases), the opposite is the case so long as the reward and punishment mechanism to incentivize agents (i.e., the agents' office-seeking

[3] Knight (1921) emphasizes the distinction between risk wherein the probability distribution itself is known and (Knightian) uncertainty wherein even the probability distribution is unknown. Ellsberg's (1961) paradox also shows the importance of this distinction.

[4] An increase in ambiguity is defined by the expansion of the core of a convex capacity. Though this includes an increase in uncertainty aversion as well as ambiguity itself, the separation of these two cannot be done in the framework of Choquet/Maxmin expected utility.

motivation) is limited.[5] This result indicates that a significant source of anti-expert attitudes is that the group of experts as a whole becomes more uncertain rather than predicting each individual expert's bias becoming more difficult.

In order to to avoid uncertainty, the principal seems to be reluctant to choose an expert under both types of high uncertainty. In a static model, this is the case. However, in the dynamic model, this is not the case. In the dynamic environment, the principal can replace the incumbent who had the bad performance, and thus the loss due to choosing a highly expert is limited. This nature creates the difference between risk and ambiguity: an increase in ambiguity rather than risk is a significant source of the delegation to non-experts.

In detail, higher risk increases both the probabilities that an expert is not biased and that an expert is highly biased. The former is the benefit for the principal, while the latter is the loss. Since the possibility of replacement limits the loss from choosing a highly expert, the benefit dominates the loss, meaning that higher risk increases the payoff when choosing a new expert. Consequently, the standard for reelecting the incumbent expert becomes stricter because the challenger is more valuable. Hence, experts become disciplined well so that the principal becomes more likely to delegate to an expert.

In contrast, this mechanism no longer works in the case of ambiguity. The principal's expected payoff when choosing a new expert is evaluated by using the prior that assigns the largest value to the probability that the degree of bias is quite high. As ambiguity increases, the set of candidates of the true distribution enlarges. As a result, the principal evaluates the payoff based on the prior that assigns a larger value to the probability that the degree of bias is quite high.[6] Hence, higher ambiguity reduces the principal's payoff when choosing a new expert, implying that the standard for reelecting the incumbent expert becomes more loose. Consequently, experts become less disciplined so that the principal becomes reluctant to delegate to experts.

These results provide the implications for the sources of populism, which is widespread in today's political landscape. One of the key of populism is anti-elitism: it often arises as protest against politics by elites.[7] Hence, populism can be regarded as a situation where voters stop delegating decisions to political elites (i.e., experts). Indeed, it has been pointed out that populism is related to direct democracy (Mudde and Kaltwasser 2013). Although the presented model is abstract, it captures this aspect of populism and provides the implication about the effect of uncertainty.

Since voters dislike uncertainty, uncertainty about elite politicians seems to increase the concern for the preference misalignment, inducing populism. The results indicate that this conclusion depends on the type of the uncertainty: larger preference heterogeneity among elite politicians does not induce populism, whereas more uncertainty about the heterogeneity

[5] Focusing on such a situation is meaningful because the principal stops delegating to experts only when controlling the experts is difficult.

[6] Here, the probability that the degree of bias is low does not increase in contrast to the case of risk. Thus, the mechanism that the principal prefers more uncertainty thanks to the possibility of replacement does not work.

[7] The aspect we focus on is based on the following definition of populism well-known in the field of political theory:

> I define populism as an ideology that considers society to be ultimately separated into two homogeneous and antagonistic groups, "the pure people" versus "the corrupt elite", and which argues that politics should be an expression of the volonté générale (general will) of the people. (Mudde 2004: 543)

of preferences itself (i.e., deep uncertainty) creates populism. In reality, voters would have abundant probabilistic knowledge about elites' degrees of bias over a traditional policy issue because there have been many learning opportunities. In contrast, such knowledge is limited regarding a new policy issue. This observation leads to the implication that the emergence of a new policy issue, something often concurrent with significant changes in society can be a source of populism.[8]

2.2 Related Literature

Delegation in a dynamic environment: In the literature, the optimal delegation problem (the delegation problem in which the principal commits to a set of decisions from which the agent chooses the action) has been extensively analyzed (e.g., Alonso and Matouschek 2008).[9] However, the dynamic delegation problems in which the delegated agent can be replaced have not been explored enough.[10] One of the exceptions is de Clippel et al. (2019), who analyze the efficient equilibrium when the principal assigns one of the two agents to a task in each period.[11] In the model, whether each agent is suitable to the task changes over time and this information is unobservable to the principal. Due to the difference in the focus, there is no distinction between experts and non-experts and they do not provide any analysis about the effect of uncertainty. In addition, there are several papers analyzing the effect of experts' preference heterogeneity on the performance of delegation to experts, and some of them show that its increase could be beneficial (e.g., Li and Suen 2004; Chan et al. 2017). However, those studies analyze neither dynamic delegation nor ambiguity.

In the context of elections, the dynamic delegation problem with replacement has been analyzed (see Duggan and Martinelli (2017) for a literature review). Duggan (2000) develops an infinite horizon repeated elections wherein candidates' policy preferences are unobservable, and voters decide whether to replace the incumbent with a new candidate whose policy preference is drawn from a distribution.[12] Subsequent studies include Banks and Duggan (2008), Bernhard et al. (2009), Bernhard, Câmara and Squintani (2011), and Câmara and Bernhard (2015). Though the framework of the present study is motivated by this literature of repeated elections, there is neither choice to stop delegating to experts nor comparative statics with respect to the extent of uncertainty in the existing studies.[13]

The contribution of the present study is to explore whether the principal delegates to experts and uncover the effect of uncertainty in the dynamic environment where the agent can be

[8] Another implication is about the party influence on politicians' preferences and activities. The recent political polarization among politicians in the U.S. partly comes from the increased party pressure (Barber and McCarty 2015), because strong party discipline lowers elite politicians' preference heterogeneity among the same party. The present result indicates that such strong party unity could encourage populism.

[9] Frankel (2014) analyzes the optimal delegation in the presence of ambiguity on the agent's preference, though his model has no dynamics.

[10] Alonso and Matouschek (2007) analyze a dynamic delegation problem so called relational delegation, but there is no possibility of replacement.

[11] The pool of agents consists of only two persons, who are common throughout the entire periods, and thus new agents never come into the pool.

[12] Banks and Sundaram (1993) also analyze a similar situation, but their focus is effort choice by a politician.

[13] Câmara and Bernhard (2015) analyze a change in the distribution of policy preferences. However, they consider the effect of a decrease in polarization (i.e., the first-order stochastic dominance) as opposed to an increase in uncertainty.

replaced by a flesh alternative agent drawn from a distribution.

Optimal stopping problem under ambiguity: The principal's optimization problem is finally reduced to a variant of optimal stopping problems. Thus, the present study is related to studies of optimal stopping problems under ambiguity. Nishimura and Ozaki (2004) analyze a one-sided labor search model, and show that the effect of an increase in ambiguity is different from that of an increase in risk in the model. Several studies have since derived a similar result in a different or general setting (e.g., Nishimura and Ozaki 2007; Miao and Wang 2011).[14] We employ Choquet expected utility as Nishimura and Ozaki (2004) do, and follow several of the assumptions introduced by them.

The novelty of the present study is to analyze a dynamic game with information asymmetry.[15] The difficulty in the dynamic analysis under ambiguity is the dynamic inconsistency problem. One tractable approach to guarantee dynamic consistency in a one-person decision-making problem is to assume an independent and indistinguishable distribution, as proposed by Epstein and Schneider (2003b).[16] Because information is completely uncovered under this assumption, rectangularity holds, and dynamic consistency is thus ensured (e.g., Nishimura and Ozaki 2004; 2007; Miao and Wang 2011). However, even under this assumption, rectangularity may fail in a dynamic incomplete information game because belief updating depends on players' strategies. Nonetheless, we succeed in solving a dynamic incomplete information game in a tractable manner by focusing on stationary equilibria.[17]

Formal model of populism: One of the prominent applications is the analysis of populism. In addition to showing the effect of uncertainty, the present study contributes to the literature of populism by providing a framework for the analysis of anti-elitism.[18] The pioneering studies of populism analyze the aspects of populism as pandering and extremism (e.g., Frisell 2009; Jennings 2011; Binswanger and Prufer 2012; Acemoglu, Egorov, and Sonin 2013). Though their studies certainly reveal some relevant features of populism, they do not sufficiently capture the aspect of anti-elitism. In contrast, by introducing the trade-off between elites and non-elites and the dynamic environment,[19] We succeed in analyzing the aspect of anti-elitism in a profound manner.[20]

[14]Riedel (2009) analyzes the optimal stopping problem under ambiguity with discrete time generally.

[15]There is also a technical difference with regard to a typical optimal stopping problem. In the present study, the principal chooses an action among three alternatives in each period, and nothing is irreversible, while there are only two alternatives for the action, and an irreversible choice exists in a typical optimal stopping problem.

[16]Another approach is to employ a complicated updating rule under which dynamic consistency holds.

[17]Boyarchenko and Levendorskiĭ (2012) analyze a game-theoretic situation (a preemption game). However, their game lacks information asymmetry. In such a setting, the belief is only based on the exogenous stochastic process. In this sense, their model is close to a one-person decision making problem in terms of belief formation.

[18]The number of studies analyzing ambiguity in political economics is relatively small (Berliant and Konishi 2005; Ghirardato and Katz 2006; Davidovitch and Ben-Haim 2010; Bade 2011; 2016; Baumann and Svec 2016; Ellis 2016; Yang 2016; Nakada, Nitzan, and Ui 2017). Furthermore, the existing studies consider not dynamic but static environments.

[19]Voters could control conflicts of interests with elites the source of anti-elitism by using a dynamic structure. Thus, the analysis of a dynamic environment is important to understand the aspect of anti-elitism.

[20]One exception analyzing anti-elitism is the study by Buisseret and Van Weelden (2018), which show that when party polarization is severe, parties are vulnerable to the entry of outsiders (non-elites) to in primary elections.

2.3 The Model

2.3.1 Setting

The model has an infinite horizon: $t = 0, 1, \ldots$. There are a principal and agents. Each player has a policy preference on $\mathbb{R}$. In period t, the principal chooses the policymaker. After that, chosen policymaker chooses policy x_t. This sequential game is infinitely repeated.

Principal

Let the principal's ideal policy in period t be $\hat{x}_t$. The desirable policy varies depending on the external circumstances. Thus, $\hat{x}_t$ is a stochastic variable that differs over time. It is independently drawn from a probability distribution F whose density function is f. f is assumed to be symmetric around zero: $f(a) = f(-a)$ for any $a \in [0, \infty)$. The value of $\hat{x}_t$ is unknown to the principal, whereas F is known.

The principal's payoff in each period is a linear loss function: $-|x_t - \hat{x}_t|$. In other words, the principal is risk-neutral with respect to uncertainty about the value of $|x_t - \hat{x}_t|$.[21] Section 2.7 discusses risk-aversion.

Agents

There are two types of agents in each period: an expert and a non-expert. The expert observes the value of $\hat{x}_t$ perfectly after chosen as the policymaker. In this sense, s/he has the ability to act for the principal. However, his/her policy preference is different from that of the principal.

Each expert's policy preference is biased compared with that of the principal: the ideal policy is given by $\hat{x}_t + \beta$, where $\beta \in [0, \bar{\beta}]$. Here, $\bar{\beta} > 0$ and the value of β differs across experts. When an expert is chosen as the policymaker in period t, her/his payoff is given by $-|x_t - (\hat{x}_t + \beta)| + \rho$. The first term is the payoff due to the policy mismatch in period t is $-|x_t - (\hat{x}_t + \beta)|$. In addition, when serving as the policymaker, the agent receives the office-seeking benefit $\rho \in (0, \infty)$. On the contrary, when an expert does not serve as the policymaker, her/his payoff is zero.[22]

Next, each non-expert can observe the value of $\hat{x}_t$ with probability $\phi \in [0, 1)$ after being elected.[23] Note that this is independent of the value of $\hat{x}_t$. Thus, non-experts have only limited ability. Let $\hat{x}_t^o \in (-\infty, \infty) \cup \emptyset$ be the observed value of $\hat{x}_t$. $\hat{x}_t^o = \emptyset$ represents that the non-expert policymaker cannot observe $\hat{x}_t$, and $\hat{x}_t^o \in (-\infty, \infty)$ represents that s/he observes that $\hat{x}_t = \hat{x}_t^o$. The advantage of non-experts is literally the unbiasedness of the policy preference. The payoff due to the policy mismatch in period t is the same as that of the principal: $-|x_t - \hat{x}_t|$. When

[21] In the literature of dynamic elections models, Bernhardt, Dubey, and Hughson (2004) adopt the linear loss function.

[22] The zero payoff during not in the office has been often used. Examples in the studies of dynamic elections models include Smart and Sturm (2011).

[23] The non-expert's ability of finding the state of the world $\hat{x}_t$ is assumed to be lower than that of an expert. An alternative setting is that the ability for policy implementation is different. Both experts and non-experts observe $\hat{x}_t$. However, to achieve the policy goal, the policymaker must choose the details of policies appropriately. In particular, suppose that non-experts have limited knowledge so that they know how to implement policy x only with probability ϕ, while experts know how to implement it. Then, the same result is obtained though Lemma 2.1 slightly changes.

serving as the policymaker, a non-expert receives $-|x_t - \hat{x}_t| + \rho$, while her/his payoff is zero when not serving as the policymaker.

Lastly, the agent who was forced to quit the job as the policymaker will never stand again as a candidate of the policymaker.

Information Asymmetries and Principal's Decision

At the beginning of period t, there are three (two) agents when $t \geq 1$ ($t = 0$): (i) the incumbent policymaker who was chosen as the policymaker in period $t-1$, and (ii) the challengers consisting of a new expert and a new non-expert (when $t = 0$, the incumbent does not exist). The principal chooses one of them as the policymaker in each period. For simplicity, we assume that the principal does not choose a non-expert if the payoff when choosing the non-expert and that when choosing an expert are the same.

The principal can distinguish between experts and non-experts. However, the principal is uncertain of experts' degrees of bias. This is the first information asymmetry (*hidden information*). In addition, the principal cannot observe the implemented policy x_t and the desirable policy $\hat{x}_t$. As a result, the principal cannot observe the implemented policy mismatch $|x_t - \hat{x}_t|$ in principle. This is the second information asymmetry (*hidden action*).

These information asymmetries are resolved through monitoring. The principal observes the implemented policy mismatch $|x_t - \hat{x}_t|$ with probability $q \in (\underline{q}, \bar{q})$, where $0 < \underline{q} < \bar{q} \leq 1$, at the end of each period. Whether monitoring is successful is observable to agents as well as the principal.

Timing

To consider a situation where the implemented policy mismatch is unobservable with some probability, the principal's payoff due to the policy mismatch should not be realized in each period. To this end, suppose that the game ends at the end of each period independently with probability $1 - \delta$, where $\delta \in (0, 1)$. When the game ends, the principal's payoff is realized. The innate discount rate is zero, and thus the discount factor is δ.

The timing of each stage game is as follows:

1. Nature draws the value of β of a new expert from a distribution.

2. The principal chooses one of the candidates.

3. Nature draws the value of $\hat{x}_t$ from distribution F. Then, the policymaker observes $\hat{x}_t$ with probability one if s/he is an expert, and with probability ϕ if s/he is a non-expert.

4. The policymaker chooses policy x_t.

5. The principal observes $|x_t - \hat{x}_t|$ with probability q.

2.3.2 Ambiguity about Agents' Types

The principal does not know each expert's degree of bias. We allow a situation in which even the distribution of β is unknown. Let $(B, \mathscr{F}_B)$ be a measurable space, where $B = [0, \bar{\beta}]$, and $\mathscr{F}_B$ is the Borel $\sigma-$algebra on B. Each element $\beta \in B$ represents the degree of bias of an expert.

For any $t \geq 0$, we construct the t-dimensional product measurable space $(B^t, \mathscr{F}_B{}^t)$ (let $\mathscr{F}_B{}^0 \equiv \{\emptyset, B^\infty\}$) and embed it into the infinite-dimensional product measurable space $(B^\infty, \mathscr{F}_B^\infty)$. We analyze both risk and ambiguity in a unified manner by adopting the Maxmin/Choquet expected utility.

Beliefs

We need to consider two types of the principal's beliefs: (i) belief about the degree of bias of a new expert, and (ii) belief about the degree of bias of the incumbent expert. They are described by capacities, which are reduced to probabilities when they are additive.

The belief formation is based on history. At the end of period t, the principal observes $s_t \in S_t = D_t \times A_t$. First, $D_t \equiv \{[0,\infty), \emptyset\}$ with its generic element d_t represents information about the implemented policy mismatch in period t. $d_t = d \in [0,\infty)$ means that the principal finds out that $|x_t - \hat{x}_t| = d$. Further, $d_t = \emptyset$ means that the principal does not find out the value of $|x_t - \hat{x}_t|$. Second, $A_t = \{0, e, n\}$ when $t \geq 1$, and $A_0 = \{e, n\}$. This represents the principal's decision in period t: 0 represents reelecting the incumbent, e represents choosing a new expert, and n represents choosing a new non-expert. The history, which has been observed by the principal until the beginning of period $t \geq 1$, is $s^{t-1} = (s_0, s_1, ..., s_{t-1}) \in S^{t-1} \equiv \Pi_{\tau=0}^{\tau=t-1} S_\tau$. The null history S^{-1} is set to be $\{\emptyset\}$.

Consider (i). Let $\theta_t : S^{t-1} \times \mathscr{F}_B \to [0,1]$, and call this a capacity kernel.[24] For any $A \in \mathscr{F}_B$, $\theta_{t,s^{t-1}}(A)$ represents a capacity that the degree of bias of a new expert in period t is in A, given history s^{t-1}. This construction allows the principal to update θ_0 based on the past history. We assume that $\theta_{t,s^{t-1}} = \theta$ for all t and s^{t-1}. The interpretation in the case of risk is simply that β follows an independent and identical distribution over time. When θ_0 is non-additive (i.e., in the case of ambiguity), the interpretation is that β follows an independent and indistinguishable distribution over time (Epstein and Schneider 2003b).[25] This time-homogeneous capacity has been widely used (e.g., Epstein and Wang 1994; 1995; Nishimura and Ozaki 2004; 2007; Miao and Wang 2011).

Next, consider (ii). Although the focus is the incumbent expert, we consider the belief about the incumbent, which includes the case where the incumbent is a non-expert as well as the case where the incumbent is an expert, since it simplifies the notation. Denote its capacity kernel by $\theta_t' : S^{t-1} \times \mathscr{F}_B \to [0,1]$ for any $t \geq 1$. This is updated based on the Naive Bayes rule.[26]

θ is assumed to be convex, continuous, and full-support on $[0, \bar{\beta}]$. Continuity guarantees the Fubini property.[27] In addition, all the probability distribution functions in core(θ) are

[24] Although the concept of a kernel is usually used to describe a Markov process, here we call the above a capacity kernel.

[25] Suppose that the data-generating mechanism is independent and identical. When the principal knows the distribution, s/he does not update her/his belief since there is nothing left to learn. By contrast, when the principal does not know the distribution, the principal updates her/his belief. However, there could be a situation in which the capacity is independent of t and s^{t-1}. This is the independent and indistinguishable distribution wherein the principal thinks that the data-generating process differs over time, but s/he does not understand how it differs, and thus there is no learning. This concept is proposed in the framework of Maxmin expected utility. However, since the iterated Choquet expceted utility is equivalent to the iterated Maxmin expected utility, it is applicable to the current framework.

[26] The Naive Bayes rule is $\theta(A|B) = \frac{\theta(A \cap B)}{\theta(B)}$ for any $A, B \in \mathscr{F}_B$. Other rules are possible so long as the belief specified later is obtained.

[27] See Nishimura and Ozaki (2004). Without continuity, this property does not necessarily hold. The mathe-

assumed to be continuous.[28] Note that a probability charge in the core of a continuous capacity is countably additive and hence a probability measure. See Appendix A.1 for the details about these assumptions.

Payoffs and Equilibrium Concept

Define the principal's payoff by the iterated (i.e., recursive) Maxmin payoff whose set of priors in each period is equivalent to the core of the aforementioned capacity in each period. Thus, the principal's payoff is the iterated Choquet expected payoff based on the aforementioned capacity kernel. This equivalence comes from the following relationship: let u be bounded and measurable, and v be a convex and continuous capacity. Then

$$\int u(\beta)dv = \min\left\{\int u(\beta)dG \middle| G \in \text{core}(v)\right\}.^{29} \tag{2.1}$$

Note that the integral in the left-hand side is Choquet integral. Choquet expected utility with a convex capacity is equivalent to Maxmin expected utility whose set of priors is the core of the capacity. Here, a situation is reduced to decision making under risk when the capacity is additive (or equivalently when its core is a singleton). That is, this payoff allows us to analyze both risk and ambiguity in a unified manner.

For the equilibrium concept, we use the following one, which is reduced to the perfect Bayesian equilibrium in the case of risk. We restrict our attention to pure strategies.

Definition 2.1. *The strategies and the belief system $(\theta, \{\theta'_t\}_{t=1}^{\infty})$ constitute an equilibrium if (i) the strategies are sequentially rational for any $t \geq 0$, and (ii) the belief system is consistent with the strategies in the sense that the belief is updated based on the Naive Bayes rule so long as it is possible.*

Under ambiguity, a possibility of dynamic inconsistency exists.[30] That is, the recursive/iterated Maxmin payoff from period t is not necessarily equivalent to the non-iterated Maxmin payoff evaluated by using only the core of the capacity in period t: the law of iterated expectation might not hold. To put it differently, when the latter payoff is employed, dynamic inconsistency can arise. However, in the candidates of equilibrium on which we focus, dynamic consistency trivially holds.[31] See Appendix A.2 for the details.

matical advantage to adopt the Choquet expected utility is that this property can be directly ensured by simply assuming that the capacity is continuous. While the Maxmin expected utility is more general than the Choquet expected utility with a convex capacity, in the former framework, complicated discussions are necessarily (Epstein and Wang 1995). From this technical reason, we consider the Choquet expected utility with a convex capacity.

[28]Under this assumption, the existence of a solution to the Bellman equation is easily ensured (Lemma A.3). Although it may be possible to guarantee the existence without continuity, we employ this assumption since the complicated technical issues are outside of the scope of this study.

[29]The minimum is attained since u is assumed to be bounded and measurable, and also core(θ) is weak* compact by the Alaoglu theorem. For the ease of notation, G represents not only a probability measure itself but also its probability distribution function in the following sections.

[30]In general, the appropriate equilibrium concept is more complicated since the complicated updating rule that guarantees dynamic consistency should be used (see Hanany, Klibanoff, and Mukerji 2016).

[31]The condition under which the payoff evaluated by using the initial capacity is equivalent to the payoff calculated recursively is still unclear (see Yoo (1991) and Dominiak (2013)) although that in the framework of Maxmin expected utility is provided by Epstein and Schneider (2003a). The verification above is based on the framework of Maxmin expected utility theory. For this reason, Maxmin expected utility is initially employed to define the principal's payoff.

2.4 Equilibrium

2.4.1 Equilibrium Refinement

Information asymmetries and the repeated game structure complicate the analysis. To avoid such complications, the literature of repeated elections has focused on symmetric Markovian stationary equilibrium (Duggan 2000; Banks and Duggan 2008; Bernhard et al. 2009; Bernhard, Câmera and Squintani 2011; Câmera and Bernhard 2015).[32] We adopt this equilibrium refinement, although the details are different from that of the existing studies. This delivers a tractable representation of the equilibrium that highlights the trade-off between experts and non-experts in a dynamic setting.

To begin with, define $\tau^*(t)$ as follows. Let $\underline{\tau}(t)$ be the period when the incumbent at the beginning of period $t \geq 1$ was chosen as the policymaker for the first time. when $t \geq 1$

$$\tau^*(t) \equiv \begin{cases} \emptyset & ((\forall \tau \in \{\underline{\tau}(t), ..., t-1\}) \ \ d_\tau = \emptyset.) \\ \max\{\tau \in \{\underline{\tau}(t), ..., t-1\} | d_\tau \neq \emptyset\} & (\text{otherwise}) \end{cases},$$

and when $t = 0$, $\tau^*(t) \equiv \emptyset$. Here, $\tau^*(t)$ is the latest period such that the policy mismatch, implemented by the incumbent in period t, was observed. $\tau^*(t) = \emptyset$ represents that the principal has never observed the policy mismatch implemented by the incumbent. Thus, $d_{\tau^*(t)}$ is the policy mismatch observed in period $\tau^*(t)$, namely the latest observed policy mismatch implemented by the incumbent. Note that when $\tau^*(t) = \emptyset$, $d_{\tau^*(t)}$ is set to be $\emptyset$ without notational abuse.

By using these notations, We introduce the Markovian stationary equilibrium with a reasonable belief restriction. Throughout the analysis, we focus on this class of equilibria.

Definition 2.2. *The equilibrium is called a Markovian stationary equilibrium if the following three conditions hold:*

(I) (Principal's strategy). The principal's equilibrium strategy must satisfy the following. When the incumbent is an expert, for any history, the principal decides whether to chooses the incumbent, a new expert, or a new non-expert, based on the same rule r: the decision in period t only depends on $d_{\tau^*(t)}$, i.e., $r : [0, \infty) \cup \emptyset \to \{0, b, u\}$, where 0 represents reelecting the incumbent, b represents choosing a new expert, and u represents choosing a new non-expert.

(II) (Agent's strategy). (i) Each expert's equilibrium strategy must satisfy the following.[33] $|x_t - \hat{x}_t|$ only depends on β and $\hat{x}_t$, and this decision rule is the same for any history. (ii) In addition, each non-expert's equilibrium strategy must satisfy the following. $|x_t - \hat{x}_t|$ only depends on $\hat{x}^o_t$, and this decision rule is the same for any history.

(III) (Belief restriction). The principal's belief that constitutes an equilibrium must satisfy the following. Suppose that the incumbent is an expert. When the principal observes d

[32] Duggan (2014), who shows the Folk theorem, is the exception. However, even he points out "the application of dynamic electoral models will rely on equilibrium refinements (e.g., the common restriction to stationary equilibria)."

[33] This assumption can be relaxed as follows. The value of $|x_t - \hat{x}_t|$ taken by an expert remains the same for any history so long as s/he has never observed deviation since s/he became the policymaker.

such that no expert chooses it given the history, the principal believes that the incumbent expert's degree of bias β is $\min\{d, \bar{\beta}\}$.

(I) requires the principal's equilibrium strategy to be stationary. Similarly, (II) requires agents' equilibrium strategies to be stationary and symmetric. The principal must infer the incumbent's bias only through the observed $|x_t - \hat{x}_t|$. Since the inference is hard without stationarity, we impose the stationarity here. Note that in (II), we consider the choice of policy mismatch $|x_t - \hat{x}_t|$ because each policymaker chooses $|x_t - \hat{x}_t|$ by choosing x_t. (I) and (II) together imply Markovian stationary equilibria.

(III) is about the belief on the off-equilibrium paths. To eliminate equilibria whose off-equilibrium belief is not plausible, we impose one restriction, which is about the case wherein the principal observes an off-equilibrium policy mismatch. If the principal observes off-equilibrium policy mismatch d, which is smaller than or equal to $\bar{\beta}$, the principal should believe that the incumbent's degree of bias is d.[34] When d is larger than $\bar{\beta}$, there is no expert whose bias is d. In that case, this restriction requires that the principal believes that the degree of bias is $\bar{\beta}$, which is closest to d.

2.4.2 Preliminaries

We first derive the principal's expected payoff when choosing a non-expert as the policymaker in every period. In each period, a non-expert observes the value of $\hat{x}_t$ with probability ϕ. In this case, the non-expert implements policy $\hat{x}_t$. On the contrary, with probability $1-\phi$, the non-expert cannot observe the value of $\hat{x}_t$. In this case, s/he chooses a policy that is the solution of the following problem to minimize the expected loss due to the policy mismatch: $\min_{x_t} \int_{-\infty}^{\infty} |x_t - \hat{x}_t| dF$. The solution of this problem is the median of x_t. Thus, the non-expert chooses 0 as x_t from the symmetry of F. Therefore, when the value of $\hat{x}_t$ is unobservable, the principal's expected payoff in period t is $\int_{-\infty}^{\infty} -|\hat{x}_t| dF = -2\int_0^{\infty} \hat{x}_t dF$.

In summary, we obtain the following lemma. All the proofs are contained in Appendix B.1.

Lemma 2.1. *The principal's expected payoff when choosing a non-expert as the policymaker in every period is*

$$-\frac{2(1-\phi)}{1-\delta}\int_0^{\infty} \hat{x}_t dF. \tag{2.2}$$

Here, we impose the following assumption.

Assumption 2.1. *The following inequality holds:*

$$\max\left\{\int_0^{\bar{\beta}} \beta dG \,\middle|\, G \in \mathrm{core}(\theta)\right\} > 2(1-\phi)\int_0^{\infty} \hat{x}_t dF.$$

Suppose that every expert chooses her/his ideal policy when chosen as the policymaker, and the principal cannot replace her/him with another agent. This is the worst scenario. Then,

[34] This is verified by assuming that with very small fraction, there is an extremely self-interested expert who always implements her/his own ideal policy.

the expected payoff when the principal continues to choose an expert as the policymaker is

$$\frac{1}{1-\delta}\min\left\{-\int_0^{\bar{\beta}}\beta dG\,\middle|\, G\in \mathrm{core}(\theta)\right\}. \tag{2.3}$$

If it is optimal for the principal to choose an expert even under this worst scenario, the analysis is meaningless. Thus, suppose that (2.3) < (2.2). This is Assumption 2.1.

In addition, we obtain the following basic property of equilibria, which will be repeatedly used in the following analysis.

Lemma 2.2. *Suppose that there is an equilibrium. Denote the principal's payoff from period* 0*, when the principal chooses an expert as the policymaker in period 0, and the players follow the equilibrium strategies after the period 0 election, by $\tilde{V}$. Then,*

1. *the principal's expected payoff from period $t \geq 1$ when the principal chooses a new expert in period t, and the players follow the equilibrium strategies after the period t election, and*

2. *the principal's expected payoff from period $t \geq 1$ when in period t the principal reelects the incumbent expert whose implemented policy mismatch has never been observed, and the players follow the equilibrium strategies after the period t election*

are also $\tilde{V}$.

Strategies

We next characterize the principal's equilibrium strategy. On this issue, we obtain the following lemma.

Lemma 2.3. *Every equilibrium outcome can be constructed by the principal's strategy r having the following property: there is $\beta^* \in [0,\bar{\beta})$ such that the principal reelects the incumbent expert if $d_{\tau^*(t)} \leq \beta^*$ and does not reelect the incumbent expert if $d_{\tau^*(t)} > \beta^*$.*

Hence, without loss of generality, we focus on the above threshold strategy.

Next, we derive each expert's strategy. Experts whose $\beta \leq \beta^*$ implement the own ideal policy $\hat{x}_t + \beta$ because it does not undermine the possibility of reelection. In addition, even experts whose $\beta > \beta^*$ may have an incentive to implement policy mismatch β^* for reelection. This incentive exists if and only if

$$\frac{\rho-(\beta-\beta^*)}{1-\delta} \geq \rho+\delta(1-q)\frac{\rho-(\beta-\beta^*)}{1-\delta} \Leftrightarrow \beta \leq \beta^{**} \equiv \beta^* + \frac{q\delta\rho}{1-(1-q)\delta}.$$

Since all the probability measures contained in core(θ) do not have an atom at the point of β^{**} from the assumption on θ, whether an expert whose $\beta = \beta^{**}$ chooses the compromised policy mismatch β^* does not affect the equilibrium outcome. Thus, we assume that such an expert chooses policy mismatch β^*. Let β^{***} be $\min\{\beta^{**},\bar{\beta}\}$. From the discussion above, an expert whose $\beta \in (\beta^*,\beta^{***}]$ will implement policy mismatch β^*. In summary, we obtain the following lemma.

Lemma 2.4. *The expert whose degree of bias is β follows the strategy below:*

$$x_t = \begin{cases} \hat{x}_t + \beta & (\beta \in [0, \beta^*]) \\ \hat{x}_t + \beta^* & (\beta \in (\beta^*, \beta^{***}]) \\ \hat{x}_t + \beta & (\beta \in (\beta^{***}, \bar{\beta}]) \end{cases} .$$

The discussion above does not depend on whether the principal reelects the incumbent expert when $d_{\tau^*(t)} = \emptyset$. In either case, an expert's strategy is described by Lemma 2.4. In addition, the principal is indifferent between reelecting the incumbent and choosing a new expert since both payoffs are V from Lemma 2.2.

These derived strategies of the principal and experts share a common feature with those derived in the literature of repeated elections.

Beliefs

The next step is to derive the principal's belief. We specify the belief when the incumbent is an expert as follows:

1. When $d_{\tau^*(t)} = \emptyset$, $\theta'_{t,s^{t-1}} = \theta$.

2. When $d_{\tau^*(t)} = \beta \in [0, \bar{\beta}] \setminus \{\beta^*\}$, $\theta'_{t,s^{t-1}}(\{\beta\}) = 1$.

3. When $d_{\tau^*(t)} = \beta^*$, $\theta'_{t,s^{t-1}}([\beta^*, \beta^{***}]) = 1$.

4. When $d_{\tau^*(t)} = \beta \in (\bar{\beta}, \infty)$, $\theta'_{t,s^{t-1}}(\{\bar{\beta}\}) = 1$.

Suppose that $d_{\tau^*(t)}$ occurs with positive probability given the previous history s^{t-1}. 1 must hold since there is no information for updating. Further, if the principal has ever observed $\beta \in [0, \beta^*)$ or $\beta \in (\beta^{***}, \bar{\beta}]$ since the incumbent won the seat, the principal must believe that the incumbent's degree of bias is β from the politician's strategy. 2 includes this. In addition, if the principal has ever observed β^*, the principal must believe that the incumbent's degree of bias is in $[\beta^*, \beta^{***}]$ from the politician's strategy. 3 includes this.[35] There is one remark on the belief specified in 3. In 3, we specify only $\theta'_{t,s^{t-1}}([\beta^*, \beta^{***}])$ and do not specify $\theta'_{t,s^{t-1}}(A)$ for $A \subset [\beta^*, \beta^{***}]$. This is because which β among $[\beta^*, \beta^{***}]$ is the incumbent's degree of bias is payoff irrelevant for the principal. Since the principal receives the same payoff whatever value the incumbent's degree of bias takes among $[\beta^*, \beta^{***}]$, the principal only uses $\theta'_{t,s^{t-1}}([\beta^*, \beta^{***}])$ when calculating the payoff.

In this belief formation, the payoff relevant information on the incumbent's degree of bias is perfectly revealed or completely not revealed.[36] It is well-known that rectangularity holds in such a case (Epstein and Schneider 2003a). Thus, given this belief and an expert's strategy, rectangularity holds (see Appendix A.2). That is, the iterated Maxmin payoff becomes equivalent to the non-iterated one even in the presence of ambiguity.

[35] Here, we arbitrary specify the belief when $d_{\tau^*(t)}$ never occurs given the previous history s^{t-1}. Although other off equilibrium beliefs exist, these do not affect the determination of β^* and β^{***}.

[36] When the principal has not observed the policy mismatch implemented by the incumbent, any information is not revealed. When the principal observed $\beta \in [0, \beta^*)$ or $\beta \in (\beta^{***}, \bar{\beta}]$, the incumbent's degree of bias is completely revealed. When the principal observed $\beta = \beta^*$, the principal finds that the policy mismatch implemented by the incumbent is β^* forever, and hence payoff relevant information is revealed.

2.4.3 Expert Equilibrium

We next give the complete characterization of the equilibrium in which the principal never delegates to non-experts on the equilibrium path. We refer to this equilibrium as *the expert equilibrium.* On the contrary, we refer to the equilibrium in which the principal never delegates to experts on the equilibrium path as *the non-expert equilibrium.* Let $\tilde{V}$ in the expert equilibrium be V_e. In addition, let β^*, β^{**}, and β^{***} in the expert equilibrium be β_e^*, β_e^{**}, and β_e^{***} respectively.

To fix the idea, we start with the case of risk, which is a special case of the presented environment. When θ is additive (i.e., when there is no ambiguity), the following Bellman equation is obtained:

$$\begin{aligned} V_e = & \left[-\int_0^{\beta_e^*} \beta dG - \int_{\beta_e^*}^{\beta_e^{***}} \beta_e^* dG - \int_{\beta_e^{***}}^{\bar{\beta}} \beta dG \right] \\ & + \delta(1-q)V_e + \delta q \left[-\frac{1}{1-\delta} \int_0^{\beta_e^*} \beta dG - \frac{1}{1-\delta} \int_{\beta_e^*}^{\beta_e^{***}} \beta_e^* dG + \int_{\beta_e^{***}}^{\bar{\beta}} V_e dG \right]. \end{aligned} \tag{2.4}$$

Consider period 0. The first term is the expected payoff in period 0 by choosing an expert. The second and third terms are the expected payoff from period 1. With probability $1-q$, the principal cannot observe the implemented policy mismatch. In this case, the principal reelects the incumbent or chooses a new expert. Then, the expected payoff from period 1 is V_e from Lemma 2.2. This is the second term. On the contrary, with probability q, the principal observes the implemented policy mismatch. This is the third term. When the observed policy mismatch is smaller than or equal to β_e^*, the principal the principal reelects her/him. When the observed policy mismatch is larger than β_e^*, the principal replaces the incumbent with a new expert. In this case, the expected payoff is V_e from Lemma 2.2.

As a simple extension of (2.4), we obtain the Bellman equation that is applicable to both risk and ambiguity:

$$\begin{aligned} V_e = \min \Bigg\{ & \left[-\int_0^{\beta_e^*} \beta dG - \int_{\beta_e^*}^{\beta_e^{***}} \beta_e^* dG - \int_{\beta_e^{***}}^{\bar{\beta}} \beta dG \right] \\ & + \delta(1-q)V_e + \delta q \left[-\frac{1}{1-\delta} \int_0^{\beta_e^*} \beta dG - \frac{1}{1-\delta} \int_{\beta_e^*}^{\beta_e^{***}} \beta_e^* dG + \int_{\beta_e^{***}}^{\bar{\beta}} V_e dG \right] \Bigg| G \in \mathrm{core}(\theta) \Bigg\}. \end{aligned} \tag{2.5}$$

Here, relationship (2.1) is used.

The last task is to characterize the value of β_e^*. For this, the following lemma is obtained.

Lemma 2.5. $-\frac{\beta_e^*}{1-\delta} = V_e$ *holds.*

Substituting this into equation (2.5) yields

$$\begin{aligned} -\frac{\beta_e^*}{1-\delta} = & -\delta(1-q)\frac{\beta_e^*}{1-\delta} \\ & \min \left\{ -\int_0^{\beta_e^*} \beta dG - \int_{\beta_e^*}^{\beta_e^{***}} \beta_e^* dG - \int_{\beta_e^{***}}^{\bar{\beta}} \beta dG + \delta q \left[-\frac{1}{1-\delta} \int_0^{\beta_e^*} \beta dG - \frac{1}{1-\delta} \int_{\beta_e^*}^{\bar{\beta}} \beta_e^* dG \right] \Bigg| G \in \mathrm{core}(\theta) \right\}. \end{aligned} \tag{2.6}$$

By solving equation (2.6), β_e^* and V_e are obtained. Furthermore, β_e^* is uniquely determined as seen in the next lemma. This is the characterization of the expert equilibrium.

Lemma 2.6. *There always exists a unique* $\beta_e^* \in \left(0, \bar{\beta} - \frac{\delta q \rho}{1-(1-q)\delta}\right)$ *that is the solution to equation (2.6).*

2.4.4 Characterization of Equilibria

By combining the above set of lemmas, we finally obtain the characterization of equilibria.

Theorem 2.1. *(a) In every equilibrium, the principal always chooses experts on the equilibrium path, if and only if for* β_e^* *that satisfies equation (2.6),*

$$\beta_e^* \leq \bar{\beta}^* \equiv 2(1-\phi)\int_0^\infty \hat{x}_t dF \tag{2.7}$$

holds.

(b) In every equilibrium, the principal always chooses non-experts on the equilibrium path, if and only if (2.7) does not hold.

If V_e is higher than or equal to (2.2), it is optimal for the principal to choose an expert in every period. Otherwise, the principal chooses a non-expert. Hence, $V_e \geq$ (2.2) is the necessary and sufficient condition for the expert equilibrium. Indeed, condition (2.7) is obtained by rewriting $V_e \geq$(2.2).

2.5 Monitoring Ability

Though the condition (2.7) is simple, it is not about the primitives. As a result, it is not clear under what conditions for primitives the delegation to experts arises. To deal with this issue, we next examine the effect of monitoring ability q.

Our starting point is the following lemma.

Lemma 2.7. β_e^* *is decreasing with q.*

That is, V_e is increasing in q. This is because the two agency problems are mitigated by a high monitoring ability. The first one is the moral hazard problem. The principal controls the incumbent expert by replacing the incumbent if the observed policy mismatch is larger than β_e^*. Hence, experts whose $\beta \in [\beta_e^*, \beta_e^{***}]$, choose policy mismatch β_e^*. The higher q is, the larger β_e^{***} is since the incumbent expert has less incentive to deviate. The second one is the adverse selection problem. The principal may choose a highly expert as the policymaker. When the monitoring ability is high, the principal can detect the highly biased incumbent expert and replace the expert with high probability . Through these two paths, the value of choosing an expert increases with q.

Define q, which is non-negative and where the solution to equation (2.6) is $\bar{\beta}^*$, by $\underline{q}^*$. Here, $\underline{q}^*$ is not necessarily in $(\underline{q}, \bar{q})$. Thus, in order to take into account the corner solution, let $\underline{q}^{**} \equiv \min\{\max\{\underline{q}, \underline{q}^*\}, \bar{q}\}$. We obtain the following proposition.

Proposition 2.1. *There is a unique $\underline{q}^{**}$. Furthermore, condition (2.7) holds if and only if $q \geq \underline{q}^{**}$.*

Thus, the monitoring ability must be high enough to prevent the delegation to non-experts. In the context of political economy, as discussed in the introduction, the decision not to delegate to experts can be interpreted as populism. Since q represents the monitoring ability of the mass media, the result indicates that the distrust of the mass media induces populism. This is consistent with the current situation where populism arises and trust in the mass media is undermined. Indeed, the trust of the pubic in the mass media has been decreasing over time (Ladd 2011; Pew 2011).

Note that a decrease in $\underline{q}^{**}$ means that the delegation to non-experts becomes less likely to arise. In the next section, $\underline{q}^{**}$ is used as an index to measure the likelihood of the delegation to non-experts.

2.6 An Increase in Uncertainty

We examine how an increase in the uncertainty about an expert's degree of bias affects the delegation decision by examining the effect on $\underline{q}^{**}$.

2.6.1 Effect of an Increase in Risk

We analyze the effect of an increase in uncertainty in the sense of *risk*. For this purpose, we employ a standard notion that measures the degree of risk: *mean-preserving spread.*

In the case of risk, θ is additive. That is, neither ambiguity nor ambiguity-aversion exist. Let the additive capacity (i.e., probability measure) be G. We compare two probability distributions G_1 and G_2, and assume that both G_1 and G_2 are differentiable. For each i, the density function of G_i is denoted by g_i, and q^{**} given G_i is also denoted by $\underline{q}^{**}(G_i)$.

Lemma 2.8. *Suppose that probability distribution G_1 is a mean-preserving spread of probability distribution G_2. Then, for any $\tilde{\beta} \in [0, \bar{\beta}]$,*

$$\int_0^{\tilde{\beta}} G_1(\beta)d\beta \geq \int_0^{\tilde{\beta}} G_2(\beta)d\beta. \tag{2.8}$$

Since G_1 is the mean-preserving spread of G_2, G_2 second order stochastically dominates G_1. The property in Lemma 2.8 is the definition of the second order stochastically dominance.

By using this property, we derive the proposition about the effect of an increase in risk.

Proposition 2.2. *Suppose that probability distribution G_1 is a mean-preserving spread of probability distribution G_2. To be specific, suppose that inequality (2.8) holds with a strong inequality when $\tilde{\beta} = \bar{\beta}^*$. Then, there is $\bar{\rho} > 0$ such that for $\rho \in (0, \bar{\rho})$, $\underline{q}^{**}(G_1) \leq \underline{q}^{**}(G_2)$.*

It seems that the more uncertain an expert's bias, the more reluctant the principal is to choose the expert. However, Proposition 2.2 argues that so long as uncertainty is risk, this is not the case when ρ is small. Since whether the principal delegates to experts matters only when it is difficult for the principal to control experts, the result when ρ is small is meaningful.

Higher risk increases the continuation payoff, whereas its effect on the payoff of the current period (i.e., the flow payoff) is ambiguous. The principal can replace the incumbent with a

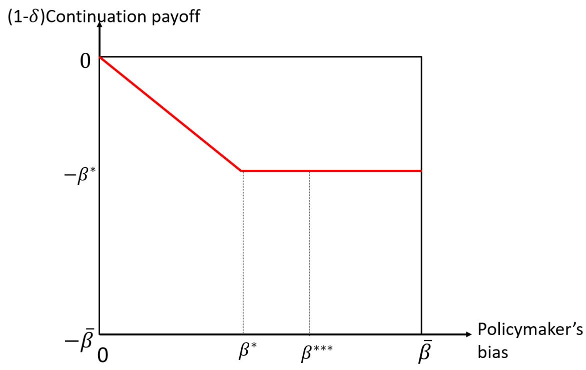

Figure 2.1: Continuation Payoff

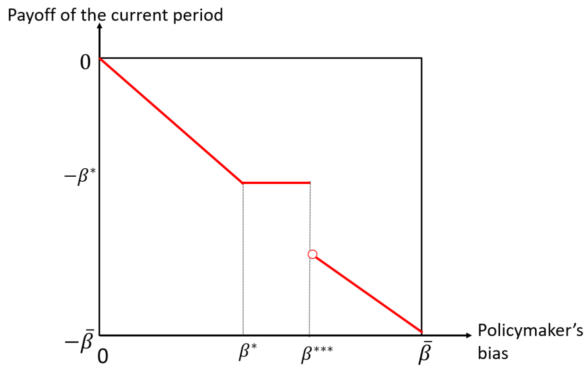

Figure 2.2: Payoff of the Current Period

new one if the principal finds that the incumbent is highly biased. The existence of this option limits the loss of electing a highly biased politician (the principal can obtain at least V_e as the continuation payoff). As a result, the mean-preserving spread increases the continuation payoff of choosing experts. Theoretically, the existence of the option makes the continuation payoff convex with respect to the observed policy mismatch (see Figure 2.1). Thus, the principal behaves as if s/he were a risk-lover, meaning that the continuation payoff increases. On the contrary, the effect on the current period payoff is ambiguous. Figure 2.2 describes the payoff of the current period when the policymaker's bias is β. In contrast to Figure 2.1, this is not convex; that is, the effect on the expected payoff of the current period may be negative, depending on the distribution functions.

Hence, when the positive effect on the continuation payoff is sufficiently large, higher risk increases the principal's payoff of delegating to experts. Since this also implies that the option value of choosing a new expert increases, the standard for reelecting the incumbent, β_e^*, becomes stricter. This enables the principal to control experts well, which further increases the payoff when delegating to experts. As such, higher risk encourages the delegation to experts.

The proposition argues that this is indeed the case when ρ is sufficiently small. As ρ goes to zero, the function of the current period payoff becomes close to be linear because β_e^{**} converges to β_e^*. As a result, the mean-preserving spread has the only negligible effect on the current period payoff. Hence, when ρ is small, the mean-preserving spread always increases the value of choosing experts. It should be emphasized that this is only a sufficient condition. In certain cases, higher risk increases the current payoff as well as the continuation payoff so that the value of choosing experts increases even if ρ is large.[37]

2.6.2 Effect of an Increase in Ambiguity

Higher ambiguity has a contrasting effect. An increase in ambiguity is defined as follows (Nishimura and Ozaki 2004; 2007; Miao and Wang 2011).

Definition 2.3. *θ_1 is more ambiguous than θ_2 if for any $A \in \mathscr{F}_B$, $\theta_1(A) \leq \theta_2(A)$ holds.*

Since both θ_1 and θ_2 are convex, this is equivalent to $\text{core}(\theta_1) \supseteq \text{core}(\theta_2)$. Remember relationship (2.1). The expansion of the core of a capacity means that the set of priors enlarges.

[37]The concrete examples are available upon request.

Thus, this definition of an increase in ambiguity means that the set of candidates of the true distribution expands. Note that this definition includes an increase in uncertainty aversion as well as that in ambiguity itself.[38] Although it should be noted as a limitation, disentangling an increase in ambiguity from that in uncertainty aversion has never been successful in the framework of Choquet/ Maxmin expected utility.[39]

By using this definition, we obtain the proposition on the effect of an increase in ambiguity.

Proposition 2.3. *Suppose that θ_1 is more ambiguous than θ_2. Then, $\underline{q}^{**}(\theta_1) \geq \underline{q}^{**}(\theta_2)$.*

Here, $\underline{q}^{**}$ given θ_i is defined by $\underline{q}^{**}(\theta_i)$ for each i. The above result indicates that an increase in ambiguity raises the least requirement of monitoring ability $\underline{q}^{**}$; that is, higher ambiguity discourages the principal to delegate to experts.

This is because higher ambiguity decreases both the continuation payoff and the payoff of the current period. Remember that under ambiguity, a player evaluates the payoff by using a probability measure that provides the lowest payoff among the core of a capacity. Thus, as ambiguity increases (i.e., the core of a capacity enlarges), the principal becomes more pessimistic about the expected degree of bias of each expert, implying that both the continuation payoff and the payoff of the current period decrease. That is, higher ambiguity decreases the value of delegating to experts. Furthermore, this decrease in V_e implies the smaller option value of choosing a new expert. Hence, the principal becomes reluctant to replace the incumbent with a new expert even if the incumbent's degree of bias is high. Consequently, experts become less disciplined because the standard for reelection becomes loose. This further decreases the payoff of delegating decisions to experts. As such, higher ambiguity discourages the principal to delegate to experts.

In the context of political economy, this result indicates that higher ambiguity rather than higher risk is a significant source of anti-elitism and associated populism. In reality, voters would have abundant probabilistic knowledge about elites' degrees of bias over a traditional policy, whereas such knowledge is limited regarding a new policy issue. Hence, the result suggests that the emergence of a new policy issue, something often concurrent with significant changes in society can be a source of populism. Note that the emergence of a new policy issue might also create ambiguity about the distribution of the principal-optimal policy (i.e., F becomes unknown to the principal and non-experts). Since this reduces the principal's payoff when choosing non-experts (2.2), condition (2.7) becomes more likely to hold. That is, in order to avoid ambiguity about the optimal policy, the principal becomes more likely to delegate to experts who know the optimal policy. Hence, whether the emergence of a new policy issue induces populism depends on which type of ambiguity is more severe. If ambiguity about the distribution of elites' degree of biases is more severe, it induces populism.

[38] The behavioral foundation is provided by Ghirardato and Marinacci (2002). Let θ_1 and θ_2 be two capacities, and let the preference relation be $\succ_i$ $(i = 1,2)$. Then, $(\forall A \in \mathscr{F}_B)$ $\theta_2(A) \geq \theta_1(A)$ if and only if for any outcome x and act f, $x \succeq_2 f \Rightarrow x \succeq_1 f$ and $x \succ_2 f \Rightarrow x \succ_1 f$. They name this *more uncertainty averse*.

[39] Klibanoff, Marinacci, and Mukerji (2005: 1825) point out this problem: "such a separation is not evident in [...] the maxmin expected utility [..]. and the Choquet expected utility model [.]" In the smooth ambiguity model proposed by them, such separation is possible. However, in their model, people are assumed to have subjective probability over the candidates of the true distribution, and in this sense, smooth ambiguity is different from the situation where people do not have even subjective probability over the candidates of the true distribution, which is our focus. Thus, we employ the framework of Choquet/Maxmin expected utility.

2.7 Risk-Averse Principal

So far, we have assumed that the principal is risk-neutral. However, the same result holds even under risk-aversion with respect to uncertainty about the value of $|x_t - \hat{x}_t|$ so long as its degree is not high. Assume that the principal's payoff is $-|x_t - \hat{x}_t|^r$, where $r > 1$. Agents' payoffs are defined similarly.

To this end, we start with the principal's payoff when choosing a non-expert as the policymaker in every period. When the non-expert observes the value of $\hat{x}_t$, s/he chooses policy $\hat{x}_t$. Otherwise, s/he chooses policy x^* that minimizes $\int_{-\infty}^{\infty} |x_t - \hat{x}_t|^r dF$. Then, the principal's expected payoff when choosing a non-expert in every period is

$$-\frac{(1-\phi)}{1-\delta}\int_{-\infty}^{\infty} |x^* - \hat{x}_t|^r dF. \tag{2.9}$$

Assume the following corresponding to Assumption 2.1, termed Assumption 2.1'.

$$\max\left\{\int_0^{\bar{\beta}} \beta^r dG \middle| G \in \text{core}(\theta)\right\} > (1-\phi)\int_{-\infty}^{\infty} |x^* - \hat{x}_t|^r dF.$$

The principal's equilibrium strategy is the same as that in the basic model since it does not depend on $r = 1$. The only change from the basic model is β^{**}. The expert whose degree of bias is β has an incentive to choose policy mismatch β^{**} if and only if

$$\frac{\rho - (\beta - \beta_e^*)^r}{1-\delta} \geq \rho + \delta(1-q)\frac{\rho - (\beta - \beta_e^*)^r}{1-\delta} \Leftrightarrow \beta \leq \beta^{**} \equiv \beta_e^* + \left(\frac{q\delta\rho}{1-(1-q)\delta}\right)^{\frac{1}{r}}.$$

Given this, the equation corresponding to (2.6) is

$$\begin{aligned}
-\frac{\tilde{\beta}^r}{1-\delta} =& -\delta(1-q)\frac{\tilde{\beta}^r}{1-\delta} \\
&-\min\left\{-\int_0^{\tilde{\beta}} \beta^r dG - \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\left(\frac{q\delta\rho}{1-(1-q)\delta}\right)^{\frac{1}{r}},\bar{\beta}\right\}} \tilde{\beta}^r dG - \int_{\min\left\{\tilde{\beta}+\left(\frac{q\delta\rho}{1-(1-q)\delta}\right)^{\frac{1}{r}},\bar{\beta}\right\}}^{\bar{\beta}} \beta^r dG\right. \\
&\left. +\delta q\left[-\frac{1}{1-\delta}\int_0^{\tilde{\beta}} \beta^r dG - \frac{1}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta}^r dG\right] \middle| G \in \text{core}(\theta)\right\}.
\end{aligned} \tag{2.10}$$

Then, as in Lemma 2.6, the unique solution to this equation is guaranteed. Finally, the correspondence to Theorem 2.1 is obtained.

Theorem 2.2. *In the equilibrium, the principal chooses experts on the equilibrium path if and only if for β_e^* that satisfies (2.10),*

$$\beta_e^* \leq \bar{\beta}_e^* \equiv (1-\phi)\int_{-\infty}^{\infty} |x^* - \hat{x}_t|^r dF \tag{2.11}$$

holds.

Given this, the following result about the effect of risk is finally obtained. Note that $\bar{\beta}^*$, $\underline{q}^*$, and $\underline{q}^{**}$ are defined similarly with the case without risk-aversion.

Proposition 2.4. *Suppose that probability distribution G_1 is a mean-preserving spread of probability distribution G_2, and that inequality (2.8) holds with a strong inequality when $\tilde{\beta} = \bar{\beta}^*$. In addition, assume $\rho \in (0, \bar{\rho})$, where $\bar{\rho}$ is defined in Proposition 2.2. Then, there is $\bar{r} > 1$ such that for any $r \in (1, \bar{r})$, $\underline{q}^{**}(G_1) \leq \underline{q}^{**}(G_2)$ holds.*

Hence, an increase in risk can encourage the principal to choose experts even when the principal hates risk because as long as the degree of risk-aversion is not large, the positive effect of an increase in risk dominates the negative effect due to risk-aversion.

2.8 Concluding Remarks

The purpose of this chapter was to analyze under what conditions the principal stops delegating decisions to experts by focusing on the role of uncertainty. To this end, we constructed an infinite horizon model in which the principal chooses to whom to delegate at the beginning of each period and the elected agent implements a policy. Then, we analyzed how an increase in the uncertainty about an expert's degree of bias affects whether the principal delegates to experts. We found that an increase in risk (ambiguity) encourages (discourages) the principal to delegate to experts, suggesting that an increase in uncertainty about the group of experts as a whole is a crucial source of not delegating to experts. The key creating the difference between risk and ambiguity is the possibility of replacement in a dynamic setting. This result has implications for the sources of anti-elitism in political economy, which is an important aspect of populism.

Before closing this chapter, we see the remaining challenges for the future researches. First, we focused on stationary equilibria. How the result changes if non-stationary equilibria are taken into account is thus an important question. Second, it may be worthwhile analyzing the learning process profoundly by assuming that the probability distribution is identical over time. These issues are left to later work.

Chapter 3

Contagion of Populist Extremism: Social Learning with Agency Problems*

Let us stop the domino effect right this week, this Wednesday.
The domino effect of the wrong sort of populism winning in this world.

Mark Rutte, the Dutch prime minister (March 13, 2017)[2]

3.1 Introduction

Policymaking in different countries is intertwined by information propagation, resulting in policy diffusion. While successful policies naturally diffuse by learning, undesirable policies may also diffuse across countries.[3] Nowadays, there is a growing concern about the diffusion of seemingly undesirale policies because it has been pointed out that populist extremism in one country may induce it in another country, leading to the "domino effect" (Kaltwasser 2015). During the last thirty years, Latin American countries have experienced several waves of populism.[4] Even today in Europe, concerns toward the domino effects of populism are widespread. Our epigraph exemplifies them. Following the national referendum on Brexit and the presidential election of the United States, Dutch prime minister Mark Rutte expressed a concern for the domino-like contagion of populism. Motivated by these concerns, we investigate the diffusion of undesirable policies as a form of populism extremism.

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[2] `https://apnews.com/e995dc2fb68549fbbc1e08fd0dab0376` (Last accessed: October 11, 2019)

[3] A historical example of the diffusion of a bad policy is that of temperance legislation in the early 20th century. Although there was a well-known superior system for alcohol regulation, many countries such as the United States had adopted the bad policy – the prohibition law, which eventually failed (Schrad 2010). A more recent example given by Shigeoka and Watanabe (2019) is Japanese inefficient healthcare subsidy policy. They empirically show that it is contagious as an electoral strategy among Japanese municipalities.

[4] Several studies also argue that far-right extreme parties in Europe spread across countries (e.g., Rydgren 2005), though in terms of mechanism, they typically focus on the adoption of the new successful master frame due to learning by politicians. Bernauer (2017) also shows that, over time, voting for right-wing populist parties in Europe occurs along a wave pattern.

The formal analysis of policy diffusion among representative democracies requires a social learning model incorporating the agency problem. An essential feature of representative democracy is that voters have to delegate decisions to elected politicians. Importantly, the interests of voters and politicians do not necessarily coincide. For example, politicians may prefer a different policy from voters. Politicians may also care about their reputation and implement policies attracting the greatest support from voters even if such policies are actually sub-optimal (Ashworth 2012). While canonical social learning models (e.g., Banerjee 1992; Bikchandani, Hirshleifer, and Welch, 1992) have been successfully applied to explain the diffusion of political decisions such as regime shift,[5] they are not directly applicable to representative democracy due to the absence of agency problems. Our novelty is to present the new observational learning model with the agency problem in order to explain the domino effect of populist extremism and to provide the characterizations of the diffusion process caused by the interesting interactions between the learning process and the agency problem. Indeed, our model predicts the long-run dynamics that are fairly different from those obtained in the canonical social learning models.

We construct an observational learning framework nesting a political agency model that extends Acemoglu, Egorov, and Sonin's (2013) model of populism. We begin our analysis with the single-country model to analyze the agency model without learning. There are two types of politicians: the congruent type who shares the same policy preference with (decisive) voters; and the non-congruent type who has a biased policy preference. Voters do not know the incumbent politician's type, and the incumbent has reputation concerns. In addition, there is information asymmetry about the state of the world, which would lead voters to be uncertain about the optimal policy. In this setting, we show that populist extremism could arise in the presence of high reputation concerns. Here, the congruent-type politician argues for a radical policy that the non-congruent type never chooses in order to signal that s/he is the good politician. Given this signaling role of the radical policy, voters support the politician arguing for such policy even if they know that the radical policy could be undesirable. In line with Acemoglu, Egorov, and Sonin (2013), we interpret this situation as populist extremism because an undesirably extreme policy is strongly supported by voters.[6]

This emergence of extremism depends on voters' belief about the state of the world. In particular, we show that extremism arises if and only if the voters' subjective probability of the optimal policy being radical exceeds a certain threshold. In other words, the more radical the public opinion, the likelier it is to induce extremism. Importantly, this threshold value could be less than a half, implying that extremism arises even when voters believe that the radical policy is unlikely to be optimal. This distinguishes our results from the pandering equilibrium of Maskin and Tirole (2004) as their results are driven by the incentive of politicians to respect voters' belief about the optimal policy.

We then extend the model to a multi-country setting wherein the incumbent's policy choice and the election are sequential across countries. This structure allows voters to learn the optimal policy through the policies previously implemented in other countries. Suppose that in

[5]Information propagation can drive the diffusion of mass revolution in authoritarian politics (e.g., Chen and Suen 2016; Barbara and Jackson 2019). The literature of revolution does not take agency problems into account, and rather emphasizes a coordination problem among citizens.

[6]At least conceptually, it could be the case that populism does not entail extremism. However, in reality, we often observe the strong connection between them, and our model indeed shows such a connection (in particular, we show that extremism arises as a symptom of anti-elitism, which is the core of populism).

one country extremism arises, leading the incumbent politician to argue for the radical policy. Since some fraction of the congruent type does not care the own reputation and sincerely supports the optimal policy, the next country's voters cannot rule out the possibility that the radical policy was implemented because it is indeed the optimal policy. Hence, voters upwardly update the probability of the radical policy being desirable. This radicalization of public opinion in turn induces extremism in the next country as seen in the single-country model. As such, policies and public opinions are distorted by each other.[7]

We explain the contagion of populist extremism by the novel interaction of the political agency problem and voters' social learning. Compared with other explanations such as politicians' learning of successful electoral tactics (Rydgren 2005), our results provide several unique characterizations about the contagion. Perhaps most importantly, our results underline the contagious nature of political distrust: A distrust shock in only one country can induce the political distrust in other countries and induce the propagation of populism. Politicians' learning alone does not predict such a catastrophic impact of political distrust.[8]

Given that populist extremism is contagious, a natural question to ask next is whether its spread also ends. Our model yields two novel implications on the dynamics of contagion. First, the domino effect of extremism may suddenly end. In particular, a moderate policy only in one country might be always enough to stop the domino effect, independently of past histories. This surprising result follows due to the agency problem: a single bounded signal is not necessarily sufficient to change belief significantly in the standard learning models. This indicates that stopping populism in one country can indeed have a power to end the domino effect, which can justify Mark Rutte's appeal in our epigraph.

Second, we show that the dynamics crucially depends on the correlation of the optimal policy across countries. When the optimal policy remains the same across countries, the spread must end in the long run. Although the spread of extremism is likely to be detrimental even in the short run, this result indicates that the worst scenario–the permanent propagation—is rejected. However, the domino effect might be much more serious when each country's optimal policy is only imperfectly correlated, which seems practically relevant since the optimal policy may change across countries as well as across time. We introduce imperfect correlation by assuming that the optimal policies follow a Markov process without absorbing states. In this case, unlike the case of perfect correlation, populist extremism never ends. Strikingly, we show the possibility of the convergence to the extremism, wherein it is impossible to escape from extremism. Even when the convergence does not occur, the cycles of extremism always occur. Overall, it is more difficult to stop the contagion of populist extremism under the conditions of imperfect correlation. This result also contrasts the result in the canonical social learning models.

From a broader perspective, our model can be regarded as a new model of social learning

[7] Ezrow, Böhmelt, and Lehrer (2019) empirically show that the anti-immigration public opinion is induced by a foreign country's radical public opinion via the electoral success of anti-immigration parties in the foreign country, which is consistent with such observation. Kaltwasser (2015) also points out a possibility that the diffusion of populism could rely on voters' learning about neighborhood countries; the author here refers to the "demonstration effect."

[8] Another implication is to widen the scope for an undesirable policy to be contagious. Our results indicate that the contagion effect is a fundamental problem not just stemming from the irrational voting behavior. As long as voters are rational, there is no straightforward explanation for the contagion of the inefficient policy being induced only by politicians' learning. On the contrary, our results indicate that voters' rational learning induces the contagion of inefficient policies.

under the agency problem, wherein the dynamic interaction between principals' opinions and agents' actions creates the failure of social learning. The model can also be applied to even non-political issues. A prominent example is the diffusion of dividend policies across firms, which is empirically shown to exist (Adhikari and Agrawal 2018; Grennan 2019). Shareholders face two information asymmetries: the executives' types and the optimal dividend policy for each firm. Our result indicates that excessively high dividend payment might be contagious across firms because the executives signal that they act in line with shareholders' interests by choosing the high dividend payment.

3.2 Related Literature

Political agency problems and reputation concerns: Politicians' reputation concerns can force congruent politicians to argue for inefficient policies—Congruent politicians pander to public opinion and implement bad policies (e.g., Canes-Wrone, Herron and Shotts 2001; Maskin and Tirole 2004; Fox and Shotts 2009; Smart and Sturm 2013). This bad reputation effect arises even in non-political contexts (Ely and Välimäki 2003).

In more striking cases, politicians arguing for a sub-optimal policy might attract the support from voters even if the policy is perceived to be bad by voters. This extremism rather than simple pandering cannot be explained by the pandering literature. Acemoglu, Egorov, and Sonin (2013) show that the congruent politician chooses an extreme policy, which is known to be bad, to signal that s/he is a good politician.[9] Their mechanism provides an explanation for populist extremism.[10] In the framework of a cheap talk game, Morris (2001) also presents an idea similar to Acemoglu, Egorov, and Sonin (2013).[11]

Although Acemoglu, Egorov, and Sonin (2013) provide novel insight on populist extremism, their single-country model has no uncertainty about the voter-optimal policy, so there is no connection between public opinion and pandering. By introducing multiple countries and uncertainty about the state of the world, we succeed in connecting the possibility of extremism and public opinion.[12] This allows us to uncover the contagion of extremism through the dynamics of public opinion.

Policy diffusion and learning: Our study is related to the literature on policy diffusion through learning. Notably, in our study, what is learned and by whom are different from most existing theoretical studies. In previous studies, the government learns the outcome of policies through other countries' experiences (e.g., Volden, Ting, and Carpenter 2008; Buera, Monge-Naranjo, and Primiceri 2011; Callander and Harstad 2015). On the contrary, in our

[9] Fox and Stephenson (2015), Matsen, Natvik, and Torvik (2016), Kartik and Van Weelden (2019), and Kasamatsu and Kishishita (2018) also apply this mechanism.

[10] Since populism is multifaceted in nature, each study focuses on different aspects of populism. The literature on populism (e.g., Frisell 2009; Jennings 2011; Karakas and Mitra 2017; Kishishita 2017; Buisseret and Van Weelden 2018; Guiso et al. 2018) has not analyzed the diffusion process of populism.

[11] However, Morris's model model has no fully separating equilibrium.

[12] To analyze cheap talk messages in an election, Kartik and Van Weelden (2019) consider the model wherein the state of the world follows a continuous distribution. However, as a result of the focus difference, voters' learning about the state of the world plays no role and the uncertainty is introduced to create imperfection of the signal on whether the incumbent implemented a good policy. Consequently, their model does not reveal a clear relationship between the possibility of extremism and voters' beliefs about the state of the world.

model, politicians know the state of the world, and instead, voters learn it.[13] Furthermore, voters face multidimensional uncertainty: they learn two factors—the state of the world and the incumbent politician's type—simultaneously.

The significance of information propagation among voters is supported by many empirical studies. Most notably, Pachenco (2012) empirically shows that neighboring states' policies affect public opinion, which in turn affects electoral outcomes and induces policy diffusion. She also reveals that in explaining policy diffusion, other channels such as politicians' learning are less important than voters' learning, at least in the context of tobacco control in the United States. We theoretically investigate this mechanism in detail and show that populist extremism may be propagated. The information propagation among voters can be observed in an international context as well (e.g., Kayser and Peress 2012).

Such voters' learning is partially investigated in the literature on yardstick competition (e.g., Besley and Case 1995; Belleflamme and Hindriks 2005). In yardstick competition models, voters observe the policies of other countries. However, governments decide policies only once, so there is no sequential learning and associated dynamics, which are essential to analyzing the domino effect. The study by Hugh-Jones (2009) is related. He analyzes yardstick competition wherein the stage game—wherein each government simultaneously decides the policy—is repeated twice. Hence, his model incorporates dynamics of policies after voters' social learning. However, due to the difference in the focus, his model does not include extremism or sequential political decisions. As we discuss in Section 3.7.3, the welfare implications of yardstick competition may be reversed in our model.

Social learning: Our model provides a new framework capturing an important aspect of observational learning under agency problems.[14] In our model, agents who are aware of the state of the world choose policies, while principals learn the state of the world by observing the past policies. Hence, players who take actions perfectly know the state. Nonetheless, learning does not work well because of the agency problem. This contrasts the existing studies wherein players who take actions face uncertainty about the state of the world and this uncertainty creates the failure of learning.[15] Studies analyzing reputation concerns are also related (e.g., Scharfstein and Stein 1990; Ottaviani and Sørensen 2001). Also in this framework, players who take actions face the uncertainty. Then, they try not to undermine their reputations by arguing for a potentially wrong policy, thus resulting in herding.

This novel structure of our model yields two important properties absent in the canonical social learning models. First, we show that the domino effect suddenly stops due to the discontinuous jump of voters' beliefs. In the standard models, such jump arises only when signals are unbounded (Smith and Sørensen 2000). In spite of bounded signals, we show that strategic interactions create paradigm shifts through the endogenous change in signal strength.

[13] In the literature of preliminary elections, voters' learning and associated information cascades are often discussed (e.g., Callander 2007). However, in those models, politicians' policy choice is exogenous; voters learn something not through politicians' actions but through other voters' previous voting strategies (i.e., the results of previous elections).

[14] See Chamley (2004) for the background of social learning studies. Our study includes heterogeneous politicians and thus relates to the literature with heterogeneous types of players. Smith and Sørensen (2000) analyze the case wherein players have opposite preferences, while Goeree, Palfrey, and Rogers (2006) explore the case wherein a player's payoff is partially dependent on a private shock.

[15] In the analysis of riots, Lohmann (2000) reveals that players' signaling motives create information cascades, though signaling motives come not from agency problems but collective action problems.

Chen and Suen (2016) consider a social learning model wherein each stage game is a global game. Then, when players face model uncertainty, such paradigm shifts might occur because of the endogenous change in signal strength. However, the mechanism inducing the endogenous signal strength is different. In the present study, we implement neither global game nor model uncertainty. As agency problems are prevalent in reality, we believe that our model substantially enlarges the possibility of sudden paradigm shifts in observational learning.

The second difference is about the case wherein the states are only imperfectly correlated in a Markovian manner. Moscarini, Ottaviani, and Smith (1998) as well as Nelson (2002) extend the canonical social learning model in this direction.[16] They show that the more likely the state of the world is to change, the herding period is sustained during the shorter period. In stark contrast, we find that the opposite is the case.

3.3 The Model

There are $N \in \mathbb{N}$ countries ($i = 1, ..., N$). For each country, there is an incumbent politician and a decisive voter.[17] Hereafter, we call the incumbent politician (the decisive voter) in country i politician i (voter i). The incumbent politician corresponds to the agent (or equivalently, the expert) and the voter corresponds to the principal. Each incumbent politician sequentially chooses a policy.[18] At the beginning of period i, politician i chooses policy x_i from the set of available policies $X = \{0, 1, 2\}$ given the policies implemented before period i by the other countries $(x_1, ..., x_{i-1}) \in X^{i-1}$. Then, voter i evaluates politician i given the policies implemented before in other countries and the policy implemented by politician i $(x_1, ..., x_i) \in X^i$. This evaluation is denoted by π_i. The definition of strategies when $N \geq 2$ will be given in section 3.5.

3.3.1 State-Dependent Policy Rankings

The optimal policy for voters depends on the state of the world. Let $\omega_i \in \Omega \equiv \{1, 2\}$ be the state of the world in country i, which indicates the optimal policy for voter i. Politician i knows the value of ω_i, while voter i does not know its value. When $\omega_i = k$, the policy optimal for voter i is k. Hence, policy 0 is never desirable for voters, whereas the other two policies can be appropriate. As seen in the next subsection, we consider single-peaked preferences so that policy 1 is close to policy 0, while policy 2 is the opposite of policy 0. Hence, we refer to policy 0 as *the non-congruent policy*, policy 1 as *the moderate policy*, and policy 2 as *the radical policy*.[19]

Note that we assume that the non-congruent politicians and voters always have different tastes—That is, the ideal policy of the non-congruent type is policy 0.[20] Such a situation nat-

[16] Peck and Yang (2011) also analyze strategic delay and the associated information cascade.

[17] Voters' heterogeneity is allowed for as long as the median voter theorem holds.

[18] The incumbent could also be interpreted as choosing a policy platform instead of the actual policy. This interpretation is plausible because voting behavior is affected by campaign promises and breaking them are often costly.

[19] The assumption that the non-congruent policy is located at the corner of the policy space is not crucial. By expanding the policy space to $X \equiv \{-2, -1, 0, 1, 2\}$, we can show that the same results hold even if the non-congruent policy is policy 0. The formal argument is available upon request.

[20] It is important to note that the asymmetry between the numbers of states and policies is not fundamental to our main conclusions, although such asymmetry is interesting and relevant in practice. Our main contagion result

urally arises when politicians come from special interest groups, such as economic elites. For example, motivated by Latin-American experience, Acemoglu, Egorov, and Sonin (2013) consider a situation wherein elites seek different policies than the average voter and elite groups might gain influence over a politician through bribery. We extend this situation, so that the average voters' ideal point may change depending on economic and social conditions, but voters always deem that what elites demand is undesirable.

As an illustration, consider taxation politics.[21] The voter-optimal tax rate is low (i.e., policy 2) when the distortion of taxation is high (i.e., $\omega = 2$), but moderate (i.e., policy 1) when the distortion is low (i.e., $\omega = 1$). On the contrary, some politicians' objective is to maximize the tax revenue for rent-seeking to ensure their optimal tax rate is higher (i.e., policy 0) independently of the distortion of taxation. Our setting captures this situation.[22]

Note that while the congruent-type politicians are 'good' for the decisive voter because they share the same interest, they might not necessarily try to maximize the total welfare of the society. For example, if voters are myopic, it may desirable to let a far-sighted politician choose a policy. The congruent type in this case is too myopic from the viewpoint of benevolent social planners. While this point might be important for welfare measurement in specific applications of the model, in the present study, we take the simplest approach to use the average voters' utility as the welfare measure.

3.3.2 Politicians' Types

There are two types of politicians: *the congruent type* and *the non-congruent type*. Voter i does not know the type of politician i—That is, information asymmetry about politicians' types exists in addition to information asymmetry about the state of the world.

The payoff of the congruent type in country i is given by $-L(|x_i - \omega_i|) + b_i V(\pi_i(x_i))$, where L is the loss due to policy mismatch, $\pi_i(x_i)$ is the updated belief voter i holds at the end of period i about the probability of the incumbent i being the congruent type given the implemented policy x_i, and $V : [0,1] \mapsto [0,1]$. The congruent type shares the same policy preference as the voter (i.e., the ideal policy is ω_i). In this regard, this type of the politician is a good politician. Note that L is assumed to be strictly increasing because we consider single-peaked preferences. As for normalization, $L(0) = 0$ and $L(1) = 1$. Furthermore, $L(2) = l > 1$, meaning that the loss due to policy mismatch is strictly convex.

On the contrary, the payoff of the non-congruent type in country i is given by $-L(|x_i|) +$

appears as long as the non-congruent type and the congruent type have sufficiently different preferences since it is based on signaling motives. Indeed, we have replicated the analogous contagion result when the non-congruent policy 0 is eliminated and the non-congruent type never implements policy 2, implying that our main result also appears in a setting with two states and two policies under a certain condition (available upon request). Note also that "tyranny," wherein the non-congruent type is less disciplined by opinion radicalization, never appears without the non-congruent policy 0. Including policy 0 allows us to analyze this interesting malfunctioning of democracy entailed in populist extremism.

[21] See Besley and Smart (2007) for details on this interpretation. Needless to say, contexts determine what the radical policy is. For instance, suppose that the non-congruent type politician is influenced by the rich so that their optimal tax rate is excessively low. In that case, the radical policy will be excessively high tax rate (Acemoglu, Egorov, and Sonin 2013).

[22] Another example is special interest politics. Policies inevitably create transfers to a special interest and the optimal degree of transfer depends on the state of the world. The non-congruent type is always maximizing the level of the transfer independently of the state of the world. See Morris (2001) for details and further examples.

$b_i V(\pi_i(x_i))$. Hence, the ideal policy for the non-congruent type is policy 0.[23] Since policy 0 is never desirable for the voter, this politician is a bad type.[24]

Politician i's reputation is severely undermined if their policymaking makes voter i believe that politician i is likely to be the non-congruent type and prefer policies that are undesirable to voters. The low reputation might damage the quality of the post-political life or the incumbent's soft legacy (Fong, Malhotra, and Margalit 2019). In addition, when the incumbent has a chance in the next term, his/her low reputation would prevent reelection. Such reputation concerns are added in the above payoff functions as the last term $b_i V(\pi_i(x_i))$.[25] We impose that V is strictly increasing, so that politicians always value higher reputation. We also assume $V(0) = 0$ and $V(1) = 1$.

Here, $b_i \geq 0$ is the intensity of reputation concerns. The non-congruent types are assumed to have strong reputation concerns because they are self-interested. That is, $b_i = b > 0$ for the non-congruent type.[26] On the contrary, some congruent politicians might only have low reputation concerns and always implement the policy that is optimal for voter i (i.e., some politicians might be so-called statesmen). To capture this, we assume that the congruent type is divided into *the congruent type H* and *the congruent type L*. The former type has high reputation concerns similar to the non-congruent type: $b_i = b$. In contrast, the latter type only has low reputation concerns: $b_i = b_L \in [0, b)$.[27] The voter does not know whether the congruent type is H or L. In country i, the incumbent is the congruent type H with probability $q_H \in (0,1)$, the congruent type L with probability $q_L \in (0,1)$, and non-congruent with probability $1 - q_H - q_L$. We define $q \equiv q_L + q_H$. $q \in (0,1)$ is also assumed. Politicians' types are independently determined across countries. Denote this type space by $T_i \equiv \{H, L, N\}$ wherein H (L) represents that politician i is the congruent type H (L) and N represents that s/he is non-congruent.

In section 3.7.2, we extend our model to a two-period election model and interpret reputation concerns as reelection concerns.

For simplicity, we assume henceforth that the reputation concern takes the linear form $V(\pi_i) = \pi_i$. Though this assumption is standard in the literature (e.g., Maskin and Tirole 2004), our conclusion does not depend on this assumption.

3.3.3 Timing of the Game and Equilibrium Concept

The timing of the game is summarized as follows.[28] In period i,

[23] L can be different across different types of politicians, though the same function is assumed for simplicity.

[24] As a whole, our setting allows the single-crossing condition to be satisfied under the binary state of the world. This is essential to generate extremism.

[25] Reputation concerns affect policymaking in the real world (Kartik and Van Weelden 2018: footnote 2).

[26] Even if some fraction of the non-congruent type has low reputation concerns, the results do not change.

[27] In the literature, there are two approaches to model the congruent type. The first one is to assume that they have reputation concerns (e.g., Maskin and Tirole 2004) and the other is to assume that they non-strategically choose voters' optimal policy (e.g., Besley and Smart 2007). Our setting can be regarded as a unified approach.

[28] The evaluation by voter i does not depend on policies implemented after politician i's policy choice, and thus politicians are not forward-looking. Such an assumption makes the analysis tractable, especially when we consider the asymptotic properties. Indeed, this is often assumed in the literature on social learning including the seminal works (Banerjee 1992; Bikhchandani, Hirshleifer, and Welch 1992). Furthermore, this situation is natural in many contexts because politicians typically care about the reputation in the near future. The prominent example is the reelection concern since the electoral result depends on the reputation at the time of the election. Moreover, voters might pay closest attention to politics during elections. Thus, the reputation would be heavily dependent on the policy implemented just before the election.

1. Nature chooses ω_i and politician i's type. Only politician i observes them.

2. Politician i chooses a policy x_i.

3. Voter i updates the belief on the incumbent's type $\pi_i(x_i)$.[29]

4. Politician i's payoff is realized.

The equilibrium concept is a (mixed strategy) perfect Bayesian equilibrium.

3.4 Equilibrium: Single-Country Model

We start with the case wherein $N = 1$, deriving the equilibria in the single-country model. Although this benchmark case cannot deal with the contagion of extremism, it provides a useful framework to consider the mechanism that induces the spread of extremism. Let the ex-ante probability that $\omega_1 = 1$ be $p_1 \in (0,1)$. Without notational abuse , we omit the subscript "1" that represents country 1.

To focus on meaningful cases wherein extremism could arise, we suppose the following:

Assumption 3.1. *$b_L \in [0,1)$ and $b \in (2,l)$.*

That is, the reputation concerns of the congruent type L are sufficiently low, while those of the other types are relatively high.[30] These assumptions are sufficient conditions to analyze meaningful cases wherein extremism could arise. Henceforth, we focus on these values. Note that $l > 2$ must be satisfied for this assumption.[31]

We allow players to mix actions. Let $\alpha^*(x;\omega)$ be the equilibrium probability that the congruent type H chooses x when the state is ω. Similarly, let $\beta^*(x)$ be the equilibrium probability that the non-congruent type chooses x and let $\gamma^*(x;\omega)$ be the equilibrium probability that the congruent type L chooses x when the state is ω.[32] Note that $\sum_{x=0}^{2} \alpha^*(x;\omega) = \sum_{x=0}^{2} \beta^*(x) = \sum_{x=0}^{2} \gamma^*(x) = 1$.

3.4.1 Equilibria

We derive equilibria of the game and show that populist extremism, which we formally define later, can arise. As a preliminary result, we show that the following types of equilibria never exist. All the proofs are relegated to B.1.

[29]If one wants to explicitly model the voter's action, consider that voter i chooses a conjecture about the probability of the incumbent being the congruent type y to minimize the quadratic loss $(\mathbf{1}\{t_i \neq N\} - y)^2$. Then, $y^* = \pi_i(x_i)$.

[30]Note that high l (i.e., the loss for the non-congruent type by implementing policy 2) weakens the restriction on b.

[31]This assumption can be weakened by allowing b to be different between the congruent type H and the non-congruent type. Even if the congruent type H's b is less than two, the similar result holds so long as the non-congruent type has high reputation concerns.

[32]To be precise, we implicitly restrict our attention to equilibria wherein each player's equilibrium strategy depends on only payoff-relevant information for him/herself. Hence, β^* does not depend on ω. This is consistent with the equilibrium concept in section 3.5. Furthermore, Proposition 3.2, the key characterization, still holds even if we allow β to depend on ω. Alternatively, if we assume that the non-congruent type does not know ω, all strategies satisfy this property.

Lemma 3.1. *(i) There is no equilibrium wherein* $\beta^*(0) = 1$. *In addition, (ii) there is no equilibrium wherein* $\beta^*(2) > 0$, *(iii) in any equilibrium,* $\alpha^*(2;2) = 1$, *(iv) there is no equilibrium wherein* $\alpha^*(0;\omega) > 0$ *for some* ω, *and (v) in any equilibrium,* $\gamma^*(\omega;\omega) = 1$.

The important properties are (ii) and (v). The non-congruent type might choose a policy different from policy 0 to pretend to be the congruent type. (ii) argues that if, the non-congruent type has this incentive, s/he never implements policy 2. Since policy 2 is too different from policy 0, the loss from policy 2 is huge for the non-congruent type. Hence, the non-congruent type never chooses policy 2. This implies that the congruent type always can separate themselves from the non-congruent type by arguing for policy 2. That is, the radical policy always works as a signal of the incumbent being the congruent type because it is too extreme for the non-congruent type. In the standard pandering models like Maskin and Tirole (2004), the policy serving as a good signal is different depending on the voter's belief p. However, in our model, the radical policy always works as a good signal for any p because it is never taken by a non-congruent politician. As we shall see, this property is important for the development of populist extremism.

Given this, even the congruent type might have an incentive to distort policies to benefit their reputations. (v) argues that the congruent type L always chooses ω, as the policy because reputation concerns are sufficiently low (i.e., $b_L < 1$). Hence, we do not highlight the strategy of the congruent type L in the following derivation of equilibria.

Based on this preliminary result, we obtain the following characterization of equilibria.

Proposition 3.1. *(a) There is an equilibrium wherein* $\alpha^*(2;\omega) = 1$ *and* $\beta^*(1) = 1$ *if and only if* $\frac{1-q}{(b-1)q_L} \leq p \leq \frac{(b-1)(1-q)}{q_L}$. *We refer to this as (E1) equilibrium.*

(b) There is an equilibrium wherein $\alpha^*(2;\omega) = 1$, $\beta^*(1) > 0$, *and* $\beta^*(0) > 0$ *if and only if* $p < \frac{1-q}{(b-1)q_L}$. *Furthermore, in this equilibrium,* $\beta^*(1) = \frac{(b-1)pq_L}{1-q}$; $\beta^*(0) = 1 - \beta^*(1)$. *We refer to this as (E2) equilibrium.*

(c) There is an equilibrium wherein $\alpha^*(2;2) = 1$, $\alpha^*(1;1) > 0$, $\alpha^*(2;1) = 1 - \alpha^*(1;1)$, *and* $\beta^*(1) = 1$ *if and only if* $\frac{(b-1)(1-q)}{q} \leq p \leq \frac{(b-1)(1-q)}{q_L}$. *Furthermore, in this equilibrium,* $\alpha^*(1;1) = \frac{(b-1)(1-q)}{pq_H} - \frac{q_L}{q_H}$. *We refer to this as (E3) equilibrium.*

(d) There is an equilibrium wherein $\alpha^*(\omega;\omega) = 1$ *and* $\beta^*(1) = 1$ *if and only if* $p \geq \frac{(b-1)(1-q)}{q}$. *We refer to this as (NE) equilibrium.*

(e) There is no other equilibrium.

Some of the equilibria in this proposition have an interesting feature called *populist extremism* or *extremism* (used interchangeably). To highlight this, let us define the extremism equilibrium. Let X^* be the set of policies that can occur with a positive probability in an equilibrium—that is, $X^*(\omega) \equiv \{x \in \{0,1,2\} : \alpha^*(x,;\omega) + \beta^*(x) + \gamma^*(x;\omega) > 0\}$.

Definition 3.1. *An equilibrium* $(\alpha^*, \beta^*, \gamma^*, \pi^*)$ *is called the (populist) extremism equilibrium if for some* ω, $X^*(\omega) \setminus \{\omega\} \neq \emptyset$ *and* $\pi^*(x) = 1$ *for some* $x \in X^*(\omega) \setminus \{\omega\}$.

If an equilibrium is not the extremism equilibrium, let us call it *the non-extremism equilibrium.* It is unsurprising that some politicians argue for extreme and undesirable policies because they have a biased ideology. However, what we observe in the proliferation of populism is a more paradoxical situation wherein the politician who chooses extreme policies obtains strong voter support. Our definition of populist extremism represents this paradoxical phenomenon. In the extremism equilibrium, some politicians choose a policy different from the voter-optimal policy. Nonetheless, their reputations are bolstered (i.e., $\pi^* = 1$), and they get re-elected or enjoy pleasant post-political life.[33]

(E1)–(E3) equilibria are extremism equilibria. To pretend to be the congruent type, the non-congruent type chooses policy 1, whereas the non-congruent type never chooses policy 2. Hence, in order to separate himself/herself from the non-congruent type, the congruent type H, who has high reputation concerns, implements the radical policy (i.e., policy 2), even if the radical policy is not the voter-optimal (i.e., extremism arises). Furthermore, the politician who argues for the radical policy indeed acquires high reputation because it is a good signal of the incumbent's type. As such, extremism with strong support by voters arises. This mechanism is analogous to that of Acemoglu, Egolov, and Sonin (2013).

Notably, (NE) is the non-extremism equilibrium. In this equilibrium, the non-congruent type chooses the non-optimal policy when $\omega = 2$. In this sense, an extreme policy could be implemented. However, the politician who chooses it does not bolster his/her reputation. Furthermore, the congruent type always chooses the voter-optimal policy. Hence, nothing is paradoxical, and this equilibrium is the non-extremism one. Distinguishing from extremism, we refer to the "bad behavior" by the non-congruent type as *tyranny* based on the analogy that citizens do not wish to elect a tyrant, but they may fail to distinguish a bad politician whose support will lead them to suffer from tyranny. Using this terminology, we can say that, in the equilibrium, extremism does not occur while tyranny exists.

In summary, we have the following properties.

Fact 3.1. *All equilibria except for the (NE) equilibrium are extremism equilibria.*

We comment on two key assumptions that induce extremism, which we believe reflect real aspects of populist extremism. The first key assumption is the existence of the non-congruent type (i.e., corrupt politicians). In our model, voters dislike a politician with different preferences from them, which leads the congruent politicians to distort policies in order to signal their aligned preferences with voters. This situation can be interpreted that voters do not want to elect an elite politician whose preferences are very different from the common people, and they strongly support populists precisely because the populists are expected to have close preferences. This well explains the aspect of populism as anti-elitism[34] and the empirical observation that voters who distrust the established politicians support populists (e.g., Akkerman, Mudde, and Zaslove 2014).

---

[33]Our definition of extremism is close to the definition of populism given by Acemoglu, Egolov, and Sonin (2013); however, they do not implement the formal definition. To be precise, not limited to the congruent type, they also regard the non-congruent type's populist behavior as pretending to be the congruent type. However, we refer to only the congruent type's behavior to signal that they are good because we focus on the situation wherein undesirably extreme policies are widely supported by voters. Kasamatsu and Kishishita (2018) also provide a formal definition of extremism similar to ours, though there is no uncertainty about the state of the world in their model.

[34]For instance, Mudde (2004: 543) defines populism as "an ideology that considers society to be ultimately separated into two homogeneous and antagonistic groups, 'the pure people' versus 'the corrupt elite,' and which argues that politics should be an expression of the volonté générale (general will) of the people."

The second assumption is that the congruent type has reputation concerns. Without high reputation concerns, the congruent type never distorts policies—That is, extremism does not arise. This implies that populists in our model choose extreme policies for opportunistic rather than ideological reasons. While, at first glance populists' motivations seem to be ideological, some scholars have argued that populists are primarily opportunistic. For instance, Weyland (2017: 62) states that "populism tailors its appeals in opportunistic ways to maximize the leader's chances of capturing the government." That is, populists' policies are chosen in terms of how to attract voters.[35] In these aspects, the underlying mechanism of populism in our model reflects the reality.

3.4.2 Extremism and Public Opinion

Proposition 3.1 can be summarized as follows by focusing on the relationship with the public opinion$p$.

Theorem 3.1. *Suppose first that* $\frac{1-q}{(b-1)q_L} < \frac{(b-1)(1-q)}{q}$. *Then,*

(i) When $p < \frac{1-q}{(b-1)q_L}$, *there is a unique class of equilibria: (E2) equilibrium.*

(ii) When $\frac{1-q}{(b-1)q_L} \leq p < \frac{(b-1)(1-q)}{q}$, *there is a unique class of equilibria: (E1) equilibrium.*

(iii) When $\frac{(b-1)(1-q)}{q} \leq p \leq \frac{(b-1)(1-q)}{q_L}$, *there exist three classes of equilibria: (E1), (E3), and (NE).*

(iv) When $p > \frac{(b-1)(1-q)}{q_L}$, *there is a unique class of equilibria: (NE) equilibrium.*

Next, suppose that $\frac{1-q}{(b-1)q_L} > \frac{(b-1)(1-q)}{q}$. *Then,*

(i) When $p < \frac{(b-1)(1-q)}{q}$, *there is a unique class of equilibria: (E2) equilibrium.*

(ii) When $\frac{(b-1)(1-q)}{q} \leq p < \frac{1-q}{(b-1)q_L}$, *there are three classes of equilibria: (E2), (E3), and (NE).*

(iii) When $\frac{1-q}{(b-1)q_L} \leq p \leq \frac{(b-1)(1-q)}{q_L}$, *there are three classes of equilibria: (E1), (E3), and (NE).*

(iv) When $p > \frac{(b-1)(1-q)}{q_L}$, *there is a unique class of equilibria: (NE) equilibrium.*

Proof. From Proposition 3.1, we directly obtain the theorem. □

While this characterization might seem complicated, it can be interpreted in a simple way. As an immediate consequence of Theorem 3.1 and Fact 3.1, we obtain the following proposition

Proposition 3.2. *The non-extremism equilibrium exists if and only if* $p \geq \bar{p} \equiv \frac{(b-1)(1-q)}{q}$.

[35] By quantitatively analyzing the recent U.S. elections, Gennaro, Lecce, and Morelli (2019) find that politicians including the president Donald Trump have rationally used populist arguments as a strategic vote-gaining tool, which suggests that the supply of populism is often strategic.

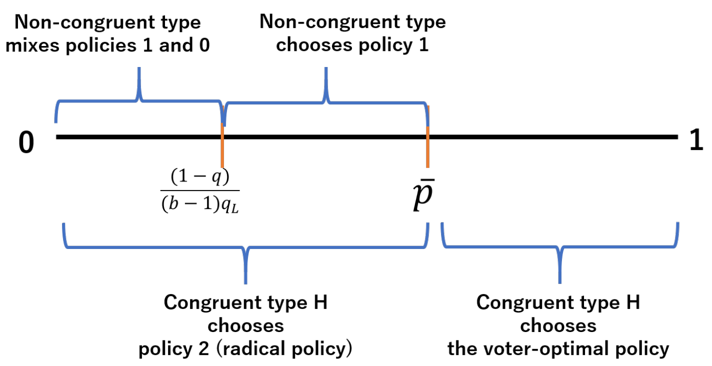

Figure 3.1: Characterization of single-country equilibria.

Notes: This is the case for $\frac{1-q}{(b-1)q_L} < \bar{p}$. We can obtain a similar figure for the case wherein this inequality does not hold.

Hence, the emergence of extremism is highly related to the prior belief p: The more strongly voters believe that the radical policy is the good policy, the more likely populist extremism is to arise. The intuition can be understood as follows. Suppose that sufficiently high reputations are maintained under policy 1. Then, even if policy 2 signals that the incumbent is the congruent type, the congruent type H might choose policy 1 when $\omega = 1$. Hence, whether the non-extremism equilibrium exists depends on whether high reputations are maintained under policy 1. Figure 3.1 summarizes the relationship between the equilibrium behavior of the non-congruent type and the belief p.[36]

Interestingly, whether high reputations are maintained under policy 1 is in turn dependent upon the voters' beliefs about the state of the world. To observe this, first assume the non-extremism equilibrium. In this equilibrium, the posterior of the incumbent being the congruent type given policy 1 is

$$\pi(1) = \frac{pq}{pq + 1 - q}.$$

Since the congruent type chooses policy 1 only when it is voter-optimal, this updated belief is increasing in p. Hence, when p is relatively low—so that voters think $\omega = 2$ is likely—choosing policy 2 is beneficial for improving reputation even when ω is actually 1, leading to an extremism equilibrium. However, note that p does not have to be less than 1/2, and thus even when voters believe that $\omega = 1$ is more likely, politicians may choose policy 2. This property contrast to the pandering literature (Maskin and Tirole 2004) comes from the fact that the policy attracting the support by voters is always the radical policy in our model, whereas the radical policy attracts a lot of support only when $p < 0.5$ in the literature.

We note two remarks. The first one is about welfare properties.[37] When p is notably small,

[36]Here, we assume that the non-extremism equilibrium arises if it exists. This is consistent with the equilibrium concept introduced in section 3.5.1.

[37]The presented welfare ranking implicitly assumes that the incumbent does not serve again because we only consider welfare from the current term. Such a situation is natural when the incumbent faces the term limit and is concerned about his/her reputation in order to establish a legacy or improve the post-political life. On the other hand, when the incumbent is able to serve another term and reputation concerns are primarily reelection concerns (see the model presented in Section 3.7.2), the extremism equilibrium might be beneficial because it facilitates detecting bad incumbent politicians, namely, exhibiting a positive selection effect (Besley 2006). Even in this setting, we can show that the extremism equilibrium must be detrimental as long as the policy issue in the second

the equilibrium is (E2). In this equilibrium, the non-congruent type chooses policy 0, which is never optimal for the voter, with a certain probability. That is, the voter suffers from severe tyranny as well as extremism. This is the worst equilibrium for the voter, and so democracy performs the worst. On the contrary, in the non-extremism equilibrium, the congruent type always chooses the optimal policy and the non-congruent type is also well-disciplined in the sense that s/he choose policy 1, which is the best equilibrium for the voter. These conclusions are summarized in the following fact.

Fact 3.2. *For any ω, the equilibrium that offers the voter the highest payoff is the (NE) equilibrium, while the equilibrium that offers the voter the lowest payoff is the (E2) equilibrium. Hence, when $p > \bar{p}$, the voter-optimal equilibrium in the single-country model is the (NE) equilibrium.*

The second remark is on the equilibrium when $p = 0$. So far, we have explored the case wherein $p \in (0,1)$. However, as seen later, $p = 0$ could be the case in the dynamic model.

Lemma 3.2. *When $p = 0$ and $\omega = 2$, $\alpha^*(2;2) = 1$ and $\beta^*(0) = 1$ in any equilibria.*

3.5 Equilibrium: Multi-Country Model

We next consider the case wherein $N \geq 2$.[38] We suppose that the state of the world is at least imperfectly correlated across countries. To capture this, we assume the following Markovian transition of states.[39] For all i and for each $j \in \{1,2\}$,

$$\Pr(\omega_{i+1} = j | \omega_i = j) = \theta_j \in (1/2, 1). \tag{3.1}$$

$\theta_1 (\theta_2)$ represents the stability of the state 1 (2). The values of θ_1 and θ_2 are known to voters as well as politicians. When $\theta_1 = \theta_2 = 1$, every country's state of the world is the same, while otherwise, the state of the world is only imperfectly correlated. In this section, we suppose that $\theta_1 = \theta_2 = 1$ (i.e., the state of the world is the same across countries) to fix the idea in the simplest case. We analyze the case where ω_i varies across countries in section 6.

3.5.1 Equilibrium Concept

First, let us formally define the equilibrium concept. Define *public history* at the beginning of period i by $h^i \equiv (x_1, ..., x_{i-1}) \in H^i \equiv X^{i-1}$. Politician i's strategy is given by $s_i : H^i \times \Omega \times T_i \to \Delta(X)$. $(p_i, 1-p_i) \in \Delta(\Omega)$ denotes the belief that voter i attaches to state 1 and 2. Our equilibrium concept is the voter-optimal Markov perfect Bayesian equilibrium:

Definition 3.2. *$(s_i^*, \pi_i^*, p_i^*)_{i \in \{1,...,N\}}$ constitutes an equilibrium if*

(i) They constitute a perfect Bayesian equilibrium;

term is not very important (k in the model of section 3.7.2 is low) and the election result is sufficiently volatile (ε is large). The formal proof is available upon request.

[38] Though we mainly consider the situation wherein each i is a different country, our model can analyze the domino effect of populist extremism overtime within one country.

[39] This is a standard way to introduce the correlation in the literature of information cascades (e.g., Moscarini, Ottaviani, and Smith 1998; Peck and Yang 2011).

(ii) For the congruent type, $s_i^* : \Delta(\Omega) \times \Omega \times T_i \to \Delta(X)$ and for the non-congruent type, $s_i^* : \Delta(\Omega) \to \Delta(X)$—That is, the equilibrium strategy of politician i depends only on their type and voter i's belief p_i, and in the case of the congruent type, it also depends on the state of the world; and

(iii) Given $p_i^* \in [0,1)$, (s_i^*, π_i^*) is the voter-optimal equilibrium in the static model.

(i) and (ii) imply the Markov perfect Bayesian equilibrium.[40] When $p_i \geq \bar{p}$, there are multiple equilibria. (iii) implies that the equilibrium in each stage game is the voter-optimal one.[41] This selection is reasonable from the following two perspectives. First, we typically focus on the principal–optimal equilibrium in the analysis of agency problems, and the voter in our model corresponds to the principal.[42] Second, from Fact 3.2, when there are multiple equilibria, the voter-optimal equilibrium is the non-extremism equilibrium. Hence, our selection is equivalent to the selection of the non-extremism equilibrium, if it exists. This is a conservative analysis of how likely extremism is to proliferate because we focus on the case wherein extremism is least likely to arise.[43]

Lastly, we assert the following assumption, which guarantees that $p \in [0,1)$ exists, such that the non-extremism equilibrium arises.

Assumption 3.2. $\bar{p} < 1$.

By focusing on the voter-optimal Markov perfect equilibrium and imposing Assumption 3.2, the equilibrium of country i can be summarized as in Figure 3.1. Extremism arises if and only if the belief p_i is sufficiently small. Moreover, small p_i might also induce tyranny by making the non-congruent type take policy 0. Under $\omega = 1$, extremism and tyranny are the causes of inefficient policymaking.

3.5.2 Updated Beliefs

Our starting point is voters' learning processes regarding the state of the world. We assume that $p_1 \in (0,1)$. When $p_{i-1} \in (0,1)$, p_i ($i \geq 2$) is given recursively based on the Bayes rule:[44]

$$p_i(x_1, \ldots, x_{i-2}, 1) = \begin{cases} \frac{1+(b-1)p_{i-1}}{b} \ ((E2) \ \textit{equilibrium}) \\ \frac{p_{i-1}(q_L+(1-q))}{p_{i-1}q_L+(1-q)} \ ((E1) \ \textit{equilibrium}) \\ \frac{p_{i-1}}{p_{i-1}q+(1-q)} \ ((NE) \ \textit{equilibrium}) \end{cases} ;$$

[40] The non-congruent type's strategy does not depend on ω, because the payoff is irrelevant for this type politician.

[41] We cannot conduct the equilibrium selection using criteria such as the intuitive criterion because the multiplicity of equilibria does not occur based on off-path belief formation. Such multiplicity of equilibria sometimes arises in political agency problems with the finite action space (e.g., Fox and Shotts 2009).

[42] An example focusing on the voter-optimal equilibrium is Forand (2015).

[43] Although we focus on the voter-optimal equilibrium for simplicity, the key for our results is that there exists a threshold value of p, such that the equilibrium is extremism if and only if p is less than that value. Hence, the wider class of equilibria indeed give us the almost same results. To illustrate, denote the equilibrium probability of policy 2 being implemented in country i given p_i by $R^*(p_i)$. We then define *the monotonic Markov perfect Bayesian equilibrium* by the equilibrium wherein (i) and (ii) are satisfied, while (iii') $R^*(p)$ is weakly decreasing in p (i.e., monotonicity holds). As long as we consider the monotonic Markov perfect Bayesian equilibrium, we obtain similar results.

[44] We do not present the posterior for the (E3) equilibrium because it does not occur according to our equilibrium concept.

$$p_i(x_1,...,x_{i-2},2) = \begin{cases} 1 - \frac{(1-p_{i-1})q}{(1-p_{i-1})q_L+q_H} \; ((E1) \text{ and } (E2) \text{ equilibria}) \\ 0 \; ((NE) \text{ equilibrium}) \end{cases} ;$$

$$p_i(x_1,....,x_{i-2},0) = p_{i-1} \; ((E2) \text{ equilibrium}).$$

3.5.3 Spread of Extremism

We show that populist extremism is contagious due to the interaction with the public opinion. Since the radical policy induced by populist extremism is problematic when the voter-optimal policy is the moderate policy, we assume that $\omega = 1$ in this section.

Populist Extremism Induces Opinion Radicalization

As seen in the updated belief derived in the previous subsection, the voter's belief about the optimal policy changes depending on the policy. To understand these opinion dynamics more clearly, we define *opinion radicalization* as follows.

Definition 3.3. *Fix h^i and $\omega = 1$. An equilibrium in country i $(\alpha^*, \beta^*, \gamma^*, \pi^*)$ induces more severe opinion radicalization if for some $x \in X^*(1)$, $p_{i+1}(h^i, x) < p_i(h^i)$ holds.*

From this definition and the updated belief, we obtain the following fact.

Fact 3.3. *Suppose $p_i \in (0,1)$ and $\omega = 1$. Extremism equilibria induce more severe opinion radicalization, whereas non-extremism equilibria never induce more severe opinion radicalization.*

Hence, when the moderate policy is the voter-optimal one, extremism equilibria induce more severe opinion radicalization. Let us illustrate this through an example of immigration policy. Suppose that the voters in country 2 are unsure about how much immigration adversely affects their social and economic situations.[45] Now, the voter in country 2 learns that country 1 enacted stringent immigration policies toward immigrants (i.e., the radical policy). Although such policies may have been implemented by a biased populist (the congruent type H), they cannot rule out the possibility that the politician in country 1 did so because it was actually good (i.e., it was implemented by the congruent type L). Thus, observing country 1's strict policy toward immigrants makes voters in country 2 believe that a strict immigration policy may be desirable even if the policy in country 1 is implemented by a populist. As such, extremism in country 1 induces opinion radicalization in country 2.

Opinion Radicalization Exacerbates Populist Extremism

Further, opinion radicalization in turn induces extremism because of Proposition 3.2. Consequently, we have an interaction between opinion radicalization and extremism. The result of such an interaction can be seen in the following lemma.

[45] We consider the following situation. No regulation on immigration is obviously too loose for voters (or at least voters think so), but some non-congruent politicians seek such policies. Then, policy 0 represents no regulation. Policy 2, for example, represents the very strict regulation, whereas policy 1 represents moderate regulation.

Lemma 3.3. *Suppose* $\omega = 1$.

(a) *For each* $\tilde{p} \in (0,1]$, $\Pr(p_{i+1} < \tilde{p}|p_i)$ *is weakly decreasing in* p_i.

(b) $\Pr(p_{i+1} \geq \bar{p}|p_i) = 1$ *for* $p_i \in [\bar{p}, 1)$, *while* $\Pr(p_{i+1} \geq \bar{p}|p_i) < 1$ *for* $p_i \in (0, \bar{p})$.

(a) indicates the probability of an extremism equilibrium arising in country $i+1$ being weakly decreasing in p_i—that is, opinion radicalization in country i induces extremism in country $i+1$. When opinion radicalization is severe in country i, the equilibrium entails extremism so as to implement radical policy. After the implementation of the radical policy, country $i+1$'s opinion becomes more radical, whereby country $i+1$ also captured by extremism. Furthermore, when country i's opinion is too radical, country i's moderate policy might not prevent extremism in country $i+1$. To worsen the situation, low p_i further limits the opportunities for learning because the probability that the non-congruent type will implement policy 1 decreases as p_i decreases. This further delays the moderation of public opinion. As such, country i's opinion radicalization induces country $i+1$'s extremism.

Next, (b) shows that extremism in one country paves the road to extremism in the subsequent country, while non-extremism never triggers extremism. When the public opinion is not radical in country i (i.e., $p_i \geq \bar{p}$), extremism never arises in country $i+1$, because policy 2 is never implemented in country i. Then, $p_{i+1} \geq \bar{p}$ always holds. Thus, once country i is not captured in the extremism equilibrium, every subsequent country never suffers from extremism. On the contrary, when country i's public opinion is radical (i.e., $p_i < \bar{p}$), country $i+1$ could face extremism through the implementation of the radical policy.

The iteration of this mechanism yields the domino effect of extremism as follows:

Proposition 3.3. *Suppose* $\omega = 1$.

(a) *Fix* $k \in \{1, ..., N-1\}$. *For* $i \in \{k+1, ..., N\}$, $\Pr(p_i \geq \bar{p})$ *is weakly increasing in* p_k.

(b) *Suppose that* $p_1 < \bar{p}$. *For* $x \in \{0,1\}$ *that is on-path and* $i \in \{2, ..., N\}$, $\Pr(p_i \geq \bar{p}|x_1 = 2) \leq \Pr(p_i \geq \bar{p}|x_1 = x)$. *In addition, there exists* $p_1 \in (0, \bar{p})$, *such that for* $x \in \{0,1\}$ *that is on-path and* $i \in \{3, ..., N\}$, $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = x)$.

(a) is the straightforward extension of Lemma 3.3. The depth of opinion radicalization indicates the depth of extremism; thus, extremism arises in subsequent countries with a lower probability as the opinion radicalization in country k exacerbates.

(a) implies (b), indicating the domino effect of extremism. In particular, (b) argues that, given country 1 is in the extremism equilibrium, whether the radical policy is implemented in country 1 affects the probability of each subsequent country being in the extremism equilibrium. In particular, the implementation of the radical policy in country 1 induces extremism in subsequent countries. While we do not specify why country 1 is in the extremism equilibrium, in section 3.7.1, we argue that shocks to political distrust in country 1 may induce the extremism equilibrium in country 1 and leads to the contagion of extremism.

To observe contagion process in more detail, we analyze a numerical example. In Figure 3.2, we present the respective average path of beliefs p_i when country 1 implements policy 1 (blue) and 2 (red). It also shows the green path denoting the scenario wherein county 1 takes policy 2, but the non-extremism equilibrium is hypothetically assumed to be realized in all of the subsequent countries.

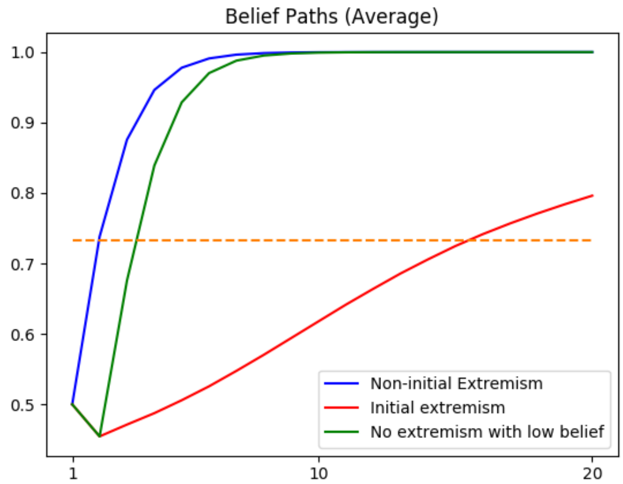

Figure 3.2: Contagion of populist extremism.

Notes: The parameter values are $l = 4$, $p_1 = 0.5$, $q_H = 0.5$, $q_L = 0.1$, $\omega = 1$, and $b = 2.1$. The blue (red) line describes the dynamics of beliefs when $x_1 = 1(2)$. The counter-factual green line describes the dynamics of beliefs when $x_1 = 2$ and the equilibrium is always the non-extremism equilibrium independently of p. Following Chen and Suen (2016), for each case, we simulate the equilibrium for 100,000 iterations and obtain the path of p_i. We then calculate the average for each i and obtain the average path of p_i.

A comparison of the blue and red lines reveals that country 1's policy crucially affects the contagion of extremism. If the country does not implement the radical policy, the extremism equilibrium ends relatively soon. On the contrary, the implementation of the radical policy propagates throughout many countries. The comparison between the red and green lines shows that the effect of the radical policy in country 1 is not limited to the change in country 2's public opinion. Recall that the green line is the hypothetical scenario wherein the non-extremism equilibrium is always taken, provided that the belief at the beginning of period 2 is equal to that of the red line. In this case, the spread of populism immediately ends. However, this does not happen in the actual equilibrium. When the radical policy is chosen in country 1, country 2 is also captured in the extremism equilibrium, which, in turn, induces distorted learning in the subsequent countries. Hence, the red line is far different from the green line.[46]

The severity of the contagion of extremism might be more pronounced once we recognize the possibility of a long-lasting domino effect. Figure 3.3 shows the country at which the extremism stops for the first time in the case of the red line in Figure 3.2. When the extremism occurs in all countries $i \leq 20$ and the extremism occurs for country $i = 21$, the value is shown as 21.[47] Figure 3.3 shows that the domino effect might be so strong that the extremism does

[46]The immediate termination of extremism in the hypothetical scenario is mostly because policy 1 is taken with probability 1 when $\omega = 1$. Formally, under the hypothetical scenario, we can prove that there exists $\bar{N}$, such that for all $i \geq \bar{N}$, $\Pr(p_i \geq \bar{p} | x_1 = x) = 1$ for $x \in \{0, 1, 2\}$. That is, the implemented policy in country 1 has no long-run effect in terms of whether the belief exceeds the threshold $\bar{p}$. Moreover, in practice, $\bar{N}$ is reasonably small because policy 1 is always taken. Contrasting this result with Proposition 3.3 (b) implies that the implemented policy in country 1 has the prolonged effect not only because the public opinion in country 2 changes, but also because it in turn induces extremism in subsequent countries.

[47]In this numerical example, after policy 2 implemented in country 1, country 3 must experience extremism

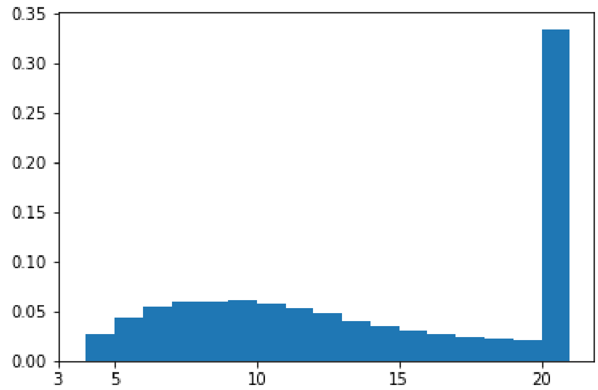

Figure 3.3: When the domino stops.

Notes: This histogram shows the frequency that the first country out of the extremism is i. If the extremism equilibrium continues for all $i \leq 20$, it shows 21. It corresponds to the red line (i.e., policy 2 in country 1) and the parameter values are $l = 4$, $p_1 = 0.5$, $q_H = 0.5$, $q_L = 0.1$, $\omega = 1$, and $b = 2.1$. We simulate the equilibrium 100,000 times to obtain the frequency.

not stop until 20 countries.

These arguments indicate that the interaction between opinion radicalization and extremism causes the spread of extremism. Note that from a different perspective, Proposition 3.3 indicates the hysteresis effect, such that country 1's politician's type affects the other subsequent countries' policy choice. In Figure 3.2, when country 1's policymaker is the congruent type L, the subsequent countries do not suffer from extremism. On the contrary, when the politician is the congruent type H (i.e., a populist), the subsequent countries are also likely to face populism due to the long-lasting negative externality created by country 1.

The resulting spread has a substantially negative impact on welfare. Note that, in the extremism equilibrium, both populist extremism and tyranny take place and both are detrimental to welfare. In the extreme case of $p_i \simeq 0$, the congruent H type always takes policy 2, while the non-congruent type almost always takes policy 0. The contagion of populist extremism induces a malfunctioning democracy in both respects.

3.5.4 When the Domino Effect Stops: Paradigm Shift

Given that the populist extremism is contagious, the next natural question is how likely it is to stop. In contrast to standard herding models, under a certain condition, the contagion suddenly stops for *any* belief. We call this situation the "paradigm shift." We again suppose that $\omega = 1$.

Proposition 3.4. *Suppose $\omega = 1$. When $(b-1)b \leq \frac{q}{1-q}$, for any i and any history h^i, which can occur on the equilibrium path, such that $p_i(x_1, \ldots, x_{i-1}) < \bar{p}$, $\Pr(p_{i+1} \geq \bar{p} | p_i) > 0$.*

Hence, under certain conditions, even if the public opinion is too radical (i.e., p is small), the voter stops believing that the radical policy is optimal after observing the moderate policy (i.e., p becomes large); thus, the politicians no longer choose the radical policy. As such, extremism stops. That is, a paradigm shift from extremism to non-extremism suddenly occurs,

even if country implements policy 1. On the other hand, if country 1 implements policy 1 (i.e., the blue scenario in Figure3.2), country 2 does not experience extremism.

even if the degree of extremism is severe. The paradigm shift is surprising. To observe it, let us contrast our result to the following updating process. The state space is $\Omega = \{1,2\}$, and the voter receives a signal about the state of the world: $s \in \{1,2\}$, where $\Pr(s = \omega) = \alpha \in (1/2,1)$. Then, the likelihood of the posterior p' given $s = 1$ is

$$\frac{p'}{1-p'} = \frac{p}{1-p}\frac{\alpha}{1-\alpha}, \tag{3.2}$$

using the prior p. Hence, as $p \to 0$, $p' \to 0$, indicating that the result in Proposition 3.4 never holds. Our setting is similar with this process. The moderate policy is just an imperfect signal that $\omega = 1$, and the voters are Bayesian rational. Nonetheless, we have Proposition 3.4.

Strategic interactions play a key role in triggering the paradigm shift. When p is sufficiently small, the non-congruent type mixes policies 1 and 0. In particular, the probability that this type chooses policy 1 is increasing in p. This implies that the smaller p is, the higher the precision of policy 1 is as the signal because, in the extremism equilibrium, policy 1 is implemented either by the non-congruent type under $\omega = 1,2$ or the congruent L under $\omega = 1$. Hence, α in (3.2) is decreasing in p. In particular, $\alpha \to 1$ as $p \to 0$. As a result, even if $p \to 0$, p' does not converge to 0.

3.5.5 The Domino Effect in the Long-Run: Asymptotic Learning

Extremism is contagious—at least in the short-term. While this spread may occur long enough to have detrimental effects on many nations' welfare, such a contagion can suddenly stop due to the paradigm shift.

The following proposition shows that voters can learn the (invariant) state of the world in the long run, eliminating the possibility of perpetual extremism due to a single shock.

Proposition 3.5. *(a) Suppose* $\omega = 1$. *Then,* $\Pr\left(\lim_{N\to\infty} p_N = 1\right) = 1$.

(b) Suppose $\omega = 2$. *Then,* $\Pr\left(\lim_{N\to\infty} p_N = 0\right) = 1$.

Voters try to learn the state of the world only through politicians' distorted policies. Nonetheless, this proposition argues that voters eventually learn the truth. Hence, at least in the long-term, politicians' extremism does not influence voters to wrongly believe that the radical policy is good. Furthermore, since extremism does not arise when p is close to one, the spread of extremism eventually stops when the optimal policy is the moderate one. That is, the contagion of extremism does not last forever when the radical policy is not good.

The key is the existence of the congruent type L, which can be arbitrarily small. Such politicians sincerely implement the voter-optimal policy, which allows information about the state of the world to be partially transmitted to voters. Consequently, voters learn the truth asymptotically.[48] That is, the existence of politicians who sincerely implement the voter-optimal policy prevents the domino effect of populism from continuing forever. Notably, any arbitrarily small fraction of the congruent type L is enough for the asymptotic result.

The exact fraction of the congruent type L does not matter for the asymptotic result. Yet, it certainly affects the stopping time of the domino effect. To illustrate this, let us first consider

[48] Using a different model, Goeree, Palfrey, and Rogers (2006) also find that social learning is successful in the long-term. They extend the standard social learning model à la Banerjee (1992) so that each player's payoff consists of the common value, which depends on the state of the world as well as the individual value.

the probability that the domino effect stops in country $i+1$, given p_i. This is indeed decreasing in the fraction of the congruent type L.

Fact 3.4. *Suppose $\omega = 1$. Fix q.*[49] *For any $p_i \in (0, \bar{p})$, $\Pr(p_{i+1} \geq \bar{p})$ is decreasing in q_L.*

To observe further, in Table 3.1, we present the frequency of long-lasting extremism (i.e., extremism continues at country $i = 21$), given the radical policy in country 1. Again, we change the fraction of the congruent type L keeping q fixed. The results show that the frequency is highly sensitive to q_L and long-lasting extremism occurs much more often when q_L is small.[50] These results together indicate that the domino effect is less likely to end with less congruent type L politicians. It should be emphasized that the asymptotic property does not mean that the spread of extremism is irrelevant. Particularly in international contexts, the number of countries that share the same state of the world may not be noticeably large. The short-term effect is still important, as seen in Table 3.1.

υ	0.8	0.82	0.84	0.86	0.88	0.9	0.92	0.94	0.96	0.98
Frequency	0.133	0.157	0.196	0.232	0.274	0.299	0.332	0.389	0.52	0.718

Table 3.1: Frequency of long-lasting extremism.

Notes: The table shows the frequency that extremism takes place in country 21. Let $\upsilon \in (0,1)$ be the parameter, such that $q_H = \upsilon q$ and $q_L = (1-\upsilon)q$. By changing υ, we investigate the change in q_L, keeping q fixed. The parameter values are $l = 4$, $q = 0.65$, $\omega = 1$, $b = 2.1$, and $p_1 = 0.4$. We suppose that policy 2 is implemented in country 1. We simulate the economy 100,000 times in calculating the frequency. All numbers are rounded up to three decimal places.

In contrast to standard models of social learning, learning may not improve welfare even though the true information is eventually learned. This is because we have two sources of welfare loss: the populist extremism and the tyranny. From Fact 3.2, when p is too low, voters' welfare is the lowest because tyranny is severe (i.e., the voter cannot discipline the non-congruent type). However, when $\omega = 2$, p goes to zero as a result of social learning. Thus, for $\omega = 2$ and sufficiently large N, voters' utility in country N when the history is unobservable (i.e., $h^N = \emptyset$) is strictly higher than the case wherein voter N observes history. Hence, social learning is not necessarily welfare-improving.

3.6 Imperfect Correlation

So far, ω has been assumed to be common across countries. This is a useful simplification in investigating the nature of the spread of extremism. However, in practice, the state of the world is not necessarily the same across countries. Social and economic conditions may be different across countries. National elections are held only occasionally, implying that there is some interval in the election of country i and $i+1$. In either case, the state is likely to be correlated only imperfectly. To this end, we assume that $\theta_1, \theta_2 \in (0,1)$ (see (3.1)).

[49] By fixing q, we can keep $\bar{p}$ fixed.

[50] This relationship does not depend on the parameter values. For various parameter values, we obtain the same relationship. The additional numerical examples are available upon request.

Then, the updated beliefs are given as follows:

$$p_{i+1}(x_1,...,x_{i-1}) = \theta_1 p^*_{i+1} + (1-\theta_2)(1-p^*_{i+1}), \tag{3.3}$$

where p^*_{i+1} is defined by p_{i+1} in section 3.5.1.

In the analysis, we assume the following inequality to focus on meaningful cases:

Assumption 3.3. $1-\theta_2 < \bar{p} \leq \theta_1$ *holds.*

When θ is too low, the policy in the previous country is not informative. For instance, when $\theta_1 = \theta_2 = 1/2$, $p_{i+1} = 1/2$ independently of x_i. Assumption 3.3 argues that the informativeness of the previous policy should not be too low. When the previous policy x_i is the perfect signal of the previous state of the world ω_i, the previous policy should largely affect voters' belief. In particular, the following property (*) should hold: When voter $i+1$ knows that $\omega_i = 1$ (2), p_{i+1} is large (small), such that $p_{i+1} \geq \bar{p}$ ($p_{i+1} < \bar{p}$). Otherwise, the informativeness of the previous state of the world is too low, and hence whether the equilibrium is extremism becomes invariant. In such an environment, it is meaningless to analyze the contagion of extremism. Hence, we impose (*), that is, Assumption 3.3.

3.6.1 Convergence towards Extremism

In the model in section 3.5, voters' beliefs converge toward the truth, and thus at the limit, extremism never occurs so long as $\omega = 1$.

$$p_S \equiv \frac{1-\theta_2}{2-\theta_1-\theta_2} \in (0,\theta_1),$$

which is equal to the steady state probability of ω being 1.[51]

Proposition 3.6. *(a) There exists $p_E \in (p_S, \theta_1)$, such that for any i, $p_i < \bar{p}$ implies that $p_j < \bar{p}$ holds for all $j \geq i+1$ if and only if $\bar{p} \geq p_E$.*

(b) When $\bar{p} \geq p_E$, $\lim_{N\to\infty} \Pr(p_N < \bar{p}) = 1$.

(c) p_E is strictly increasing in θ_1 and weakly increasing in q_L (while q kept fixed).

(a) and (b) argue that, when $\bar{p} \geq p_E$, the equilibrium eventually shifts into the region wherein extremism arises, and extremism then continues forever. A convergence to extremism occurs, which contrasts the result obtained in section 3.5. This result can be illustrated in Figure 3.4. In this example, the initial state is 1 and the implemented policy in country 1 is also 1. Eventually, voters' beliefs decrease to lower than $\bar{p}$, and the equilibrium never shifts outside of the extremism equilibria.[52]

Countries cannot escape from extremism once captured, because the belief p may decrease even if policy 1 is observed, as illustrated in Figure 3.6. The intuition is as follows. Suppose $\bar{p} > p_S$, which is the necessary condition for the convergence toward extremism. In a changing world, a policy is less informative about the state because the state might change in the next

[51] Since $\theta_1, \theta_2 \in (0,1)$, the Markov chain converges to the steady state distribution.

[52] Note that if the states are observable, the convergence to extremism does not occur. Indeed, if $\omega_i = 1$, $p_{i+1} = 0.7 > \bar{p}$.

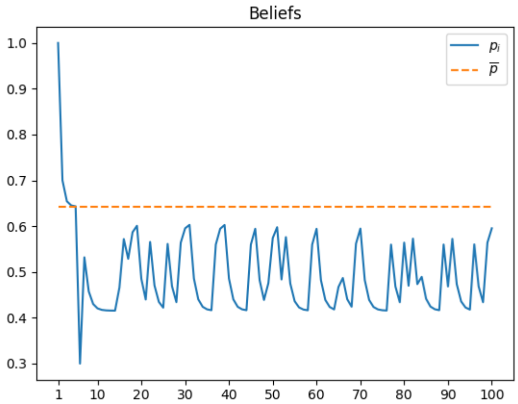

Figure 3.4: Convergence to extremism.

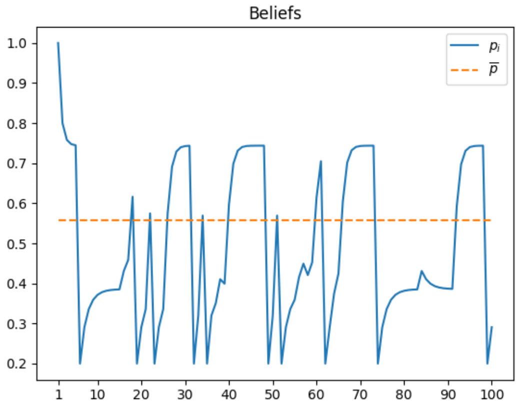

Figure 3.5: Cycles of extremism.

Notes. The left panel is a sample path when $l = 4$; $p_1 = 1$; $\omega_1 = 1; \theta_1 = \theta_2 = 0.8; q_H = 0.5; q_L = 0.2; b = 2.3$. The right panel is a sample path when $l = 4$; $p_1 = 1$; $\omega_1 = 1; \theta_1 = \theta_2 = 0.7; q_H = 0.4; q_L = 0.3; b = 2.5$. The orange dotted line is $\bar{p}$. The orange dotted line is $\bar{p}$.

period, pushing the updated belief toward p_S, the steady state probability of $\omega = 1$. Thus, when $\bar{p} > p_S$, the belief p around $\bar{p}$ increases less when policy 1 is observed.[53] This is the first force. Furthermore, policy 1 in the extremism equilibrium is not too informative about the true state because both the congruent type L and the non-congruent type take policy 1.[54] Combined with these two forces, policy 1 becomes so uninformative that the belief approaches toward $p_S < \bar{p}$ ("negative updating" in Figure 3.6) even when policy 1 is observed, and hence extremism becomes unavoidable.

This mechanism is confirmed by (c): p_E is increasing in θ_1 and q_L. When θ_1 is large, the state of the world is highly stable, given that the previous state is 1. Hence, policy 1 remains sufficiently informative. In addition, when q_L is high, voters strongly believe that ω_i is likely to be 1—that is, p_{i+1} is high because the congruent type L always takes the optimal policy. On the contrary, when both θ_1 and q_L are small, the information value of policy 1 about the true state of the world is not sufficient to overturn the extremism equilibrium.

This result contrasts the conclusions of the canonical social learning model, where a changing world is less likely to sustain herding (Moscarini, Ottaviani, and Smith 1998; Nelson 2002). The primary reason is the difference in the belief under which distorted policies are implemented. In the canonical model, player i ignores the private signal and herds to the previous actions when p_i is close to either zero or one because the past actions strongly indicate that a certain policy is optimal. Hence, the changing world making p_i converge to a moderate value, p_S, prevents herding. On the contrary, in our model, with political agency problems, politician i implements the distorted policy when $p_i < \bar{p}$. Thus, when $p_S < \bar{p}$, the belief always remains

[53] Indeed, $p_{i+1} \lesseqgtr p^*_{i+1} \Leftrightarrow p^*_{i+1} \gtreqless p_S$.

[54] On the other hand, policy 2 in the non-extremism equilibrium is perfectly informative about the true state, since no politician takes policy 2 under $\omega = 1$. Thus, extremism can start relatively easily. More precisely, suppose that $p_i \geq \bar{p}$. With a positive probability, the radical policy is observed, since the state of the world could be 2. When the radical policy is observed in country i, $p_{i+1} = 1 - \theta_2 < p_S < \bar{p}$. Hence, country $i+1$ is captured in the extremism equilibria. This property facilitates the emergence of extremism.

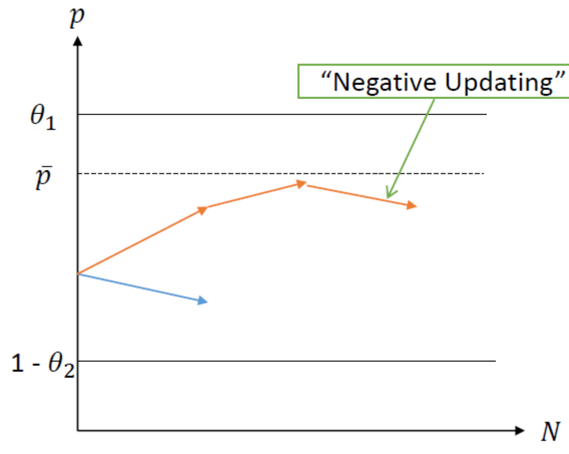

Figure 3.6: Convergence to extremism: Mechanism.

Notes. The orange arrows (blue arrow) represent the updating when the observed policy is 1 (2).

moderate and herding toward extremism occurs.

This result also highlights that the extremism equilibrium is diffused differently from the non-extremism equilibrium. In our model, both of them are diffused. For instance, in the perfect correlation case, both equilibria asympotically arise. However, there is a large difference: When the state of the world is imperfectly correlated, the contagion of the extremism equilibrium could never end, while that of the non-extremism equilibrium eventually ends. That is, the diffusion effect of populism is more severe than that of non-populism.

3.6.2 Cycles of Extremism

Next, we consider the case wherein the convergence does not hold (i.e., $\bar{p} < p_E$). In this case, cycles of extremism are exhibited as seen in the following proposition.

Proposition 3.7. *Suppose $\bar{p} < p_E$.*

(a) For any integer $M \geq 1$, $\lim_{N\to\infty} \Pr(\forall i \text{ s.t. } M \leq i \leq N : p_i \geq \bar{p}) = 0$.

(b) For any integer $M \geq 1$, $\lim_{N\to\infty} \Pr(\forall i \text{ s.t. } M \leq i \leq N : p_i < \bar{p}) = 0$.

Proposition 3.7 shows that the probability of staying in either the non-extremism or extremism equilibrium forever is zero. Thus, in the long-term, we observe both equilibria.

Such cycles can be observed in Figure 3.5. In this example, extremism initially arises. Although it spreads to around 20 countries due to the contagion mechanism described in section 3.5, its proliferation finally ceases. After a while, extremism then re-emerges because, in the case of $\omega = 2$, voters may observe policy 2 even when $p > \overline{p}$. As such, cycles of extremism exist. The mechanism itself is straightforward. Since the state of the world changes across countries, voters' beliefs fluctuate highly. Hence, we obtain cycles.

3.6.3 Extremism and State Instability

Lastly, we investigate when the domino effect becomes serious in the sense that populism in one country induces it in many countries by focusing on the state instability. To simply

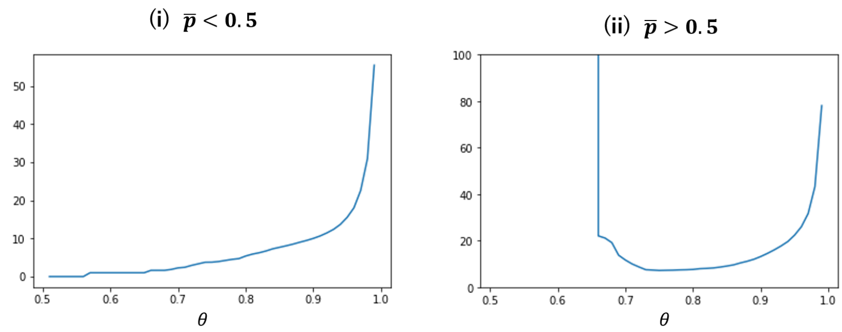

Figure 3.7: Effect of θ on average duration of extremism.

Notes. $q_H = 0.5; q_L = 0.2$. $b = 2.01$ (hence $\bar{p} = 0.432...$) in the left panel, and $b = 2.35$ (hence $\bar{p} = 0.578...$) in the right panel. The figures are calculated by simulating the model by 1,000,000 times and taking the average.

analyze the role of the fluctuation of the state of the world, let us suppose that $\theta_1 = \theta_2 = \theta$ (i.e., $p_S = 0.5$). θ can be interpreted as the stability of the state of the world.[55]

We start with analyzing the condition under which the convergence to extremism occurs.

Fact 3.5. *p_E is strictly increasing in θ.*

Fact 3.5 implies that, decreasing θ triggers the convergence to extremism. This result is straightforward, since the convergence to extremism occurs due to the instability of the moderate state. This leads to the first important observation: The convergence of extremism is more likely to occur in an unstable world.

While this effect is important, it still remains that a serious domino effect may also arise even without the convergence to extremism. To illustrate, Figure 3.7 plots the relationship between θ and the average duration of the extremism equilibrium.[56] The left panel of the figure represents the case wherein $\bar{p} < 0.5$, whereby the extremism is not likely to arise. In this case, an increase in θ induces the longer duration of the extremism equilibrium—That is, the higher stability induces the more severe extremism once extremism arises, which is a contrast to the conjecture we obtain from Fact 3.5. On the contrary, we obtain the non-monotonic relationship in the right panel describing the case wherein $\bar{p} > 0.5$ (i.e., extremism is likely to arise).[57] In short, the relationship between the stability of the state and long-lasting extremism is highly complicated, depending on how likely extremism is to arise.

There are three key factors that make the duration of the extremism equilibrium longer: (i) the higher stability of the radical state, (ii) more opinion radicalization after observing the radical policy, and (iii) less opinion moderation after observing the moderate policy. The higher θ strengthens the former two factors.[58] The effect on the last factor is different depending on

[55] An increase in θ_1 implies an increase in the steady state probability of the state being moderate as well as the higher stability of the moderate state. Hence, to isolate the effect of the changes in stability, we must change the values of θ_1 and θ_2, fixing p_S. The easiest way is to assume the symmetric case wherein $p_S = 0.5$. Note that we can also consider a change in the stability when $\theta_1 \neq \theta_2$. The results do not change much.

[56] Suppose that the extremism equilibrium is observed for countries 12–21, 26–40, and 71–100. Then, the length of each sequence is 9, 15, and 30, respectively. The average duration of the extremism equilibrium is calculated as (9+15+30)/3=18.

[57] Note that, in this case, the convergence to extremism occurs for sufficiently low θ.

[58] When $p_i > 0.5$, higher θ may induce less opinion radicalization after the radical policy because the opinion

whether $\bar{p} < 0.5$ or not. The lower stability makes the belief rapidly converge to 0.5 (the steady state probability). When $\bar{p} < 0.5$, the lower stability is beneficial for countries to escape from extremism after observing the moderate policy. In other words, the higher θ also strengthens the last factor. On the contrary, when $\bar{p} > 0.5$, the lower stability is unbeneficial for countries because then the updated belief falls lower than the threshold $\bar{p}$. That is, the higher θ instead weakens the last factor.

These properties yield the relationship in Figure 3.7. On the one hand, when $\bar{p} < 0.5$, the higher stability strengthens all the three factors inducing the longer duration. It follows that an increase in θ induces the longer duration of the extremism equilibrium.[59] On the other hand, when $\bar{p} > 0.5$, the higher stability weakens the last factor. In particular, when θ is sufficiently small, the effect on the last factor dominates that on the other two factors, and the duration of the contagion begins to decrease in stability θ. Moreover, the convergence to extremism occurs when θ is so small that $\bar{p} > p_E$.

These arguments suggest various forms of populism contagion. For example, suppose that θ is negatively correlated with the geographical distance across countries. In this case, among neighborhood countries, Figure 3.7 suggests a long duration of the populism contagion, although the convergence to extremism is not likely to occur. On the other hand, the contagion may be prolonged even among remote countries when $\bar{p} > 0.5$. Another interpretation of θ is that it is related to the length of the interval between each country's election. In reality, there is some time interval between the election in one country and that in another. The correlation of the state of the world would be weaker as the time span between two elections expands. Our results suggest that, in the year wherein elections are held in many countries (i.e., θ is high), a serious populism contagion might occur if populism appears in one country. When the time interval between elections is long (i.e., θ is low), the convergence to extremism might occur, making the populism contagious when $\bar{p} > 0.5$. Note taht θ may also depend on what is the issue in elections. For example, sometimes immigration policy is important in many countries, while redistribution may be in another time.

3.7 Discussions

3.7.1 Distrust Shock in a Country Triggers the Domino Effect

It has been pointed out that the distrust of politics leads to populism (e.g., Akkerman, Mudde, and Zaslove 2014). Our model captures this idea since q, the fraction of the congruent type, represents the political trust level and $\bar{p}$ is decreasing in q. our model predicts that political distrust in country i induces populism in country i.

Our model implies a surprisingly catastrophical consequence of a distrust shock: the shock in only country 1 induces the domino effect of populism. This implies that representative democracy is fragile against the distrust of politics in the sense that the political distrust shock only in one country can induce populist extremism in subsequent countries.

tends to converge to 0.5. While it may prolong the contagion when $\bar{p} > 0.5$, in our numerical simulations, this effect is mostly not strong enough to overturn the pattern of higher θ being associated with longer duration.

[59]The longer duration of the extremism equilibrium might not imply that extremism is more likely to arise because the duration is the length of the extremism equilibrium conditional upon the extremism equilibrium occurring in a country.

The mechanism is illustrated as follows. Suppose that $\omega_i = 1$ for all i and that the value of q is initially $\bar{q}$, which is relatively high so that $p_1 > \bar{p}(\bar{q})$. That is, populism does not arise in the countries. We then consider the distrust shock in country 1: Country 1's q changes from $\bar{q}$ to $\underline{q}$, while the other countries' q is $\bar{q}$. For example, the scandals about politicians' behaviors are reported in country 1, which intensify the distrust of politics in country 1. A sufficiently large shock leads to $p_1 < \bar{p}(\underline{q})$ so that country 1 is in the extremism equilibrium. Thus, country 1's congruent type H implements the radical policy, which makes country 2's opinion more radical. Consequently, it could be the case that $p_2 < \bar{p}(\bar{q})$ i.e., country 2 is also captured by extremism. That is, the distrust shock in country 1 induces populism in country 1, which in turn induces country 2's populism.

This result emphasizes that some important properties of the domino effect might be overlooked without considering voters' learning. In particular, politicians' learning, which is another important mechanism to explain the domino effect, is unlikely to predict such detrimental consequences of the distrust shock. Indeed, without the concurrent distrust shock, the shock in country 1 is irrelevant to the electoral advantage of country 2's populist parties.

3.7.2 Dynamic Election Model

We provide a foundation of our model as a two-period election model. In period 1, there is an incumbent politician. In each period, there is one policy issue. The policy issue in period 1 is the same as that of our basic model. In period 2, there is another policy issue y. The policy regarding this issue is chosen from $\{0,1,2\}$. Let the policy chosen by country i's policymaker in period 2 be y_i.

At the beginning of period 2, there are two candidates: the incumbent and a challenger who is the congruent type with probability q. Let the valence advantage of the incumbent be θ, which follows a uniform distribution $U[-\varepsilon,\varepsilon]$, where $\varepsilon > 0$. Voter i's utility is given by $-L(|x_i - \omega_i|) - kL(|y_i - \omega_i'|) + \mathbf{1}_i\theta$, where $\mathbf{1}_i$ is the indicator function that takes one if the incumbent is reelected. The voter's optimal policy for the issue in period 2 is $\omega_i' \in \{1,2\}$. However, since the issue is different, its relevance is also different. $k > 0$ represents the importance of the issue in period 2.[60] The prior probability of $\omega_i' = 1$ is denoted by $r \in [0,1]$. To exclude learning about ω_i' and focus on that about ω_i, we assume that ω_i' is determined independently across countries for simplicity. The voter decides whether to reelect the incumbent based on this expected utility.[61] When the voter is indifferent between the incumbent and the challenger, the incumbent is reelected.

The congruent type's utility is given by $-L(|x_i - \omega_i|) + \mathbf{1}_i[\lambda_i - kL(|y_i - \omega_i'|)]$, where $\mathbf{1}_i$ is the indicator function that takes one if the politician is reelected in period 2, and $\lambda_i \geq 0$

[60] Another interpretation is that the policy is irreversible to some extent. Suppose that both are the same issue (and thus $\omega_i = \omega_i'$). If we consider the situation wherein the policy determined in period 1 can be changed in period 2 only with a certain probability, we obtain a similar objective function and the result.

[61] This implies that the voter's strategy is not retrospective in that the voter gives the high evaluation to the incumbent who chooses the radical policy even if $p > 0.5$. Voters instead engages in prospective voting. It can be justified from various grounds. First, it allows us to show that populism could be contagious without assuming any kind of irrationality. Our full rationality assumption implies that the domino effect is a fundamental problem not just stemming from some ad-hoc behavioral assumptions. Second, Woon (2012) experimentally reveals that in a simple pandering model, voters tend to reelect the politician pandering to the public opinion even if the implemented policy is found to be inefficient. This suggests that voters indeed behave prospectively, although he also shows that this conclusion depends on the strategic complexity of the model.

represents the office-seeking motivation.[62] On the other hand, the non-congruent type's utility is $-L(|x_i|)+\mathbf{1}_i[\lambda_i - kL(|y_i|)]$.

Under this setting, the reelection probability of the incumbent is equal to

$$\Pr(\theta \geq (q-\pi)k[r+l(1-r)]) = \frac{1}{2} - \frac{qk}{2\varepsilon}[r+l(1-r)] + \frac{\pi_i(x_i)k}{2\varepsilon}[r+l(1-r)].^{63}$$

under the assumption that $\varepsilon \geq (1-q)k[r+l(1-r)]$. Hence, ignoring constants, the incumbent's objective at the beginning of period 1 is to maximize

$$-L(|x_i - x_i^*|) + \frac{\lambda_i k}{2\varepsilon}[r+l(1-r)]\pi_i(x_i),$$

where $x_i^* = \omega_i$ for the congruent type, while $x_i^* = 0$ for the non-congruent type. Hence, by defining $b_i \equiv \frac{\lambda_i k}{2\varepsilon}[r+l(1-r)]$, the present dynamic election model is reduced to the original model. In particular, the congruent type L has low office-seeking motivation (i.e., small λ_i), whereby b_i is sufficiently low.[64]

3.7.3 Diffusion in Specific Policy Issues

Empirically, various policies have been found to be correlated across space. While various explanations are possible for the policy diffusion, our results indicate a novel explanation and yield some interesting implications. As a primary example, we discuss the implications for yardstick competition in personal income taxation. Besley and Case (1995) show that excessive spending is curbed when citizens observe the political outcomes of other jurisdictions. Our model, on the other hand, reveals a new disadvantage of voters' benchmarking in elections.

Suppose that when $\omega = 1(2)$, jurisdiction experiences moderate (low) fiscal needs. Policy 1 is a moderate tax rate, policy 2 is a low tax rate, and policy 0 is a high tax rate. Here, following Besley and Case (1995), we assume that policy 0 is preferred by a "Leviathan" who seeks fiscal control and is unambiguously harmful to voters. The utility loss of voters depends on the difference between their fiscal needs and the implemented tax rate.

Our propositions predict that low tax rates may be contagious even when fiscal needs are not significantly low. Thus, information flow between jurisdictions may induce excessively low tax rates. The congruent type H sets a lower tax rate than the country's fiscal needs to signal that they are not a "Leviathan". Moreover, the excessively low tax rate in one jurisdiction can propagate because voters in other jurisdictions now believe more strongly that the low tax rate is optimal. This result reveals an important side-effect of yardstick competition. While yardstick competition is typically regarded as beneficial by disciplining politicians, it may also distort policies by facilitating the propagation of wrong information. This drawback of yardstick competition is indeed consistent with Shigeoka and Watanabe (2019) showing that inefficient childcare policy diffused due to election concerns.

[62] As in Kartik and Van Weelden (2019), we normalize the payoff when they are not reelected to zero. Using a slightly different model, analogous results are obtained if the unelected candidate derives utility from policy.

[63] Since politicians are unaccountable in period 2, the expected payoff when the voter reelects the incumbent is $-(1-\pi_i(x_i))k[r+l(1-r)]$, while that when the voter elects the challenger is $-(1-q)k[r+l(1-r)]$. The former is larger than or equal to the latter if and only if $\theta \geq (q-\pi)k[r+l(1-r)]$.

[64] Note that $b < l-1$ holds under weak conditions. To illustrate, suppose that $\lambda_i k/\varepsilon$ for the non-congruent type and the congruent type H is one. Then, $b < l-1$ can be rewritten as $l > (r/2+1)/(r/2+1/2)$, which always holds when $l > 2$.

3.7.4 Applications to Non-Political Issues

There are various non-political settings where agency problems and reputation concerns of agents co-exist (e.g., Ely and Välimäki 2003). We briefly describe the application to managerial delegation, which is a central issue in corporate finance.

Suppose that shareholders are uncertain about whether managers act to maximize shareholders' economic benefits. The non-congruent type manager does not want to pay high dividends. That is, her/his ideal policy is to pay only low dividends, namely, $x = 0$. On the contrary, the congruent type is concerned with the shareholders' benefits. The shareholders' optimal amount of dividends is either high or moderate (i.e., $x = 2$ or 1). Managers care about their own reputation partly because it could affect their future income (Scharfstein and Stein 1990). This setting is formally the same as that of our analysis. Managers try to pay excessively high dividends to acquire a congruent-type reputation. Moreover, upon observing the dividend payment of company A, shareholders of company B start thinking that the high dividend payment is affordable. This belief updating leads the managers of company B to pay higher dividends to acquire better reputation, causing the contagion of excessively high dividend payments. Empirically, Adhikari and Agrawal (2018) and Grennan (2019) show that the behavior of peer firms substantially affects dividend payments. Our model provides a new mechanism that induces inefficient dividend payments through peer effects.[65]

3.8 Concluding Remarks

This chapter investigated the diffusion of undesirable policies in the form of populist extremism. To this end, we constructed a novel social learning model with agency problems. In the single-country model, we showed that populist extremism can arise depending on voters' beliefs about the state of the world. We then analyzed the dynamic multi-country model. We first found that populist extremism is contagious across countries through the dynamic interaction between the public opinion and implemented policies. The long-run dynamics have unique features absent in the canonical social learning models. First, populist extremism could suddenly stop even if the public opinion is quite radical, because of the discontinuous jump of the public opinion. Second, the long-run dynamics depends on the correlation of the state of the world across countries. We showed the possibility of never-ending populist extremism under the imperfect correlation, while extremism eventually stops spreading under the perfect correlation. Overall, we identified novel patterns of policy diffusion.

Before concluding this chapter, we point out the remaining challenges for future research. First, examining whether similar patterns of the propagation occur for other aspects of populism may be worthwhile. Second, studying learning patterns in more complex networks may also be beneficial. Third, although our model assumes Bayesian rationality to focus on the fundamental contagion mechanism, voters might not be Bayesian rational in reality. These issues are left to future work.

[65] Grennan (2019) also demonstrates that younger CEOs, who Grennan supposes to be more strongly driven by reputation concerns than the older ones are, do not seem to exhibit stronger peer effects. While this result might suggest that reputation concerns are not too important, another interpretation is that reputation concerns are equally important for both old and young CEOs. For example, old CEOs may care reputation possibly because high reputation enables them to affect their firms even after the retirement. In a different context, Fong, Malhorta, and Margalit (2019) show that the legacy effect of high reputation exists in the case of politicians.

Chapter 4

Does High Labor Mobility Always Promote Trade Liberalization?*

4.1 Introduction

Many economists argue that trade protection is Pareto inefficient. Nonetheless, in the real world, trade liberalization is achieved only partially and often opposed by many people. The reason is that people in protected industries face loss due to trade liberalization, which is difficult to be compensated perfectly. Indeed, many sources of difficulties of lump sum transfer have been pointed out: the political credibility of future compensation (e.g., Acemoglu and Robinson 2001; Acemoglu 2003; Jain and Mukand 2003), the political feasibility (e.g., Coate and Morris 1995), the information asymmetry (e.g., Mitchell and Moro 2006), and the state capacity (e.g., Jain and Majumdar 2016; Jain and Mukand 2016). Thus, losers oppose trade liberalization.

Given the difficulty of compensation, the strength of the opposition to trade liberalization depends on the degree of sectoral adjustment.[2] If workers in protected industries can move to other industries easily due to low adjustment cost (i.e., labor mobility is high), their loss due to trade liberalization is not severe. Hence, the strength of the opposition would be small. Indeed, many papers show that a difficulty of sectoral adjustment due to labor immobility hinders trade liberalization and subsidies promoting sectoral adjustment are beneficial (e.g., Bradford 2006; Davidson, Matusz 2006; Davidson, Matusz and Nelson 2007; Blanchard and Willmann 2011; Davidson, Matusz and Nelson 2012). Such a subsidy scheme is introduced in many countries: a typical example is Trade Adjustment Assistance in the United States.

However, does higher labor mobility really promote trade liberalization? To be sure, the higher labor immobility implies the larger the number of people who oppose trade liberalization, which induces trade protection under direct democracy. However, our society employs representative democracy wherein we face conflicts of interests between politicians and voters. We construct a model that combines a simple two-period election model with a two-period

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[2]Sectoral adjustment plays an important role in politics of trade liberalization and has been discussed in many papers (e.g., Staiger and Tabellini 1987; Fernandez and Rodrik 1991; Brainard and Verdier 1997; Maggi and Rodriguez-Clare 1998; 2007).

sectoral adjustment model employed by Blanchard and Willmann (2011).[3] We then show that the non-monotonic relationship between labor mobility and trade liberalization arises under representative democracy.

The key is conflicts of interests between politicians and voters. In reality, even a politician elected from a district whose electorate prefers trade protection often thinks that trade should be liberalized to some extent. How does such politician – the politician who is less protectionist than the electorate is – behave? Since trade policies affect the outcomes of elections (e.g., Autor et al. 2016; Che et al. 2016), the politician decides her/his action given that it can affect the outcomes of elections. More specifically, whether the politician deceives the electorate (i.e., whether s/he tries to implement trade liberalization) would depend on her/his electoral strength. On the one hand, suppose that the politician's base of the support is weak. Then, the politician will lose an election after trying to liberalize trade policies, and thus s/he supports trade protection. On the other hand, if the politician's base of the support is strong, s/he will win the election even after supporting trade liberalization. Given this, the politician promotes free trade. Indeed, this mechanism is shown empirically by several studies (e.g., Feigenbaum and Hall 2015; Ito 2015).[4] This relationship between the electoral strength and trade policies is what creates the non-monotonic relationship between labor mobility and trade liberalization.

To see this, consider a two-period model in which the politician who is elected by voters chooses the tariff rate in each period. Suppose that the incumbent politician in period 1 is the most pro-protection among politicians, but prefers a lower tariff rate than the current level. Thus, workers in protected industries face conflicts of interests even with the most pro-protection politician. Under this setting, workers in the protected industries are supporters of this pro-protection politician because other politicians would implement a lower tariff rate than that this politician would implement.[5] Thus, a reduction of the current tariff rate undermines the pro-protection politician's base of support since the number of workers in protected industries decreases as a result of sectoral adjustment. Therefore, whether the pro-protection politician reduces the current tariff rate depends on if the base of support is strong in terms of the degree of sectoral adjustment.

Under high labor mobility, sectoral adjustment occurs on a large scale. As a result, the politician loses a lot of supporters after the reduction of the tariff rate and cannot win the election. Thus, the politician maintains the current level protection in order to win the next election. By contrast, under low labor mobility, sectoral adjustment does not occur. As a result, many voters still vote for the politician even after the reduction of the tariff rate since s/he provides the protection level higher than other politicians do. Thus, the politician reduces the tariff rate, resulting in partial trade liberalization. In short, trade is protected more under high labor mobility than under low labor mobility, implying that higher labor mobility does

[3]To be precise, their model is a two-period overlapping generations model, whereas our model is not an overlapping generations model.

[4]In addition, Conconi, Facchini and Zanardi (2014) show that the electoral pressure in the sense that the remaining term of the incumbent is short, deters the incumbent from supporting free trade. Though a source of the electoral pressure is different from the electoral strength, their study also shows the effect of electoral pressure.

[5]The validity of this logic depends on the presumption that the other politicians cannot commit a higher tariff rate than that the most pro-protection politician can commit. If one of them can do so, the workers in the protected industries may vote for her/him after the most pro-protection politician reduces the tariff rate. We focus on a situation where such a possibility of commitment does not exist by considering a two-period model. Thus, the workers in the protected industries are always supporters of the pro-protection politician.

not necessarily promote trade liberalization. This mechanism creates the non-monotonicity. To our knowledge, the present study is the first to show such non-monotonic relationship due to the conflicts of interests between voters and politicians. Furthermore, the results also shed new lights on the role of representative democracy in the determination of trade policies.

The most related work is that of Jain and Mukand (2003), which develops a model à la Fernandez and Rodrik (1991).[6] They consider an economic reform with individual-specific uncertainty under direct democracy. They then show the non-monotonicity between the number of winners and the likelihood of adoption of the reform. Since the number of winners increases with labor mobility, our result is similar with theirs. However, it should be emphasized that the mechanism generating the non-monotonicity is different. Their focus is the effect of the number of losers on the credibility of future compensation under direct democracy. When the number of losers is not small, the majority would oppose the reform without compensation. Thus, whether the reform is adopted depends on the credibility of future compensation. When the number of losers is large, the sufficient number of voters agree to compensation even after the reform. Thus, compensation becomes credible so that the reform is adopted. However, when the number of losers is moderate, compensation is no longer credible because the ex-post number of winners who oppose compensation is large. As a result, the majority would oppose the reform. Therefore, an increase in the number of winners does not necessarily induce the reform. In their model, the non-monotonicity is created by the effect of the number of winners on the credibility of future compensation. In contrast, there is no possibility of compensation in our model. Instead, we consider representative democracy. Then, we show that it is created by the effect of the number of winners on the principal-agent relationship. Since trade policies are determined by elected politicians in most countries, our result is insightful.

4.2 The Model

The model consists of two politicians (A and B)[7] and continuum of workers with measure one. Workers have the rights to vote, and thus they are also voters. We employ a two-period model. At the beginning of each period, the policy-maker is elected, and the winner of the election decides the current tariff rate. After that, workers decide where they are working. The discount factor is $\delta \in (0,1]$.

4.2.1 Consumption

The settings in this and the next subsections are based on those of Blanchard and Willmann (2011). Workers produce and consume every time in their life. There are two goods L and H. This county is a small open economy, and only good L is protected using tariff.

Denote the relative price of good L by 1 as numeraire. Define $\tau =$(tariff rate of good L)+1.[8] Here, there are only three alternatives of the tariff rate: $\tau \in \{\tau_H, \tau_M, \tau_L\}$, where $\tau_H > \tau_M >$

[6] Giordani and Mariani (2019) also present a mechanism similar with that of Jain and Mukhand (2003), though their model has no individual uncertainty.

[7] An alternative interpretation is that there are two political parties.

[8] The model excludes tariff revenue in order to focus on sectoral adjustment. This simplification has been adopted by several studies (e.g., Krishna and Mitra 2008).

$\tau_L \geq 1$.[9] Using these expressions, the relative price of good H, p, can be written as p_w/τ where p_w is the world price of good H. The price of good L is assumed to be smaller than the price of good H i.e., $p_w > 1$.

Denote the amount of consumption of good L in period t by $x_L(t)$ and that of good H by $x_H(t)$. We use a Cobb-Douglas utility function as the utility function in period t: $u(x_L(t), x_H(t)) = x_L(t)^{1-\alpha} x_H(t)^{\alpha}$. Assume that there is no intertemporal substitution, for simplicity.[10] Then, the indirect utility in period t is $v(p(t), I(t)) = Kp(t)^{-\alpha} I(t)$, where $K = \alpha^{\alpha}(1-\alpha)^{1-\alpha}$. Here, $I(t)$ is the income in period t. The total utility throughout one's life is $v(\tau_1, I(1)) + \delta v(\tau_2, I(2))$.

4.2.2 Production

Each good is produced only by labor under perfect competition with constant returns to scale technologies. The production of good L does not require any skills, but the production of good H requires skills. The productivity about good L is the same across workers and every worker can create one unit of goods per one unit of labor. The productivity of producing good H is different across workers and each worker can produce a unit of good H per one unit of labor. Here, a represents each worker's own ability, which is distributed over $[0, A]$ following a distribution function G. This distribution function has no mass point and has full-support. Here, $A \in \mathbb{R}^+$. Each worker's value of a is known to all the workers and all the politicians. We call the worker, whose ability is a, *worker a*.

Let the wage for producing one unit of each good be W_H, W_L respectively. Then, the wage for working for one unit of time in each industry becomes aW_H, W_L. Under perfect competition, the wage for producing one unit of good must be equal to the price of the good. Thus, the wages for working for one unit of time in industries H and L are ap and 1 respectively.[11]

Producing good H requires skills. Although one's skill depends on her/his innate ability, workers cannot obtain the skills without training. Training takes one period and workers have to pay c units of labor for training. In addition, workers work in industry L during training. Thus, one's wage during training is $(1-c)W_L = (1-c)$. For example, workers, who decide to work in industry H at birth, undergo training in period 1 and work in industry H in period 2. We assume that a worker chooses to begin to train if the utility when beginning to train is the same as the utility when remaining in industry L. In addition, c is assumed to be large so that the following inequality holds:

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[9] The assumption that only three tariff rates are available could be plausible for the following reason. Suppose that this country is not part of any international trade agreement, but it can sign an agreement with an existing group of countries. The country can sign the agreement either (i) as a partial member of the trade agreement, implying the moderate tariff rate τ_M, or (ii) as a full member of the group, implying the lowest tariff rate τ_L. Therefore, the country has only partial control of the tariff and cannot control the values of τ_M and τ_L.

[10] Under constant marginal utility of income, workers' decisions on job-change are independent of savings and wealth. This formulation allows us to focus on people's job-change decisions abstracting from consumption smoothing.

[11] This holds only when the domestic demand for good L is larger than its domestic supply. Otherwise, some of good L produced in the country cannot be sold at the protected high price. Throughout the chapter, we focus on the case where this condition holds by implicitly assuming the existence of sufficiently large external domestic demand for good L. Such external demand exists when there is a sufficient number of consumers who do not engage in production, or when there is subsidy which guarantees that producers of good L can always sell the good at the protected high price.

Assumption 4.1.

$$c > \delta \left[1 - \left(\frac{\tau_L}{\tau_M} \right)^{\alpha} \right].$$

When the adjustment cost c is too low, even workers whose productivity is low begin to train when they expect the low tariff rate in period 2. Those who have low productivity would oppose trade liberalization despite of the fact that they bore the adjustment cost. To guarantee that such workers do not begin to train and thus all the workers who bore the adjustment cost prefer trade liberalization, we need this assumption (see Fact 4.1).

4.2.3 Politician and Election

In each period, the winner of the election decides the tariff rate. We assume the irreversibility of policy change to make our analysis tractable.[12] In other words, all the three alternatives can be chosen in period 1, but only the tariff rates lower than or equal to the tariff rate in period 1 are feasible in period 2. For example, after τ_M is implemented in period 1, only τ_M or τ_L can be chosen as the tariff rate in period 2.

Each politician has a policy preference over τ. Let $\hat{\tau}_i$ be party i's ideal policy. $\hat{\tau}_A = \tau_M$ and $\hat{\tau}_B = \tau_L$ hold.[13] This implies that politician A is more pro-protection than politician B. Each one obtains the utility $-u(\tau, \hat{\tau}_i)$ if tariff rate τ is implemented, where $u(\tau, \hat{\tau}_i) > u(\hat{\tau}_i, \hat{\tau}_i)$ for any $\tau \neq \hat{\tau}_i$. This captures the disutility from policy mismatch. In addition, politician i obtains the utility $b > 0$ if s/he assumes power. b represents office-seeking motivation. In summary, the utility of politician i in period t is: $-u(\tau_t, \hat{\tau}_i) + \mathbf{1}_i(t)b$, where τ_t is the implemented tariff rate in period t and $\mathbf{1}_i(t)$ is an indicator function which takes 1 if and only if politician i assumes power in period t.

At the beginning of each period, there exists an election. All the workers vote sincerely based on their own utilities. If a voter is indifferent between both politicians, the voter votes for politician B.[14] If the amount of votes each politician obtains is the same, politician B wins the election.

4.2.4 Timing of the Game

In summary, the timing of the game is as follows.

[12] We put this assumption for simplicity. We have multiple equilibria, which makes our analysis complicated. To mitigate such complication, we introduce this assumption. In addition, this assumption is realistic because the irreversibility of policy change exists in trade policy. First, in World Trade Organization, countries cannot raise the tariff rates higher than the level of agreed bound duty once after countries agreed to the reduction of bound duty. Second, if we assume that the country is signing a trade agreement with a group of countries, it might be too costly to break the agreement.

[13] That is, even the pro-protection politician prefers not the highest but moderate tariff rate. Several empirical results show that even a politician elected from a district, where the electorate prefers trade protection, proposes trade liberalization under low electoral pressure (e.g., Conconi, Facchini and Zanardi 2014; Feigenbaum and Hall 2015; Ito 2015). This finding suggests that even a pro-protection politician does not necessarily prefer the same degree of protection as that the electorate prefers.

[14] This is imposed in order to guarantee that (i) politician A never implements τ_L in period 1 and (ii) politician B implements τ_L in period 1. To this end, it suffices to assume that politician B wins the election in period 2 when $\tau_1 = \tau_L$ and so both politicians implement the same tariff rate. This is realistic since politicians differ in their expertise and a politician has an advantage at implementing policies closer to her/his own ideal policy. In other words, politician B who prefers free trade would be suitable to implement such policy. The alternative setting is that each voter votes either one with the equal probability when s/he is different between the two candidates. In this case, whether (i) and (ii) hold depends on parameter values. See footnote 17.

Period 1

1. Each worker votes for either politician A or B.
2. The elected politician chooses the tariff rate in period 1.
3. Each worker decides whether to take training. Then, consumption and production are done.

Period 2

1. Each worker votes for either politician A or B.
2. The elected politician chooses the tariff rate in period 2.
3. Each worker decides where to work in period 2. Then, consumption and production are done.

4.2.5 Equilibrium Concept

Lastly, as the equilibrium concept, we employ a subgame perfect equilibrium. To be specific, the equilibrium is defined as follows.

Definition 4.1. *The strategies of each worker and each politician constitute an equilibrium if*

(i) (Sequential Rationality) In any sub-game, for each a, worker a's strategy about training and job-change is optimal given the others' strategies and each politician's strategy is optimal given the others' strategies.

(ii) (Sincere Voting in Period 1) For each a, worker a's voting decision in period 1 $v_a^1 \in \{A, B\}$ *is sincere in the sense that* $v_a^1 = A$ *if and only if the utility when politician A is elected in period 1 and all the players follow the strategies after that is strictly larger than that when politician B is elected in period 1 and all the players follow the strategies after that.*

(iii) (Sincere Voting in Period 2) For each a, worker a's voting decision in period 2 v_a^2 : $\{A, B\} \times \{\tau_L, \tau_M, \tau_H\} \times \{0, 1\}^{[0,A]} \to \{A, B\}$[15] *is sincere in the sense that s/he votes for politician A if and only if the utility when politician A is elected in period 2 and all the players follow the strategies after that is strictly larger than that when politician B is elected in period 2 and all the players follow the strategies after that.*

4.3 Equilibrium

4.3.1 Utility of Workers

Since there are no uncertainty and information asymmetry, workers can expect the tariff rate in period 2 perfectly after the tariff determination in period 1 (i.e., perfect foresight). Thus, workers make decisions about training in period 1 given τ_2. There are two alternatives: (a)

[15] $\{0, 1\}^{[0,A]}$ is history about who took training in period 1.

beginning to train in period 1 and working in industry H in period 2 and (b) working in industry L in both periods. The expected utility of (a) is

$$K\left(\frac{p_w}{\tau_1}\right)^{-\alpha}(1-c)+\delta K\left(\frac{p_w}{\tau_2}\right)^{-\alpha}a\frac{p_w}{\tau_2}, \tag{4.1}$$

while the expected utility of (b) is

$$K\left(\frac{p_w}{\tau_1}\right)^{-\alpha}+\delta K\left(\frac{p_w}{\tau_2}\right)^{-\alpha}. \tag{4.2}$$

4.3.2 Voting in Period 2

We solve the game backwardly. In this subsection, we examine who can win the election in period 2 when politician A assumes power in period 1 and chooses τ_1 as the tariff rate in period 1. Here, politician A obviously has no incentive to choose τ_L as the tariff rate in period 1 since s/he cannot win the election after that. Thus, we focus on the case where $\tau_1 \in \{\tau_H, \tau_M\}$.

Since period 2 is the last period, politician A chooses τ_M as the tariff rate in period 2 and politician B chooses τ_L as the tariff rate in period 2.

It is straightforward that only workers who began training in period 1 can prefer τ_L to τ_M. Worker a begins to train in period 1 if and only if (4.1)≥(4.2):

$$a \geq \frac{\tau_2}{\delta p_w}\left[\delta + c\left(\frac{\tau_1}{\tau_2}\right)^{\alpha}\right].$$

This depends on the expectation about the future tariff rate τ_2 since workers have a larger incentive to begin to train if the future tariff rate is lower.

Some of the workers who bore the adjustment cost c may still prefer trade protection. This is because workers whose a is low can earn only small income in industry H and thus it is better for such workers to work in industry L under τ_M than to work in industry H under τ_L. The workers who began training in period 1 prefer τ_L to τ_M if and only if

$$a\left(\frac{p_w}{\tau_L}\right)^{1-\alpha} \geq \left(\frac{p_w}{\tau_M}\right)^{-\alpha} \Leftrightarrow a \geq \frac{\tau_L}{p_w}\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}.$$

Thus, workers whose ability satisfies

$$a \geq \max\left\{\frac{\tau_L}{p_w}\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}, \frac{\tau_2}{\delta p_w}\left[\delta + c\left(\frac{\tau_1}{\tau_2}\right)^{\alpha}\right]\right\} \tag{4.3}$$

prefer τ_L to τ_M and vote for politician B in period 2. This number is smallest when $\tau_2 = \tau_L$ since the right-hand side of inequality (4.3) is increasing with τ_2. Here, the following fact holds. All the proofs are contained in Appendix C.

Fact 4.1. *For $\tau_1 \in \{\tau_H, \tau_M\}$, the following inequality holds:*

$$\frac{\tau_L}{\delta p_w}\left[\delta + c\left(\frac{\tau_1}{\tau_L}\right)^{\alpha}\right] \geq \frac{\tau_L}{p_w}\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}.$$

Under Assumption 4.1, the adjustment cost is not too low. As a result, workers whose a is too low do not begin to train in period 1. Hence, all the workers who bore the adjustment cost at the beginning of period 2 prefer τ_L to τ_M. This is Fact 4.1.

Therefore, the largest number of votes for politician B in period 2 is

$$1-G\left(\min\left\{A, \frac{\tau_L}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_L}\right)^{\alpha}\right]\right\}\right). \tag{4.4}$$

Denote a such that $G(a)=1/2$ by a_M. Note that this is uniquely determined because G has full-support. Then, (4.4)$\geq \frac{1}{2}$ is equivalent to

$$\frac{\tau_L}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_L}\right)^{\alpha}\right] \leq a_M. \tag{4.5}$$

In summary, we have the following lemma.

Lemma 4.1. *If and only if inequality (4.5) holds, there exists a subgame where politician B wins the election in period 2 in an equilibrium of the subgame, given that the tariff rate in period 1 is* $\tau_1 \in \{\tau_H, \tau_M\}$.[16]

On the other hand, the number of voters who vote for politician A in period 2 is largest when $\tau_2 = \tau_M$, because the right-hand side of inequality (4.3) is increasing with τ_2. In addition,

$$\frac{\tau_M}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_M}\right)^{\alpha}\right] \geq \frac{\tau_L}{p_w}\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}$$

holds since

$$\frac{\tau_M}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_M}\right)^{\alpha}\right] > \frac{\tau_L}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_L}\right)^{\alpha}\right],$$

and Fact 4.1 hold. Therefore, the largest number of voters who vote for politician A is

$$G\left(\min\left\{A, \frac{\tau_M}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_M}\right)^{\alpha}\right]\right\}\right). \tag{4.6}$$

Here, (4.6)$> 1/2$ is equivalent to

$$\frac{\tau_M}{\delta p_w}\left[\delta+c\left(\frac{\tau_1}{\tau_M}\right)^{\alpha}\right] > a_M. \tag{4.7}$$

In summary, we have the following lemma.

Lemma 4.2. *If and only if inequality (4.7) holds, there exists a subgame where politician A wins the election in period 2 in an equilibrium of the subgame, given that the tariff rate in period 1 is* $\tau_1 \in \{\tau_H, \tau_M\}$.

[16]If workers expect that politician A will win in the election, most of them do not change their jobs and as a result, politician A may win in the election. Similarly, if workers expect that politician B will win in the election, most of them change their jobs and as a result, politician B may win in the election. Thus, expectation affects the future tariff rate as Blanchard and Willmann (2011; 2014) and Kishishita (2018b) also show. Due to this nature, multiple equilibria can exist.

4.3.3 Voting in Period 1

In period 1, voters vote based on the expectation about the tariff rates in both periods. First, consider the case where politician A is the policy-maker in period 1. Denote the expectation about the tariff rates in periods 1 and 2 in this case by τ_1^A and $\tau_2(\tau_1^A)$. As pointed out, politician A will implement either $\hat{x}_H$ or $\hat{x}_M$ in period 1. Thus, $\tau_1^A \in \{\tau_H, \tau_M\}$. Next, consider the case where politician B is the policy-maker in period 1. When politician B chooses τ_L in period 1, the tariff rate in period 2 will be τ_L due to the irreversibility of policy change. As a result, politician B will win the election in period 2. Thus, politician B chooses τ_L in period 1. Therefore, voters expect $\tau_1 = \tau_2 = \tau_L$ if politician B wins the election in period 1.

Provided that (i) $\tau_1 = \tau_1^A$ and $\tau_2 = \tau_2(\tau_1^A)$ when politician A wins the election in period 1 and (ii) $\tau_1 = \tau_2 = \tau_L$ when politician B wins the election in period 1, voters who vote for politician A in period 1 are workers such that

$$\begin{aligned}
&\max\left\{K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} + \delta K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}, K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}(1-c) + \delta K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} a\frac{p_w}{\tau_L}\right\} \\
&\quad < \max\left\{K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha} + \delta K\left(\frac{p_w}{\tau_2(\tau_1^A)}\right)^{-\alpha}, K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha}(1-c) + \delta K\left(\frac{p_w}{\tau_2(\tau_1^A)}\right)^{-\alpha} a\frac{p_w}{\tau_2(\tau_1^A)}\right\}.
\end{aligned} \tag{4.8}$$

In summary, we have the following lemma.

Lemma 4.3. *When the amount of voters whose a satisfies inequality (4.8) is larger than $A/2$, politician A assumes power in period 1. Otherwise, politician B assumes power in period 1.*

4.3.4 Equilibrium

Using the preceding lemmas, we derive equilibria. Our focus is whether τ_H can be chosen as the tariff rate in period 1.

To begin with, examine the incentive for politician A to choose τ_H in period 1. If politician A can win the election even after choosing τ_M, s/he obviously chooses τ_M in period 1. For now, suppose that s/he cannot win the election after choosing τ_M , but can win the election after choosing τ_H . Given this, s/he has no incentive to deviate from τ_H if and only if

$$\begin{aligned}
&-u(\tau_H,\tau_M) + b + \delta(-u(\tau_M,\tau_M) + b) \geq -u(\tau_M,\tau_M) + b - \delta u(\tau_L,\tau_M) \\
&\Leftrightarrow b \geq \frac{1}{1-\delta}\left[u(\tau_H,\tau_M) - u(\tau_M,\tau_M) + \delta\left(u(\tau_H,\tau_M) - u(\tau_L,\tau_M)\right)\right].
\end{aligned} \tag{4.9}$$

Our interest is the effect of labor immobility. To focus on this issue, we assume that b is sufficiently high so that inequality (4.9) is satisfied i.e., politician A has an incentive to choose τ_H as the tariff rate in period 1 given the credibility of punishment for the deviation from $\hat{x}_H$.

Assumption 4.2. *Inequality (4.9) holds.*

Define $\underline{c}^1(\tau_1^A)$, $c^1(\tau_1^A)$ and $c^2(\tau_1,\tau_2)$ as follows:

$$\underline{c}^1(\tau_1^A) \equiv 1 - a_M\delta p_w\left[\frac{1}{\tau_L^{1-\alpha}} - \frac{1}{\tau_M^{1-\alpha}}\right]\frac{1}{\tau_1^{A\,\alpha} - \tau_L^{\alpha}},\; c^1(\tau_1^A) \equiv a_M\frac{\delta p_w}{\tau_L} + 1 - \left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha} - \delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha};$$

$$c^2(\tau_1,\tau_2) \equiv a_M \left(\frac{\tau_1}{\tau_2}\right)^{\alpha} \frac{\delta p_w}{\tau_1} - \delta \left(\frac{\tau_1}{\tau_2}\right)^{\alpha}.$$

Given these definitions, we have the following lemma.

Lemma 4.4. *Consider the case where $\tau_1^A \in \{\tau_H, \tau_M\}$ and $\tau_2(\tau_1^A) = \tau_M$. Then, politician A wins the election in period 1 if and only if either $c < \underline{c}^1(\tau_1^A)$ or $c > c^1(\tau_1^A)$ holds.*

It is straightforward that politician A (pro-protection politician) can win the election in period 1 when the cost of job-change is high. This is the second inequality. In addition, the above result argues that when the cost of job-change is quite low, politician A can win the election. This is the first inequality. The reason why this counterintuitive result is obtained is as follows. In our model, the income of a worker who undergoes training in period 1 is $(1-c)W_L$ because the worker works in industry L. When the value of c is small, even a worker who moves to industry H obtains the large amount of income through working in industry L in period 1. Thus, even such a worker prefers a high tariff rate in period 1 (i.e., votes for politician A) so as to obtain high income in period 1. Hence, when c is quite small, politician A can win the election in period 1 though a lot of workers move to industry H. Note that a decrease in a_M implies that the condition under which politician A wins the election is more likely to hold. This is because the lower the median voter's productivity in industry H is, the larger number of workers oppose trade liberalization.

In addition, we have some useful properties under several weak conditions.

Lemma 4.5. *Suppose that $c^2(\tau_M,\tau_L) > c^1(\tau_M)$ and $\tau_H\tau_L < \tau_M^2$ hold. Then, $c^2(\tau_M,\tau_L) > c^2(\tau_H,\tau_M)$, $c^1(\tau_H) < c^1(\tau_M)$ and $\underline{c}^1(\tau_H) > \underline{c}^1(\tau_M)$ hold.*[17]

Notice that the conditions in Lemma 4.5 are not restrictive. The first inequality holds when the value of $a_M p_W$ is not so large. Since the majority of voters would prefer trade liberalization when the value is high, this is realistic. The second inequality holds when the value of τ_H is not high compared to τ_M. For example, when $\tau_H - \tau_M = \tau_M - \tau_L$, this inequality always holds. Hence, we assume the conditions in Lemma 4.5.

Assumption 4.3. *$c^2(\tau_M,\tau_L) > c^1(\tau_M)$ and $\tau_H\tau_L < \tau_M^2$ hold.*

We finally obtain the main theorem that describes political equilibria.[18]

Theorem 4.1. *Suppose that Assumptions 4.1-4.3 hold.*[19]

[17] $c^2(\tau_H,\tau_M)$ ($c^2(\tau_M,\tau_L)$) is the threshold value of c for which politician A wins the election in period 2 given $(\tau_1,\tau_2) = (\tau_H,\tau_M)$ ((τ_M,τ_L)) (see the proof of Theorem 4.1). Thus, the first inequality means that politician A is more likely to win the election in period 1 under the higher tariff rates than the lower tariff rates. The second and third inequalities mean that politician A is more likely to win the election in period 1when politician A chooses τ_H than when s/he chooses τ_L. This is also plausible since workers prefer the highest tariff rate in period 1.

[18] Suppose that each voter votes either candidate with the equal probability when s/he is indifferent between the two. The same result holds when $c > c^2(\tau_M,\tau_M)$ and b is sufficiently high. To see this, check (i) and (ii) in footnote 14. When $c > c^2(\tau_M,\tau_M)$, there is an equilibrium of the subgame such that politician A wins the election in period 2 by implementing τ_M in period 1. Given this, for sufficiently high b, politician A has no incentive to choose τ_L in period 1. Consider (ii). There is an equilibrium of the subgame such that politician A wins the election in period 2 when politician B chooses τ_M in period 1. Given this equilibrium, politician B never chooses τ_M (and similarly τ_H) in period 1. This implies that the highest tariff rates in Theorem4.1 are sustained by equilibria. Furthermore, we can show that the tariff rates sustained by equilibria under this alternative setting cannot be higher than that in Theorem 1. Notice that $c^2(\tau_M,\tau_M) < c^2(\tau_M,\tau_L)$ so long as $c^2(\tau_M,\tau_L) > 0$. Thus, the non-monotonicity is obtained even if $c > c^2(\tau_M,\tau_M)$ is assumed.

[19] Given the assumptions, the following (I)-(III) are all the possible cases since $c^1(\tau_H) < c^2(\tau_M,\tau_L)$ holds. This is because $c^1(\tau_H) < c^1(\tau_M)$ from Lemma 4.5 and $c^1(\tau_M) < c^2(\tau_M,\tau_L)$ from the assumption.

(I) When $c^1(\tau_H) \le c^2(\tau_H, \tau_M)$, the highest pair of tariff rates in period 1 and 2 (τ_1, τ_2) supported by an equilibrium[20] *is: (i) (τ_M, τ_M) if $c > c^2(\tau_M, \tau_L)$, (ii) (τ_H, τ_M) if $c^2(\tau_H, \tau_M) < c \le c^2(\tau_M, \tau_L)$ and (iii) (τ_M, τ_L) if $c \le c^2(\tau_H, \tau_M)$.*

(II) When $c^2(\tau_H, \tau_M) < c^1(\tau_H) < c^2(\tau_M, \tau_L)$ and $c^2(\tau_H, \tau_M) < \underline{c}^1(\tau_H)$, the highest pair of tariff rates in periods 1 and 2 (τ_1, τ_2) supported by an equilibrium is: (i) (τ_M, τ_M) if $c > c^2(\tau_M, \tau_L)$, (ii) (τ_H, τ_M) if $c^1(\tau_H) < c \le c^2(\tau_M, \tau_L)$, (iii) (τ_M, τ_L) if $\underline{c}^1(\tau_H) \le c \le c^1(\tau_H)$.[21]*, (iv) (τ_H, τ_M) if $c^2(\tau_H, \tau_M) < c < \min\{\underline{c}^1(\tau_H), c^2(\tau_M, \tau_L)\}$ and (v) (τ_M, τ_L) if $c \le c^2(\tau_H, \tau_M)$.*

(III) When $c^2(\tau_H, \tau_M) < c^1(\tau_H) < c^2(\tau_M, \tau_L)$ and $c^2(\tau_H, \tau_M) \ge \underline{c}^1(\tau_H)$, the highest pair of tariff rates in periods 1 and 2 (τ_1, τ_2) supported by an equilibrium is: (i) (τ_M, τ_M) if $c > c^2(\tau_M, \tau_L)$, (ii) (τ_H, τ_M) if $c^1(\tau_H) < c \le c^2(\tau_M, \tau_L)$ and (iii) (τ_M, τ_L) if $c \le c^1(\tau_H)$.

It seems that low labor mobility hinders trade liberalization because the number of people who oppose trade liberalization increases with the degree of labor immobility. Under direct democracy, this would be the case. However, many countries employ representative democracy and we face conflicts on interests between politicians and voters under this regime. If we take into account this, the result can be reversed. This can be seen in Theorem 4.1 (I) and (III) clearly. Lower cost of job-change does not necessarily induce the lower equilibrium tariff rates. The basic mechanism behind this non-monotonic relationship is as follows.

Under sufficiently high labor mobility (low adjustment cost), many workers begin to change their jobs and politician B wins the election in period 2 even if τ_H is implemented in period 1.[22] Given this, politician A has no incentive to choose τ_H in period 1. Thus, τ_H cannot be implemented in period 1. This is (iii) in Theorem 4.1 (I) and (III).

If labor mobility is not high, politician A can win the election in period 2 after s/he chose τ_H in period 1. Here, politician A faces a trade-off between policy mismatch and support for him. Workers in the protected industry prefer τ_H while politician A prefers τ_M. Thus, politician A has an incentive to choose τ_M, which is undesirable for workers in the protected industry. Hence, politician A chooses τ_H instead of τ_M only when the reduction of the tariff rates undermines her/his base of supports.

Examine the possible mechanism that the reduction of the tariff rate undermines politician A's base of supports. Workers' decisions on job-change depend on the expectation about the future tariff rate. Thus, workers can change their voting behaviors in period 2 depending on the tariff rate in period 1 by changing their expectations about the future tariff rate. Suppose that workers expect that $\tau_2 = \tau_M$ when $\tau_1 = \tau_H$, while they expect that $\tau_2 = \tau_L$ when $\tau_1 = \tau_M$. Then, many workers do not begin to move to industry H when $\tau_1 = \tau_H$ because they expect that politician A wins the election and implements τ_M in period 2. As a result, politician A can obtain a lot of votes in the period 2 election when $\tau_1 = \tau_H$. On the contrary, many workers begin to move to industry H when $\tau_1 = \tau_M$ because they expect that politician B wins the election and implements τ_L in period 2. As a result, politician A can obtain only a small

[20] The highest pair of tariff rates in periods 1 and 2 (τ_1, τ_2) supported by an equilibrium is a pair of tariff rates which satisfies $\tau_1 \ge \tau_1'$ and $\tau_1 \ge \tau_2'$ for all (τ_1', τ_2') supported by an equilibrium.

[21] This region does not exist when $\underline{c}^1(\tau_H) > c^1(\tau_H)$.

[22] Here, politician A wins the election in period 1 because all the workers are in industry L in period 1 in our setting. If we assume that there are some fractions of workers who are in industry H even in period 1, politician A may not win the election in period 1. Then, the result in (iii) can change to (τ_L, τ_L).

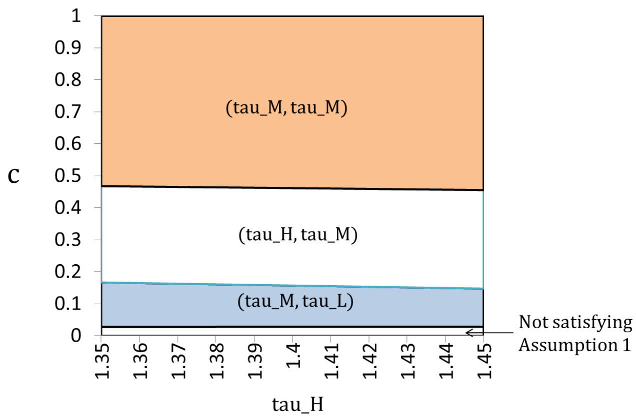

Figure 4.1: Numerical Example.

Notes. $\alpha = 0.5$; $\delta = 0.6$; $a_M = 1.5$; $\tau_L = 1$; $\tau_M = 1.2$; and $p_w = 1.2$.

amount of votes in the period 2 election when $\tau_1 = \tau_M$. As such, politician A's base of supports is undermined by the reduction of the tariff rate through the change in expectations.[23]

To make this mechanism work, the expectation that $\tau_2 = \tau_L$ must be self-fulfilling. Otherwise, there is no equilibrium in which politician B wins the election in period 2 when politician A chooses τ_M. Here, whether $\tau_2 = \tau_L$ can be self-fulfilling depends on the degree of labor mobility. Suppose that workers expect that the tariff rate in period 2 is τ_L. When labor mobility is not so low (adjustment cost is not so high), many workers then begin to move to industry H and politician B who will choose τ_L wins the election. Hence, $\tau_2 = \tau_L$ can be self-fulfilling. As a result, the above mechanism works so that politician A chooses not τ_M but τ_H as the tariff rate in period 1 to prevent sectoral adjustment. This is (ii) in Theorem 4.1 (I) and (III).

In contrast, when labor mobility is quite low (adjustment cost is quite high), this is not the case. Even if workers expect that $\tau_2 = \tau_L$, only a small number of workers begin to move to industry H and as a result, politician B cannot win the election. Thus, the expectation that $\tau_2 = \tau_L$ cannot be self-fulfilling. Hence, even after politician A chose τ_M in period 1, sectoral adjustment does not occur because the change in expectations never occurs. As a result, politician A is still reelected. Thus, politician A chooses τ_M in period 1. This is (i) in Theorem 4.1 (I) and (III).[24]

In summary, the non-monotonic relationship between labor mobility and trade liberalization exists. This non-monotonic relationship can be easily seen using a numerical example. In Figure 4.1, we illustrate this relationship. Note that this is an example that corresponds to (III) in Theorem 4.1. In this example, when the cost of job-change is moderate (i.e., the value of c is roughly around 0.25-0.45), the highest pair of tariff rates can be supported by an equilibrium.

[23] In other words, workers can punish politician A by using the multiple equilibria in period 2 as in the finite repeated games. In period 2, there are two equilibria: one is the equilibrium in which politician A wins and the other is the equilibrium in which politician B wins. By switching from the former equilibrium to the latter equilibrium, workers can punish politician A's deviation from τ_H to τ_M.

[24] (iii) in Theorem 4.1 (II) is not owing to the principal-agent relationship. To see this, remember Lemma 4.4. If $\underline{c}^1(\tau_H) \leq c \leq c^1(\tau_H)$, politician A cannot win the election in period 1 given that politician A will win the election in period 2.[25] In such a case, politician B wins the election in period 2 so that the implemented tariff rates are (τ_M, τ_L). Though this region does not exist in (I) and (III), it can arise in (II). This is owing to the fact that politician A would not obtain a majority of votes when the cost of job-change is moderate.

4.4 Extension

In this section, we provide one micro-foundation for politicians' preferences over tariff rates. In the model, we have assumed that all the workers are in industry L in period 1. Though this is useful to highlight the effect of job-change, it could be problematic when we analyze politicians' preferences since politicians should take into account workers in industry H in their period 1's utility. Hence, we modify the model as follows. $H \in (0, \frac{1}{2})$ fraction of workers can work in industry H in both periods without training. Their a is assumed to be sufficiently high so that they work in industry H in both periods whatever tariff rates are implemented. Let us call the set of these workers S. a of the workers who are not in S is distributed following G.

Fix workers' strategies. Politician i's utility in period t is $\gamma\bar{v}_t + (1-\gamma)\underline{v}_t - \lambda \mathbf{1}\{\underline{v}_t < \kappa_i\}$, where $\gamma \in (0,1)$, $\lambda > 0$ and $\kappa_i \geq 0$.[26] $\bar{v}_t$ ($\underline{v}_t$) is the utility in period t of a worker whose discounted sum of utility across two periods is the highest (lowest) among all the workers. In our setting, the highest (lowest) utility is the utility of workers who work in industry H (L):

$$\bar{v}_t = KA\left(\frac{p_w}{\tau_t}\right)^{1-\alpha}; \quad \underline{v}_t = K\left(\frac{p_w}{\tau_t}\right)^{-\alpha}.$$

Thus, the first two terms represent the weighted sum of the highest utility and the lowest utility. In addition to this weighted welfare, politician i thinks that the lowest utility should be larger than or equal to a certain threshold κ_i. In particular, politician i receives a penalty $\lambda > 0$ if $\underline{v}_t < \kappa_i$. Under sufficiently high λ, this implies that politician i maximizes the weighted sum of the utilities under the constraint of the minimum required utility.[27] This constraint represents that politicians think that people should get the minimum level of utility for living. Here, κ_i is different across politicians and low κ_i implies that politician i does not care such minimum level of utility for living.[28]

Under this setting, we obtain the following lemma.

Lemma 4.6. *Suppose that λ is sufficiently high,*

$$\frac{\gamma}{1-\gamma} > \frac{\tau_H^\alpha - \tau_L^\alpha}{Ap_w}\left[\left(\frac{1}{\tau_L}\right)^{1-\alpha} - \left(\frac{1}{\tau_H}\right)^{1-\alpha}\right]^{-1}; \quad \kappa_A \in \left(K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}, K\left(\frac{p_w}{\tau_M}\right)^{-\alpha}\right]; \quad \kappa_B = 0.$$

Then, the tariff rate maximizing politician A's utility in period t is τ_M while that for politician B is τ_L.

The mechanism behind this result is as follows. First, politicians' ideal policies do not depend on the adjustment cost c since politicians' objective functions only depend on the utilities of workers who get the highest utility and the lowest utility. Workers who get the lowest utility are those with the lowest ability and who always work in industry L. In addition, workers

[26]Without the last term, the maximizer of this objective function becomes the corner solution so that politicians never prefer the moderate tariff rate. This is because each worker's value function is linear with respect to the income under the Cobb-Douglas utility function.

[27]The alternative setting is that politician i's utility is $\gamma_i F(\bar{v}_t) + (1-\gamma_i)F(\underline{v}_t)$ for some concave function F. For instance, when F is the quadratic function, results similar with Proposition 1 is obtained for $\lambda = 0$. When F is log, the solution is always a corner solution so that we cannot obtain the results.

[28]In reality, people want the minimum level of utility for living. Our setting can be regarded that politicians' evaluations about such minimum level of utility for living is different.

who get the highest utility always work in industry H. Hence, their utilities do not depend on c, implying that politicians' ideal tariff rates are also independent of c. The assumption that politicians care only about such extreme voters simplifies politicians' policy preferences. Second, the difference in politicians' ideal tariff rates is created due to the difference in κ_i. The condition about γ represents that both politicians prefer lower tariff rates in principle. However, politicians' attitudes toward the lowest utility are different. The conditions about κ_i represent that politician A's requirement for the lowest utility is higher than that of politician B. As a result, politician A prefers τ_M while politician B prefers τ_L.

Hence, given the conditions in Lemma 4.6, each politician's policy preference is the same as that in the basic model. Based on our new politicians' utility functions, redefine $u(\tau,\hat{\tau}_i)$:

$$-u(\tau,\tau_M) \equiv \gamma\bar{v}_t + (1-\gamma)\underline{v}_t - \lambda\mathbf{1}\{\underline{v}_t < \kappa_A\}; \;\; -u(\tau,\tau_L) \equiv \gamma\bar{v}_t + (1-\gamma)\underline{v}_t - \lambda\mathbf{1}\{\underline{v}_t < \kappa_B\}.$$

Here, we redefine u since that appears in Assumption 4.2.

In addition, we need to redefine a_M since we now have workers who work in industry H in both periods. Let $\underline{a}$ be $a \in [0,A]$ such that

$$G(\underline{a}) = \frac{H}{1-H}.$$

This is the value of a such that the number of workers whose ability is lower than a is H. Let the set of workers whose $a \le \underline{a}$ be U and the distribution of a for workers who are neither in S nor U be G'. Hereafter, we assume that worker $\underline{a}$ always work in industry L independently of tariff rates.[29] Here, workers in S prefer the lower tariff rate, while those in U prefer the higher tariff rate. Hence, the median voter of the whole electorate is the median voter among workers who are neither in S nor U since $|S| = |U|$. Thus, redefine a_M by a such that $G'(a) = 1/2$.

Given these notations, it is shown that Theorem 1 still holds:

Proposition 4.1. *Assume the conditions in Lemma 4.6. In addition, suppose that Assumptions 4.1-4.3 hold. Then, Theorem 4.1 holds.*

4.5 Concluding Remarks

Labor immobility is a major obstacle to trade liberalization under direct democracy. However, the result can be reversed under representative democracy due to conflicts of interests between politicians and voters. We constructed a simple two periods model including both elections and sectoral adjustment. We then showed the non-monotonic relationship between labor mobility and trade liberalization. Higher labor mobility can hinder trade liberalization in some cases. Our results highlight the importance to take into account principal-agent relationship in the analysis of politics on trade liberalization.

Before closing this chapter, we discuss the remaining challenges for the future researches. In this study, we used the simple two-period model. To describe workers' job-change behaviors in a more realistic way, it may be promising to employ an overlapping generations model or an infinite horizon model. In addition, introducing a repeated games setting as in Chapter 2 may be useful to take politicians' ability to commit to policies into account.

[29] More specifically, this condition can be written as $\underline{a} < [\tau_L/(\alpha p_w)](\delta + c)$.

Appendix A

Appendix for Chapter 2

A.1 Definitions on Capacities

In Choquet expected utility theory, not a probability measure but a probability capacity is used.

Definition A.1. *A probability capacity on* $(B, \mathscr{F}_B)$ *is a function* θ*:* $\mathscr{F}_B) \to [0,1]$ *which satisfies the followings: (a)* $\theta(\emptyset) = 0$*; (b)* $\theta(B) = 1$*; and (c) for any* $C, D \in \mathscr{F}_{\mathscr{B}}$*, if* $C \subseteq D$*, then* $\theta(C) \leq \theta(D)$*.*

(c) is called *monotonicity*. In a probability measure, a probability satisfies $\sigma-$additivity rather than (c). To be specific, the capacity is assumed to be convex, which is defined as follows.

Definition A.2. *A probability capacity* θ *is convex if for any* $C, D \in \mathscr{F}_{\mathscr{B}}$*,*

$$\theta(C \cup D) + \theta(C \cap D) \geq \theta(C) + \theta(D).$$

The several assumptions are additionaly imposed on θ. The first one is continuity.

Definition A.3. θ *is continuous if the following two conditions hold:*

$$(\forall \langle A_i \rangle_i \subseteq \mathscr{F}_B) \ A_1 \subseteq A_2 \subseteq A_3 \subseteq ... \Rightarrow \theta(\cup_i A_i) = \lim_{i \to \infty} \theta(A_i).$$

$$(\forall \langle A_i \rangle_i \subseteq \mathscr{F}_B) \ A_1 \supseteq A_2 \supseteq A_3 \supseteq ... \Rightarrow \theta(\cap_i A_i) = \lim_{i \to \infty} \theta(A_i).$$

One example, where continuity does not hold, is $\varepsilon-$contamination, whose axiomatic foundation is given by Nishimura and Ozaki (2006) and Kopylov (2009): for any $A \in \mathscr{F}_B$,

$$\theta(A) = \begin{cases} (1-\varepsilon)P_0(A) \ \ (A \neq B) \\ 1 \ \ (A = B) \end{cases},$$

where $\varepsilon \in (0,1)$ and P_0 is a probability measure.

However, a non-continuous capacity can be approximated by using a continuous capacity. To see this, consider the following approximation of $\varepsilon-$contamination, which is called $\delta-$approximation of $\varepsilon-$contamination and is provided by Nishimura and Ozaki (2004): for any $A \in \mathscr{F}_B$,

$$\theta_\delta(A) = \begin{cases} (1-\varepsilon)P_0(A) \ \ (P_0(A) \leq 1-\delta) \\ (1-\varepsilon)P_0(A) + \varepsilon[(P_0(A)-1)/\delta + 1] \ \ (P_0(A) > 1-\delta) \end{cases}.$$

(δ is different from the discount factor δ defined in the model). When δ is sufficiently small, this capacity is an approximation of ε-contamination. And, this capacity satisfies continuity. In this sense, continuity is not that restrictive.

Lastly, we provide one example that satisfies the assumption that all the probability distribution functions contained in the core of θ are continuous. The example is $\delta-$approximation of $\varepsilon-$contamination discussed above. In this case, the core of θ can be written as $\text{core}(\theta) = \{(1-\varepsilon)P_0 + \varepsilon\mu | \mu \in \mathscr{M}(P_0, \delta)\}$, where $\mathscr{M}(P_0, \delta) = \{\mu \in \mathscr{M} | (\forall A) \ \ \delta\mu(A) \leq P_0(A)\}$. Note that $\mathscr{M}$ is the set of all probability measures.[1] Thus, all the probability measures contained in $\text{core}(\theta)$ assign the zero probability to any single point (i.e., continuous distribution function) so long as $\delta > 0$ and P_0 assigns the zero probability.

A.2 Non-Iterated Maxmin Payoff

Define the non-iterated payoff. To this end, fix each player's strategy. Since agents' strategies only depend on the public history and β in equilibria on which we focus, suppose that agents' strategies only depend on them. Let p_t be a stochastic kernel for the belief about a new expert's degree of bias in period t, and p'_t be a stochastic kernel for the belief about the incumbent expert's degree of bias in period t. For any $t \geq 1$ and s^{t-1} under which the principal chooses an expert in period t, further, let $r_{t,s^{t-1}}$ be an objective stochastic kernel about the value of d_t. In particular, $r_{t,s^{t-1},\beta}$ is a probability measure about the value of d_t when the policymaker in period t is an expert whose degree of bias is β, and the history is s^{t-1}. Similarly, for any $t \geq 1$ and s^{t-1} under which the principal chooses a non-expert in period t, let $r'_{t,s^{t-1}}$ be an objective probability measure about the value of d_t.

By using p_τ $(\tau \geq t)$, p'_t, $r_{\tau,s^{\tau-1}}$ $(\tau \geq t)$, and $r'_{\tau,s^{\tau-1}}$ $(\tau \geq t)$, one can construct a probability measure p^t about the sequence of the implemented policy mismatch, given the history s^{t-1}. Here, for each τ, $p_{\tau,s^{\tau-1}} \in \text{core}(\theta)$, and $p'_{t,s^{t-1}} \in \text{core}(\theta'_{t,s^{t-1}})$ for any $s^{t-1} \in S^{t-1}$. Denote the set of p^t given s^{t-1} by $\mathscr{P}_{t,s^{t-1}}$. Then, the principal's non-iterated Maxmin payoff from period t conditional on s^{t-1} is

$$\inf_{p^t \in \mathscr{P}_{t,s^{t-1}}} EP_t(p^t, s^{t-1}),$$

where $EP_t(p^t, s^{t-1})$ is the expected payoff from period t conditional on s^{t-1} using p^t. Here, minimum takes only once.[2] Since holds, the following lemma is obtained.

Lemma A.1. *Under the non-iterated Maxmin payoff, Theorem 2.1 holds.*

Proof. We only prove (a) of Theorem 2.1.

(i) "Only if" part: Suppose that the expert equilibrium exists when the iterated payoff is employed. Then, the same equilibrium outcome can be created using the strategy specified in Section 2.4.2 and the belief system specified in Section 2.4.2. Consider the equilibrium with these strategies and beliefs. Since rectangularity holds, the iterated payoff is equivalent to the non-iterated payoff. Thus, the equilibrium is sustained also when the non-iterated payoff is employed.

(ii) "If" part: Suppose that the expert equilibrium exists when the non-iterated payoff is employed. Observe that the proofs of Lemmas 2.2-2.5 do not depend on the fact that the payoff is iterated one. Thus, the same equilibrium outcome can be created using the specified strategy and the specified belief system. Consider the equilibrium with these strategies and beliefs. Since rectangularity holds, the iterated payoff is equivalent to the non-iterated payoff. Thus, the equilibrium is sustained also when the iterated payoff is employed.

[1] In general, the core of a convex capacity θ is defined by $\text{core}(\theta) = \{P \in \mathscr{P} | (\forall A) \ \ P(A) \geq \theta(A)\}$, where $\mathscr{P}$ is the set of all probability charges. As mentioned in Section 2.3.2, when θ is continuous, a probability charge in $\text{core}(\theta)$ is a probability measure.

[2] In this framework, the strategies and belief system constitute an equilibrium if the strategies are sequentially rational, and $\text{core}(\theta'_t)$ is updated by using the full Bayesian updating rule so long as it is possible. Although we use the full Bayesian updating rule, other updating rules are possible so long as the belief in Section 2.4.2 is obtained.

□

A.3 Omitted Proofs

A.3.1 Proof of Lemma 2.2

(Strategy) Each expert's strategy is the same across time from Definition 2.2 (II).

(Belief) From the specified capacity, the beliefs about (i) a new expert and (ii) the incumbent expert, whose implemented policy has never been observed are equal to θ. This is the same as the belief about an expert in period 0. In addition, how the belief about the expert is updated after period t is the same as that in period 0 since the initial capacity is the same, and an expert's strategy is also the same.

Therefore, the principal's payoff must be the same. □

A.3.2 Proof of Lemma 2.3

Lemma A.2. *Given the history s^{t-1}, if the principal's equilibrium strategy is to replace the incumbent expert when $d_{\tau^*(t)} = d > 0$, the principal believes that the incumbent's degree of bias $\beta = \min\{d, \bar{\beta}\}$ when $d_{\tau^*(t)} = d > 0$.*

Proof. When $d_{\tau^*(t)} = d$ cannot be observed given the experts' equilibrium strategies, this holds from Definition 2.2 (III). Thus, consider the case where $d_{\tau^*(t)} = d$ can be observed given the experts' equilibrium strategies. Since the incumbent expert cannot be reelected when s/he chooses policy mismatch d, only an expert whose degree of bias is d has an incentive to do so. Notice that such an expert exists only when $d \le \bar{\beta}$. Hence, if $d_{\tau^*(t)} = d$ can be observed given the experts' equilibrium strategies, the principal believes that the incumbent's degree of bias is d. □

Let the principal's payoff when the principal chooses a new non-expert and follows the equilibrium strategy be $\tilde{V}'$.

Step. 1: The principal (does not) reelects the incumbent expert if $d_{\tau^*(t)} < \beta^*$ ($d_{\tau^*(t)} > \beta^*$)

For any strategy such that there is no $d_{\tau^*(t)} > 0$ where the principal reelects the incumbent expert, this property is trivially satisfied. Thus, we focus on a strategy such that there is $d_{\tau^*(t)} > 0$ where the principal reelects the incumbent expert. Denote such $d_{\tau^*(t)}$ by d^*.

Case (i): $d^* \in (0, \bar{\beta}]$

We show that for any $d_{\tau^*(t)} \in [0, d^*]$, the principal reelects the incumbent expert.

Since the expert can be reelected after implementing a policy satisfying $|x_t - \hat{x}_t| = d^*$, the expert whose bias β is d^* chooses a policy such that $|x_t - \hat{x}_t| = d^*$. Given this, from Definition 2.2 (II), the principal expects that the incumbent expert will implement a policy such that $|x_t - \hat{x}_t| = d^*$ forever. Thus, the principal reelects her/him only if

$$-\frac{d^*}{1-\delta} \ge \max\{\tilde{V}, \tilde{V}'\}. \tag{A.1}$$

Consider $d < d^*$. Suppose that there is $d < d^*$ such that the principal does not reelect the incumbent expert when $d_{\tau^*(t)} = d$. From Lemma A.2, the principal expects that the incumbent expert's degree of bias β is d when $d_{\tau^*(t)} = d$. Thus, when $d_{\tau^*(t)} = d$, the principal has no incentive to reelect the incumbent expert only if $-d+\delta\max\{\tilde{V},\tilde{V}'\} \leq \max\{\tilde{V},\tilde{V}'\}$. However, this contradicts inequality (A.1) since $d<d^*$. Thus, for any $d_{\tau^*(t)} \in [0,d^*]$, the principal reelects the incumbent expert.

Case (ii): $d^* \in (\bar{\beta},\infty)$ and d^* is chosen by some experts

From Definition 2.2 (II), the principal expects that the incumbent expert will implement a policy such that $|x_t - \hat{x}_t| = d^*$ forever. Thus, the principal reelects her/him only if inequality (A.1) holds.

Consider $d<d^*$. Suppose that there is $d<d^*$ such that the principal does not reelect the incumbent expert when $d_{\tau^*(t)} = d$. The principal expects that the incumbent expert's degree of bias β is $\min\{d,\bar{\beta}\}$ when $d_{\tau^*(t)} = d$. Then, using the same procedure as in (i), it can be shown that for any $d_{\tau^*(t)} \in [0,d^*]$, the principal reelects the incumbent expert.

Case (iii): $d^* \in (\bar{\beta},\infty)$ and d^* is never chosen by experts

This implies that any expert has no incentive to choose a policy such that $|x_t - \hat{x}_t| = d^*$. Thus, the same outcome can be sustained by the principal's strategy such that the principal does not reelect the incumbent expert when $d_{\tau^*(t)} = d^*$. Thus, it is unnecessary to take into account case (iii).

From (i) to (iii), every equilibrium outcome can be constructed by the principal's strategy such that the principal (does not) reelects the incumbent expert if $d_{\tau^*(t)} < \beta^* (d_{\tau^*(t)} > \beta^*)$.

Step. 2: $\beta^* < \bar{\beta}$ holds

Prove by contradiction. Consider the case where $d_{\tau^*(t)} = \bar{\beta}$. From Definition 2.2 (II), the principal expects that the incumbent expert will implement a policy such that $|x_t - \hat{x}_t| = \bar{\beta}$ forever. However, from Assumption 2.1, the principal has no incentive to reelect the incumbent expert when $d_{\tau^*(t)} = \bar{\beta}$. This is a contradiction.

Step. 3: The principal reelects the incumbent expert if $d_{\tau^*(t)} = \beta^*$

Prove by contradiction. Suppose that the principal does not reelect the incumbent expert if $d_{\tau^*(t)} = \beta^*$. Since $\rho,\delta,q>0$ hold, there are experts whose $\beta > \beta^*$ and who choose a policy mismatch which is smaller than β^*. However, there is no optimal policy these experts should choose because for any policy mismatch which is smaller than β^*, there is a policy mismatch which is closer to β^* and is better for them. Thus, there is no such equilibrium. Therefore, in the equilibrium, the principal reelects the incumbent expert if $d_{\tau^*(t)} = \beta^*$. □

A.3.3 Proof of Lemma 2.5

(i) $-\frac{\beta_e^*}{1-\delta} < V_e$ does not hold.

The principal has no incentive to deviate from the strategy on the equilibrium path when $d_{\tau^*(t)} = \beta_e^*$ only if $-\frac{\beta_e^*}{1-\delta} \geq V_e$. Thus, $-\frac{\beta_e^*}{1-\delta} < V_e$ does not hold.

(ii) $-\frac{\beta_e^*}{1-\delta} > V_e$ does not hold.

Suppose that the incumbent politician whose β is $\beta' \in (\beta_e^*, \beta_e^{**})$ chooses $x_t = \hat{x}_t + \beta'$ in period t. From Lemma A.2, the principal expects that the incumbent expert's bias is β' when $d_{\tau^*(t)} = \beta'$. Hence, if reelected, this incumbent is expected to choose $x_{t+1} = \hat{x}_{t+1} + \beta_e^*$ in period $t+1$. Thus, by one-shot deviation, the principal obtains the utility when reelecting this incumbent: $-\beta_e^* + \delta V_e$. This must be smaller than or equal to V_e i.e., $-\frac{\beta_e^*}{1-\delta} \leq V_e$ must hold. This is a contradiction.

From (i) and (ii), $-\frac{\beta_e^*}{1-\delta} = V_e$. □

A.3.4 Proof of Lemma 2.6

Let the left-hand side minus the right-hand side of (2.6) be

$$h(\tilde{\beta}) \equiv (1-\delta(1-q))\frac{\tilde{\beta}}{1-\delta} - \min\left\{ -\int_0^{\tilde{\beta}} \beta dG - \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} \tilde{\beta} dG - \int_{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}}^{\bar{\beta}} \beta dG \right.$$
$$\left. +\delta q\left[-\frac{1}{1-\delta}\int_0^{\tilde{\beta}} \beta dG - \frac{1}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG\right] \middle| G \in \mathrm{core}(\theta) \right\}. \tag{A.2}$$

We prove several lemmas about the properties of $h(\tilde{\beta})$.

Lemma A.3. *(i) $h(\tilde{\beta})$ is a decreasing function of $\tilde{\beta} \in \left[0, \bar{\beta} - \frac{\delta q\rho}{1-(1-q)\delta}\right]$, and (ii) $h(\tilde{\beta}) < 0$ holds for $\tilde{\beta} \in \left[\bar{\beta} - \frac{\delta q\rho}{1-(1-q)\delta}, \bar{\beta}\right]$.*

Proof. (i) Denote

$$J(\tilde{\beta}, G|q) \equiv \int_0^{\tilde{\beta}} \beta dG + \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} \tilde{\beta} dG + \int_{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}}^{\bar{\beta}} \beta dG$$
$$+\delta q\left[\frac{1}{1-\delta}\int_0^{\tilde{\beta}} \beta dG + \frac{1}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG\right]. \tag{A.3}$$

Using this, let $G_{\tilde{\beta}+\varepsilon} \in \arg\min\{-J(\tilde{\beta}+\varepsilon|q)|G \in \mathrm{core}(\theta)\}$. Then, for any $\varepsilon \in \left(0, \bar{\beta} - \frac{\delta q\rho}{1-(1-q)\delta}\right)$,

$$\begin{aligned}
&h(\tilde{\beta}+\varepsilon) - h(\tilde{\beta}) \\
<& -(1-\delta(1-q))\frac{\varepsilon}{1-\delta} + \int_0^{\tilde{\beta}+\varepsilon} \beta dG_{\tilde{\beta}+\varepsilon} + \int_{\tilde{\beta}+\varepsilon}^{\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}} (\tilde{\beta}+\varepsilon) dG_{\tilde{\beta}+\varepsilon} + \int_{\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}}^{\bar{\beta}} \beta dG_{\tilde{\beta}+\varepsilon} \\
&+\frac{\delta q}{1-\delta}\int_0^{\tilde{\beta}+\varepsilon} \beta dG_{\tilde{\beta}+\varepsilon} + \frac{\delta q}{1-\delta}\int_{\tilde{\beta}+\varepsilon}^{\bar{\beta}} (\tilde{\beta}+\varepsilon) dG_{\tilde{\beta}+\varepsilon} - \int_0^{\tilde{\beta}} \beta dG_{\tilde{\beta}+\varepsilon} - \int_{\tilde{\beta}}^{\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}} \tilde{\beta} dG_{\tilde{\beta}+\varepsilon} \\
&-\int_{\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}}^{\bar{\beta}} \beta dG_{\tilde{\beta}+\varepsilon} - \frac{\delta q}{1-\delta}\int_0^{\tilde{\beta}} \beta dG_{\tilde{\beta}+\varepsilon} - \frac{\delta q}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG_{\tilde{\beta}+\varepsilon} \\
<& -(1-\delta(1-q))\frac{\varepsilon}{1-\delta} + (\tilde{\beta}+\varepsilon)\left[G_{\tilde{\beta}+\varepsilon}(\tilde{\beta}+\varepsilon) - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right] \\
&+\tilde{\beta}\left[G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}\right) - G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}\right)\right] - \tilde{\beta}\left[G_{\tilde{\beta}+\varepsilon}(\tilde{\beta}+\varepsilon) - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right] \\
&+\varepsilon\left[G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}\right) - G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon\right)\right] \\
&-\left(\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}\right)\left[G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}\right) - G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}\right)\right] \\
&+\frac{\delta q}{1-\delta}(\tilde{\beta}+\varepsilon)\left[G_{\tilde{\beta}+\varepsilon}(\tilde{\beta}+\varepsilon) - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right] - \frac{\delta q}{1-\delta}\tilde{\beta}\left[G_{\tilde{\beta}+\varepsilon}(\tilde{\beta}+\varepsilon) - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right] \\
&+\frac{\delta q}{1-\delta}\varepsilon\left[1 - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta}+\varepsilon)\right] \\
=&\varepsilon\left\{\left[G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}\right) - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right] + \frac{\delta q}{1-\delta}\left[1 - G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right] - \frac{(1-\delta(1-q))}{1-\delta}\right\} \\
&-\frac{\delta q\rho}{1-(1-q)\delta}\left[G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}\right) - G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\frac{\delta q\rho}{1-(1-q)\delta}\right)\right].
\end{aligned} \tag{A.4}$$

The first inequality comes from the nature of $\min\{\cdot\}$. Here, the first term of (A.4) is negative since

$$G_{\tilde{\beta}+\varepsilon}\left(\tilde{\beta}+\varepsilon+\frac{\delta q\rho}{1-(1-q)\delta}\right)-G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})+\frac{\delta q}{1-\delta}\left[1-G_{\tilde{\beta}+\varepsilon}(\tilde{\beta})\right]-\frac{(1-\delta(1-q))}{1-\delta}$$
$$<1+\frac{\delta q}{1-\delta}-\frac{(1-\delta(1-q))}{1-\delta}=0.$$

In addition, the second term is obviously negative. Thus, (A.4)<0, and so $h(\tilde{\beta}+\varepsilon)-h(\tilde{\beta})<0$.

□

(ii) For $\tilde{\beta}\in\left[\bar{\beta}-\frac{\delta q\rho}{1-(1-q)\delta},\bar{\beta}\right]$,

$$\begin{aligned} h(\tilde{\beta}) &= -(1-\delta(1-q))\frac{\tilde{\beta}}{1-\delta}-\min\left\{-\frac{1-\delta(1-q)}{1-\delta}\left[\int_0^{\tilde{\beta}}\beta dG+\int_{\tilde{\beta}}^{\bar{\beta}}\tilde{\beta}dG\right]\middle|G\in\mathrm{core}(\theta)\right\} \\ &= -\frac{(1-\delta(1-q))}{1-\delta}\left\{-\tilde{\beta}+\max\left\{\int_0^{\tilde{\beta}}\beta dG+\int_{\tilde{\beta}}^{\bar{\beta}}\tilde{\beta}dG\middle|G\in\mathrm{core}(\theta)\right\}\right\}<0. \end{aligned}$$

The last inequality holds since

$$\tilde{\beta}<\max\left\{\int_0^{\tilde{\beta}}\beta dG+\int_{\tilde{\beta}}^{\bar{\beta}}\tilde{\beta}dG\middle|G\in\mathrm{core}(\theta)\right\}$$

holds because of the fact that G is full support.

□

From the second part of this lemma, $\beta_e^*\in\left[0,\bar{\beta}-\frac{\delta q\rho}{1-(1-q)\delta}\right)$. Moreover, since $h(\tilde{\beta})$ is monotonically decreasing with $\tilde{\beta}\in\left[0,\bar{\beta}-\frac{\delta q\rho}{1-(1-q)\delta}\right]$, there is only a unique solution if β_e^* such that $h(\beta_e^*)=0$ exists.

The next lemma is about the continuity of $h(\tilde{\beta})$.

Lemma A.4. $I(\tilde{\beta})=\min\left\{J(\tilde{\beta},G)\middle|G\in\mathrm{core}(\theta)\right\}$ *is continuous with respect to* $\tilde{\beta}\in(0,\bar{\beta})$ *if* J *is continuous function.*[3]

When $\mathrm{core}(\theta)$ is a singleton, $h(\tilde{\beta})$ is continuous. However, its continuity is not necessarily obvious when $\mathrm{core}(\theta)$ is not a singleton. By using this lemma, we have the continuity of $h(\tilde{\beta})$. The first term of h is obviously continuous. Thus, we focus on the second term. For the second term of $h(\tilde{\beta})$,

$$J(\tilde{\beta},G)=-\int_0^{\tilde{\beta}}\beta dG-\int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}}\tilde{\beta}dG-\int_{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}}^{\bar{\beta}}\beta dG+\delta q\left[-\frac{1}{1-\delta}\int_0^{\tilde{\beta}}\beta dG-\frac{1}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}}\tilde{\beta}dG\right].$$

Since $G\in\mathrm{core}(\theta)$ is a continuous distribution function from the assumption, $J(\tilde{\beta},G)$ is obviously continuous. Thus, the second term is also continuous from Lemma A.4. In summary, $h(\tilde{\beta})$ is continuous. This property is used to show that a solution to $h(\tilde{\beta})=0$ exists.

By using Lemmas A.3 and A.4, we obtain the following result for the existence of a unique β_e^*.

To begin with, from Lemma A.3, $h(\tilde{\beta})<0$ holds for any $\tilde{\beta}\in\left[\bar{\beta}-\frac{\delta q\rho}{1-(1-q)\delta},\bar{\beta}\right]$. Thus, $\beta_e^*<\bar{\beta}-\frac{\delta q\rho}{1-(1-q)\delta}$. Therefore, we focus on $\tilde{\beta}\in\left[0,\bar{\beta}-\frac{\delta q\rho}{1-(1-q)\delta}\right)$.

[3]This result directly comes from Berge Maximum Theorem.

Here, $h(\tilde{\beta})$ is decreasing with $\tilde{\beta}$ for any $\tilde{\beta} \in \left[0, \bar{\beta} - \frac{\delta q \rho}{1-(1-q)\delta}\right)$ from Lemma A.3. And,

$$h(0) = \max \left\{ \int_{\frac{\delta q \rho}{1-(1-q)\delta}}^{\bar{\beta}} \beta dG \middle| G \in \text{core}(\theta) \right\} > 0.$$

Thus, from the continuity of h (Lemma A.4), there is a unique $\beta_e^* \in \left(0, \bar{\beta} - \frac{\delta q \rho}{1-(1-q)\delta}\right)$ which satisfies equation (2.6) if and only if $h\left(\bar{\beta} - \frac{\delta q \rho}{1-(1-q)\delta}\right) < 0$. Actually this holds from Lemma A.3. Therefore, there is a unique $\beta_e^* \in \left(0, \bar{\beta} - \frac{\delta q \rho}{1-(1-q)\delta}\right)$ which satisfies equation (2.6). □

A.3.5 Proof of Theorem 2.1

From Definition 2.2 (I), there could exist only two class of equilibria: (i) one is the equilibrium wherein the principal chooses to an expert when choosing a new candidate, and the other one is the equilibrium wherein the principal chooses to a non-expert when choosing a new candidate. The first class of equilibria is the expert equilibrium, and the second class of equilibria is the non-expert equilibrium.

Lemma A.5. *The expert equilibrium exists if and only if (2.7) holds.*

Proof. Suppose the expert equilibrium. From the previous discussions, the principal has no incentive to choose an expert who is different from the expert the principal must choose in the equilibrium. Thus, it suffices to examine the principal's one-shot deviation such that the principal chooses a new non-expert.

Case (i): the incumbent is an expert and $d_{\tau^*(t)} \in [0, \beta_e^*]$.

The principal has no incentive to choose a new non-expert if and only if

$$-\frac{d_{\tau^*(t)}}{1-\delta} \geq -2(1-\phi)\int_0^\infty \hat{x}_t dF + \delta V.$$

This holds for any $d_{\tau^*(t)} \in [0, \beta_e^*]$ if and only if (2.7) holds.

Case (ii): the incumbent is an expert and $d_{\tau^*(t)} = \emptyset$.

The principal has no incentive to choose a new non-expert if and only if

$$V \geq -2(1-\phi)\int_0^\infty \hat{x}_t dF + \delta V.$$

This is written as condition (2.7) because $V = -\frac{\beta_e^*}{1-\delta}$ holds.

Case (iii): the principal must choose a new expert based on her/his equilibrium strategy.

The principal has no incentive to choose a new non-expert if and only if

$$V \geq -2(1-\phi)\int_0^\infty \hat{x}_t dF + \delta V.$$

This is written as condition (2.7).

□

Lemma A.6. *The non-expert equilibrium exists if and only if the inverse of (2.7) holds.*

Proof. Let the principal's equilibrium payoff when choosing a new non-expert be V_n and $\tilde{V}$ in the non-expert equilibrium be $V_n(e)$. Furthermore, let β^*, β^{**}, and β^{***} in the non-expert equilibrium be β_n^*, β_n^{**}, and β_n^{***} respectively. Then, the value of choosing a new expert, $V_n(e)$, is given by

$$V_n(e) = \min\left\{\left[-\int_0^{\beta_n^*}\beta dG - \int_{\beta_n^*}^{\beta_n^{***}}\beta_n^* dG - \int_{\beta_n^{***}}^{\bar{\beta}}\beta dG\right]\right.$$
$$\left. +\delta(1-q)V_n + \delta q\left[-\frac{1}{1-\delta}\int_0^{\beta_n^*}\beta dG - \frac{1}{1-\delta}\int_{\beta_n^*}^{\beta_n^{***}}\beta_n^* dG + \int_{\beta_n^{***}}^{\bar{\beta}} V_n dG\right]\middle| G \in \mathrm{core}(\theta)\right\}. \tag{A.5}$$

Here, it is straightforward that the principal has no incentive to deviate from this equilibrium if and only if

$$V_n(e) < V(n) = -\frac{2(1-\phi)}{1-\delta}\int_0^\infty \hat{x}_t dF. \tag{A.6}$$

Hence, the remaining task is to show that (A.6) is equivalent to the inverse of (2.7).

To see this, observe that $V_n = -\frac{\beta_n^*}{1-\delta}$ holds as in Lemma 2.5. By substituting this into (A.7), (A.6) is equivalent that

$$-\frac{\beta_n^*}{1-\delta} > \min\left\{\left[-\int_0^{\beta_n^*}\beta dG - \int_{\beta_n^*}^{\beta_n^{***}}\beta_n^* dG - \int_{\beta_n^{***}}^{\bar{\beta}}\beta dG\right]\right.$$
$$\left. -\delta(1-q)\frac{\beta_n^*}{1-\delta} + \delta q\left[-\frac{1}{1-\delta}\int_0^{\beta_n^*}\beta dG - \frac{1}{1-\delta}\int_{\beta_n^*}^{\beta_n^{***}}\beta_n^* dG - \int_{\beta_n^{***}}^{\bar{\beta}} \frac{\beta_n^*}{1-\delta} dG\right]\middle| G \in \mathrm{core}(\theta)\right\}. \tag{A.7}$$

From Lemmas A.3 and A.4, this holds if and only if $\beta_n^* < \beta_e^*$. Since

$$-\frac{\beta_n^*}{1-\delta} = V_n = \frac{2(1-\phi)}{1-\delta}\int_0^\infty \hat{x}_t dF,$$

this condition can be rewritten as the inverse of (2.7). □

From Lemmas A.5 and A.6, the theorem is obtained. □

A.3.6 Proof of Lemma 2.7

Suppose that $q_1 > q_2$. The objective is to show that $\beta_e^*(q_1) < \beta_e^*(q_2)$ holds. From Lemma A.3, $h(\tilde{\beta}) < 0$ holds for any $\tilde{\beta} > \beta_e^*$. This implies that when $h(\tilde{\beta}|q^1) < 0$ is satisfied for any $\tilde{\beta} \geq \beta_e^*(q^2)$, $\beta_e^*(q^1) < \beta_e^*(q^2)$ holds. Therefore, the task is to show that $h(\tilde{\beta}|q^1) < 0$ is satisfied for any $\tilde{\beta} \geq \beta_e^*(q^2)$.

When $h(\tilde{\beta}|q_1) < h(\tilde{\beta}|q_2)$, this trivially holds since $h(\tilde{\beta}|q_2) \leq 0$. Let $G_{q_1} \in \arg\min\left\{-J(\tilde{\beta}|q_1)\middle| G \in \mathrm{core}(\theta)\right\}$, where $J(\tilde{\beta}|q)$ is defined by (A.3). Indeed, $h(\tilde{\beta}|q_1) < h(\tilde{\beta}|q_2)$ holds since

$$\begin{aligned}
&h(\tilde{\beta}|q_1) - h(\tilde{\beta}|q_2) \\
\leq& -\delta(q_1-q_2)\frac{\tilde{\beta}}{1-\delta} + \int_0^{\tilde{\beta}} \beta dG_{q_1} + \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q_1)\delta},\bar{\beta}\right\}} \tilde{\beta} dG_{q_1} + \int_{\min\left\{\tilde{\beta}+\frac{q_1\delta\rho}{1-(1-q_1)\delta},\bar{\beta}\right\}}^{\bar{\beta}} \beta dG_{q_1} \\
&+ \delta q_1 \left[\frac{1}{1-\delta}\int_0^{\tilde{\beta}} \beta dG_{q_1} + \frac{1}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG_{q_1}\right] - \int_0^{\tilde{\beta}} \beta dG_{q_1} - \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q_2\delta\rho}{1-(1-q_2)\delta},\bar{\beta}\right\}} \tilde{\beta} dG_{q_1} \\
&- \int_{\min\left\{\tilde{\beta}+\frac{q_2\delta\rho}{1-(1-q_2)\delta},\bar{\beta}\right\}}^{\bar{\beta}} \beta dG_{q_1} - \delta q_2 \left[\frac{1}{1-\delta}\int_0^{\tilde{\beta}} \beta dG_{q_1} + \frac{1}{1-\delta}\int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG_{q_1}\right] \\
=& -\delta(q_1-q_2)\frac{\tilde{\beta}}{1-\delta} + \int_{\min\left\{\tilde{\beta}+\frac{q_2\delta\rho}{1-(1-q_2)\delta},\bar{\beta}\right\}}^{\min\left\{\tilde{\beta}+\frac{q_1\delta\rho}{1-(1-q_1)\delta},\bar{\beta}\right\}} (\tilde{\beta}-\beta) dG_{q_1} + \frac{\delta(q_1-q_2)}{1-\delta}\left[\int_0^{\tilde{\beta}} \beta dG_{q_1} + \int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG_{q_1}\right] \\
=& -\frac{\delta(q_1-q_2)}{1-\delta}\left\{\tilde{\beta} - \left[\int_0^{\tilde{\beta}} \beta dG_{q_1} + \int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG_{q_1}\right]\right\} + \int_{\min\left\{\tilde{\beta}+\frac{q_2\delta\rho}{1-(1-q_2)\delta},\bar{\beta}\right\}}^{\min\left\{\tilde{\beta}+\frac{q_1\delta\rho}{1-(1-q_1)\delta},\bar{\beta}\right\}} (\tilde{\beta}-\beta) dG_{q_1}. \qquad \text{(A.8)}
\end{aligned}$$

Here, in the second equality, we use the fact that

$$\tilde{\beta} + \frac{q_2\delta\rho}{1-(1-q_2)\delta} < \tilde{\beta} + \frac{q_1\delta\rho}{1-(1-q_1)\delta}.$$

Then, the first term of (A.8) is negative since G_{q_1} has full-support and the second term of (A.8) is obviously non-positive. In summary, $h(\tilde{\beta}|q_1) - h(\tilde{\beta}|q_2) < 0$.

Therefore, $\beta_e^*(q_1) < \beta_e^*(q_2)$ holds. □

A.3.7 Proof of Proposition 2.1

We show only that there is unique $\underline{q}^{**}$ because the other part trivially holds given Lemma 2.7. To prove this, it suffices to show the existence of unique $\underline{q}^*$.

$h(\bar{\beta}^*) > 0$ when $q = 0$ since

$$h(\bar{\beta}^*|q=0) = -(1-\delta)\frac{\bar{\beta}^*}{1-\delta} - \min\left\{-\int_0^{\bar{\beta}} \beta dG \middle| G \in \mathrm{core}(\theta)\right\} = -\bar{\beta}^* + \max\left\{\int_0^{\bar{\beta}} \beta dG \middle| G \in \mathrm{core}(\theta)\right\} > 0.$$

The last inequality comes from Assumption 2.1. In addition, $h(\tilde{\beta})$ is decreasing with $q \geq 0$, and obviously $h(\tilde{\beta})$ is continuous with respect to q. Thus, there is unique $\underline{q}^* \geq 0$. □

A.3.8 Proof of Proposition 2.2

We first prove the alternative representation of $h(\tilde{\beta})$. Since the cumulative distribution function is assumed to be differentiable, this expression is possible.

Lemma A.7. *$h(\tilde{\beta})$ can be rewritten as follows:*

$$h(\tilde{\beta}) = -\tilde{\beta} + \int_0^{\tilde{\beta}} \beta dG + \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} (\beta-\tilde{\beta}) dG - \frac{\delta q}{1-\delta}\int_0^{\tilde{\beta}} G(\beta) d\beta. \qquad \text{(A.9)}$$

Proof.

$$h(\tilde{\beta}) = -\frac{1-\delta(1-q)}{1-\delta}\tilde{\beta} + \int_0^{\bar{\beta}} \beta dG - \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}-\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} (\beta-\tilde{\beta})dG + \frac{\delta q}{1-\delta}\left[\int_0^{\tilde{\beta}} \beta dG + \int_{\tilde{\beta}}^{\bar{\beta}} \tilde{\beta} dG\right]. \tag{A.10}$$

Here,

$$\int_0^{\tilde{\beta}} \beta dG = \beta G(\beta)|_0^{\tilde{\beta}} - \int_0^{\tilde{\beta}} G(\beta)d\beta = \tilde{\beta}G(\tilde{\beta}) - \int_0^{\tilde{\beta}} G(\beta)d\beta. \tag{A.11}$$

since G is differentiable. Thus, by substituting (A.11) into (A.10),

$$(A.10) = -\tilde{\beta} + \int_0^{\bar{\beta}} \beta dG + \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}-\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} (\beta-\tilde{\beta})dG - \frac{\delta q}{1-\delta}\int_0^{\tilde{\beta}} G(\beta)d\beta.$$

□

To begin with, we show that if $h(\bar{\beta}^*|q,G_1) < h(\bar{\beta}^*|qG_2)$ holds for any $q \in [\underline{q},1]$, $\underline{q}^{**}(G_1) \le \underline{q}^{**}(G_2)$.

Case (i): $\underline{q}^{**}(G_2) = \bar{q}$.

In this case, $\underline{q}^{**}(G_1) \le \underline{q}^{**}(G_2)$ always holds by definition.

Case (ii): $\underline{q}^{**}(G_2) \in (\underline{q},\bar{q})$.

For any $q \in [0,\underline{q}^*(G_1)]$, $h(\bar{\beta}^*|q,G_1) \ge 0$ since $h(\tilde{\beta})$ is decreasing with q. Thus, when $h(\bar{\beta}^*|\underline{q}^*(G_2),G_1) < 0$, $\underline{q}^{**}(G_1) < \underline{q}^{**}(G_2)$ holds. Here, $h(\bar{\beta}^*|\underline{q}^*(G_2),G_1) < 0$ is equivalent to $h(\bar{\beta}^*|\underline{q}^*(G_2),G_1) < h(\bar{\beta}^*|\underline{q}^*(G_2),G_2)$ since $h(\bar{\beta}^*|\underline{q}^*(G_2),G_2) = 0$. Therefore, when $h(\bar{\beta}^*|q,G_1) < h(\bar{\beta}^*|qG_2)$ holds for any $q \in [\underline{q},1]$, $h(\bar{\beta}^*|\underline{q}^*(G_2),G_1) < 0$ is satisfied.

Case (iii): $\underline{q}^{**}(G_2) = \underline{q}$.

$\underline{q}^{**} = \underline{q}$ holds if and only if $h(\tilde{\beta}|q,G) < 0$ holds for any $q \in (\underline{q},1]$. Thus, $h(\tilde{\beta}|q,G_2) < 0$ holds for any $q \in (\underline{q},1]$. Therefore, when $h(\tilde{\beta}|q,G_1) < h(\bar{\beta}^*|q,G_2)(< 0)$ is satisfied for any $q \in (\underline{q},1]$, $\underline{q}^{**}(G_1) = \underline{q} = \underline{q}^{**}(G_2)$ is obtained.

From (i) to (iii), if $h(\bar{\beta}^*|q,G_1) < h(\bar{\beta}^*|q,G_2)$ holds for any $q \in [\underline{q},1]$, $\underline{q}^{**}(G_1) \le \underline{q}^{**}(G_2)$. Therefore, it suffices to show that $h(\bar{\beta}^*|q,G_1) < h(\bar{\beta}^*|q,G_2)$ holds for any $q \in [\underline{q},1]$.

Using the expression of $h(\tilde{\beta})$ derived in Lemma A.7,

$$\begin{aligned} h(\bar{\beta}^*|q,G_1) - h(\bar{\beta}^*|q,G_2) = &-\frac{\delta q}{1-\delta}\left[\int_0^{\tilde{\beta}} G_1(\beta)d\beta - \int_0^{\tilde{\beta}} G_2(\beta)d\beta\right] \\ &+ \left[-\int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} (\beta-\bar{\beta})dG_1 + \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} (\beta-\bar{\beta})dG_2\right]. \end{aligned} \tag{A.12}$$

Note that $\int_0^{\bar{\beta}} \beta dG_1 = \int_0^{\bar{\beta}} \beta dG_2$ from the definition of mean-preserving spread. We use this fact in the above.

Here,

$$(A.12) \le -\frac{\delta q}{1-\delta}\left[\int_0^{\tilde{\beta}} G_1(\beta)d\beta - \int_0^{\tilde{\beta}} G_2(\beta)d\beta\right] + \int_{\tilde{\beta}}^{\min\left\{\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}} (\beta-\bar{\beta})|g_1(\beta)-g_2(\beta)|d\beta. \tag{A.13}$$

The first term of (A.13) is independent of ρ and negative. On the other hand, the second term of (A.13) is weakly decreasing with ρ, and it goes to zero as ρ goes to zero since

$$\tilde{\beta}+\frac{q\delta\rho}{1-(1-q)\delta}\to\tilde{\beta}.$$

Thus, for each $q\in[\underline{q},1]$, there is $\bar{\rho}(q)>0$ such that for $\rho\in(0,\bar{\rho}(q)]$, $h(\bar{\beta}^*|q,G_1)<h(\bar{\beta}^*|qG_2)$ holds. Take the minimum of $\bar{\rho}(q)$, and denote it by $\bar{\rho}$. Then, for $\rho\in(0,\bar{\rho}]$, $h(\bar{\beta}^*|q,G_1)<h(\bar{\beta}^*|qG_2)$ holds for any $q\in[\underline{q},1]$. Therefore, for $\rho\in(0,\bar{\rho}]$, $\underline{q}^{**}(G_1)\le\underline{q}^{**}(G_2)$. □

A.3.9 Proof of Proposition 2.3

As in the proof of Proposition 2.2, if $h(\bar{\beta}^*|\underline{q}^*(\theta_2),\theta_1)\ge h(\bar{\beta}^*|\underline{q}^*(\theta_2),\theta_2)$ holds, $\underline{q}^*(\theta_1)\ge\underline{q}^*(\theta_2)$. Thus, it suffices to prove that $h(\bar{\beta}^*|\underline{q}^*(\theta_2),\theta_1)\ge h(\bar{\beta}^*|\underline{q}^*(\theta_2),\theta_2)$ holds.

Then, using $J(\tilde{\beta}|q)$ defined by (A.3),

$$\begin{aligned}
&h(\bar{\beta}^*|\underline{q}^*(\theta_2),\theta_1)-h(\bar{\beta}^*|\underline{q}^*(\theta_2),\theta_2)\\
&\qquad=-\min\left\{-J(\bar{\beta}^*|\underline{q}^*(\theta_2))\middle|G\in\mathrm{core}(\theta_1)\right\}+\min\left\{-J(\bar{\beta}^*|\underline{q}^*(\theta_2))\middle|G\in\mathrm{core}(\theta_2)\right\}\\
&\qquad=\max\left\{J(\bar{\beta}^*|\underline{q}^*(\theta_2))\middle|G\in\mathrm{core}(\theta_1)\right\}-\max\left\{J(\bar{\beta}^*|\underline{q}^*(\theta_2))\middle|G\in\mathrm{core}(\theta_2)\right\}\ge 0
\end{aligned}$$

The last inequality comes from the fact that $\mathrm{core}(\theta_1)\supseteq\mathrm{core}(\theta_2)$ and $J(\bar{\beta}^*|\underline{q}^*(\theta_2))>0$.

Therefore, $\underline{q}^*(\theta_1)\ge\underline{q}^*(\theta_2)$. □

A.3.10 Proof of Proposition 2.4

As in the proof of Proposition 2.2, it suffices to prove that $h(\bar{\beta}^*|q,G_1)<h(\bar{\beta}^*|q,G_2)$ holds for any $q\in[\underline{q},1]$. Note that h in this proof is as in before based on (2.10). Let

$$\begin{aligned}
H(G,r)\equiv&\int_0^{\bar{\beta}^*}(\beta^r-\beta)dG+\int_{\bar{\beta}^*}^{\min\left\{\bar{\beta}^*+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}}((\bar{\beta}^*)^r-\bar{\beta}^*)dG+\int_{\min\left\{\bar{\beta}^*+\frac{q\delta\rho}{1-(1-q)\delta},\bar{\beta}\right\}}^{\min\left\{\bar{\beta}^*+\left(\frac{q\delta\rho}{1-(1-q)\delta}\right)^{\frac{1}{r}},\bar{\beta}\right\}}((\bar{\beta}^*)^r-\beta)dG\\
&+\int_{\min\left\{\bar{\beta}^*+\left(\frac{q\delta\rho}{1-(1-q)\delta}\right)^{\frac{1}{r}},\bar{\beta}\right\}}^{\bar{\beta}}(\beta^r-\beta)dG+\frac{\delta q}{1-\delta}\int_0^{\bar{\beta}^*}(\beta^r-\beta)dG+\frac{\delta q}{1-\delta}\int_{\bar{\beta}^*}^{\bar{\beta}}((\bar{\beta}^*)^r-\bar{\beta}^*)dG.
\end{aligned}$$

Then,

$$h(\bar{\beta}^*|q,G_1)-h(\bar{\beta}^*|q,G_2)=(A.12)+H(G_1,r)-H(G_2,r). \tag{A.14}$$

In the above, $h(\bar{\beta}^*|q,G_1)-h(\bar{\beta}^*|q,G_2)$ is approximated by (A.12). As a matter of fact, $h(\bar{\beta}^*|q,G_1)-h(\bar{\beta}^*|q,G_2)=(A.12)$ when $r=1$. Here, $H(G_1,r)-H(G_2,r)$ represents the approximation error.

From the assumption, (A.12) is negative, and (A.12) is independent of r. On the other hand, $H(G_1,r)-H(G_2,r)$ is continuous with respect to r, and zero when $r=1$. Therefore, there is $\bar{r}>1$ such that for any $r\in(1,\bar{r})$, the right-hand side of equation (A.14) is negative. □

Appendix B

Appendix for Chapter 3

B.1 Omitted Proofs

B.1.1 Proof of Lemma 3.1

(i): Suppose that there exists such an equilibrium. In this equilibrium, $\pi(1) = 1$ holds since the non-congruent type never chooses 1 (see (v)). Given this, consider the deviation incentive of the non-congruent type. S/he deviates from 0 to 1 if $-1+b \geq 0$. This holds since $b > 2$. Hence, there is no such equilibrium.

(ii): The non-congruent type loses l by taking 2 instead from 0. Since $b < l$, it never does so whatever belief the voter holds.

(iii): From (ii), $\pi(2) = 1$. Given this, $\alpha^*(2;2) = 1$ must hold because it is the ideal policy for the congruent type, and it ensures the high reputation.

(iv): From (ii), $\pi(2) = 1$. Given this, $\alpha^*(0;\omega) > 0$ can be the case only when $\pi(0) = 1$. Note that taking 2 also brings the same utility loss of 1 and ensures the high reputation. However, when $\pi(0) = 1$, the non-congruent type chooses 0 so that $\pi(0) \neq 1$. This is contradiction.

(v): The congruent type loses at least one by taking the policy different from ω. Since $b_L < 1$, this is not optimal for the congruent type L. □

B.1.2 Proof of Proposition 3.1

(a) First, observe that from this equilibrium strategy,

$$\pi(2) = 1;\ \ \pi(1) = \frac{q_L p}{q_L p + (1-q)}. \tag{B.1}$$

Given this, the congruent type H has no deviation incentive from 2 to 1 when $\omega = 1$ if and only if

$$-1+b \geq b\frac{q_L p}{q_L p + (1-q)} \Leftrightarrow p \leq \frac{(b-1)(1-q)}{q_L}. \tag{B.2}$$

Note that the congruent type H obviously has no deviation incentive when $\omega = 2$.

Next, consider the non-congruent type's incentive. S/he has no incentive to deviate from 1 to 0 if and only if

$$-1+b\frac{q_L p}{q_L p + (1-q)} \geq \pi(0).$$

The right-hand side is minimized when $\pi(0) = 0$. Hence, there is an off-path belief for which the non-congruent type has no deviation incentive if and only if

$$-1 + b\frac{q_L p}{q_L p + (1-q)} \geq 0 \Leftrightarrow p \geq \frac{1-q}{(b-1)q_L}. \tag{B.3}$$

Note that the non-congruent type has no incentive to choose 2 from Lemma 3.1.

Combining (B.2) and (B.3) yields the condition.

(b) First of all, from Lemma 3.1, $\beta^*(2;\omega) = 0$.

The non-congruent type mixes 1 and 0 only when s/he is indifferent between these two policies i.e.,

$$-1 + b\frac{pq_L}{pq_L + \beta^*(1)(1-q)} = 0 \Leftrightarrow \beta^*(1) = \frac{(b-1)pq_L}{1-q}. \tag{B.4}$$

This $\beta^*(1) < 1$ if and only if

$$p < \frac{1-q}{(b-1)q_L}.$$

Given this, examine whether the congruent type H has a deviation incentive. The congruent type H has no incentive to deviate from 2 to 1 if and only if

$$-1 + b \geq b\frac{pq_L}{pq_L + \beta^*(1)(1-q)} \Leftrightarrow b \geq 2,$$

which holds since $b > 2$.

(c) In this equilibrium,

$$\pi(2) = 1; \;\; \pi(1) = \frac{pq_L + p\alpha^*(1;1)q_H}{pq_L + p\alpha^*(1;1)q_H + (1-q)}.$$

Given this, the congruent type H mixes 1 and 2 when $\omega = 1$ if and only if

$$b\frac{pq_L + p\alpha^*(1;1)q_H}{pq_L + p\alpha^*(1;1)q_H + (1-q)} = -1 + b \Leftrightarrow \alpha^*(1;1) = \frac{(b-1)(1-q)}{pq_H} - \frac{q_L}{q_H}. \tag{B.5}$$

Here, the derived $\alpha^*(1;1)$ is less than one if and only if

$$p \geq \frac{(b-1)(1-q)}{q}. \tag{B.6}$$

In addition, it is larger than zero if and only if

$$p \leq \frac{(b-1)(1-q)}{q_L}. \tag{B.7}$$

Combining these two inequalities, we have the condition.

Lastly, examine the non-congruent type's incentive. Since the deviation incentive of the non-congruent type is minimized when $\pi(0) = 0$, s/he has no deviation incentive when

$$-1 + b\frac{pq_L + p\alpha^*(1;1)q_H}{pq_L + p\alpha^*(1;1)q_H + (1-q)} \geq 0 \Leftrightarrow b \geq 2,$$

which holds since $b > 2$.

(d) First, the equilibrium belief is given by

$$\pi(2) = 1; \;\; \pi(1) = \frac{pq}{pq + (1-q)}.$$

Given this belief, the congruent type H has no incentive to deviate from 1 to 2 when $\omega = 1$ if and only if

$$-1 + b \leq b\frac{pq}{pq + (1-q)} \Leftrightarrow p \geq \frac{(b-1)(1-q)}{q}. \tag{B.8}$$

Note that the congruent type H obviously has no deviation incentive when $\omega = 2$.

Next, consider the non-congruent type's deviation incentive. S/he has no incentive to deviate from 1 to 0 if and only if

$$-1 + b\frac{pq}{pq + (1-q)} \geq 0 \Leftrightarrow p \geq \frac{1-q}{(b-1)q}. \tag{B.9}$$

This is because the deviation incentive is minimized when $\pi(0) = 0$.

Combining (B.8) and (B.9), we have the lemma. Note that because $b > 2$, $(b-1)(1-q)/q > (1-q)/[(b-1)q]$.

(e) Denote the set of policies chosen by the congruent type H with a positive probability given the state ω by $X_C^*(\omega) \equiv \{x \in \{0,1,2\} : \alpha^*(x;\omega) > 0\}$, and denote the element of $X_C^*(\omega)$ by $x_C^*(\omega)$. Similarly, define X_N^* and x_N^* for those of the non-congruent type corresponding to the above notions.

Step 1. We start by investigating the conditions under which equilibria fully separate, such that $X_C^*(\omega) \cap X_N^* = \emptyset$ for all ω. Prove that there is no separating equilibrium except for (E1) and (E2) equilibria. From Lemma 3.1 (i) and (ii), if such an equilibrium exists, either (I) $\beta^*(1) = 1$, or (II) $\beta^*(1) + \beta^*(0) = 1$, $\beta^*(1) \in (0,1)$, and $\beta^*(0) \in (0,1)$. Then, from Lemma 3.1 (iv), $\alpha^*(2;\omega) = 1$ holds in any fully separating equilibrium.

Step 2. Next, we explore semi-separating equilibria, such that $X_C^*(\omega) \cap X_N^* \neq \emptyset$ for some ω, but $X_C^*(\omega) \neq X_N^*$ for some ω. Prove that there is no separating equilibrium except for (E3) and (NE) equilibria.

From Lemma 3.1 (i) and (ii), if such an equilibrium exists, either (I) $\beta^*(1) = 1$, or (II) $\beta^*(1) + \beta^*(0) = 1$, $\beta^*(1) \in (0,1)$, and $\beta^*(0) \in (0,1)$.

Case (I). $\alpha^*(1;1) > 0$ must hold in semi-separating equilibria because $\alpha^*(2;2) = 1$ from Lemma 3.1 (iii). When $\alpha^*(1;1) = 1$, this is the equilibrium in (a). When the congruent type mixes 1 and 2, that is the equilibrium in (b).

Case (II). As in case (I), $\alpha^*(1;1) > 0$ must hold. Consider the case where $\alpha^*(1;1) = 1$ and the case where the congruent type H takes a mixed strategy one by one.

Case (II-1). $\alpha^*(1;1) = 1$. The non-congruent type mixes 0 and 1 if and only if

$$-1 + b\frac{pq}{pq + \beta^*(1)(1-q)} = 0 \Leftrightarrow \beta^*(1) = \frac{(b-1)pq}{1-q}.$$

Given this, the congruent type H has no incentive to deviate from 1 to 2 when $\omega = 1$ if and only if

$$b\frac{pq}{pq + \beta^*(1)(1-q)} \geq -1 + b \Leftrightarrow b \leq 2,$$

which does not hold. Hence, there is no such an equilibrium.

Case (II-2). Mixed strategy. The congruent type H mixes 1 and 2 when $\omega = 1$ if and only if

$$b\frac{pq_L + \alpha^*(1;1)q_H}{pq_L + \alpha^*(1;1)pq_H + \beta^*(1)(1-q)} = -1 + b. \tag{B.10}$$

Similarly, the non-congruent type mixes 0 and 1 if and only if

$$-1 + b\frac{pq_L + \alpha^*(1;1)q_H}{pq_L + \alpha^*(1;1)pq_H + \beta^*(1)(1-q)} = 0. \tag{B.11}$$

(B.10) and (B.11) simultaneously hold only when $b = 2$. Hence, this equilibrium does not exist.

Step 3. Lastly, there is no equilibrium wherein for any ω, $X_C^*(\omega) = X_N^*$ because $\alpha^*(2;2) = 1$ but $\beta^*(2) = 0$ (Lemma 3.1).

From steps 1-3, we have (e). □

B.1.3 Proof of Lemma 3.2

Step 1. Prove that there is an equilibrium, such that $\alpha^*(2;2) = 1$ and $\beta^*(0) = 1$. When $\pi(1) = 0$, it is straightforward that no one has deviation incentive.
Step 2. Prove that there exist no other equilibria. From Lemma 3.1, $\alpha^*(2;2) = 1$ and $\beta^*(2) = 0$. Hence, the candidate of other equilibria is that $\beta^*(1) > 0$. Prove by contradiction. When $\beta^*(1) > 0$, $\pi(1) = 0$ since $p = 0$. Thus, the non-congruent type has no incentive to choose 1, which contradicts $\beta^*(1) > 0$. □

B.1.4 Proof of Lemma 3.3

(b) is straightforward, and thus we prove only (a).

From Theorem 3.1, $p_{i+1}(p_i,2)$, $p_{i+1}(p_i,1)$, and $p_{i+1}(p_i,0)$ are increasing in p_i and $p_{i+1}(p_i,2) < p_{i+1}(p_i,0) < p_{i+1}(p_i,1)$.[1] Note that both $\Pr(x_i = 2|p_i)$ and $\Pr(x_i = 0|p_i)$ are weakly decreasing in p_i.

Fix $\tilde{p}$. Depending on the value of p_i, we can potentially have the following cases. The cases are ordered so that a case with a smaller number corresponds to that under smaller p_i.

Case 1. $p_{i+1}(p_i,1) < \tilde{p}$: In this case, $\Pr(p_{i+1} < \tilde{p}|p_i) = 1$.

Case 2. $p_{i+1}(p_i,0) < \tilde{p} \leq p_{i+1}(p_i,1)$: In this case, $p_{i+1} < \tilde{p}$ if and only if $x_i = 0$ or 2. Hence, $\Pr(p_{i+1} < \tilde{p}|p_i) < 1$. In addition, since both $\Pr(x_i = 2|p_i)$ and $\Pr(x_i = 0|p_i)$ are weakly decreasing in p_i, $\Pr(p_{i+1} < \tilde{p}|p_i)$ is weakly decreasing in p_i.

Case 3. $p_{i+1}(p_i,2) < \tilde{p} \leq p_{i+1}(p_i,0)$: In this case, $p_i < \tilde{p}$ if and only if $x_i = 2$. Hence, $\Pr(p_{i+1} < \tilde{p}|p_i)$ is smaller than that of Case 2. In addition, since $\Pr(x_i = 2|p_i)$ is weakly decreasing in p_i, $\Pr(p_{i+1} < \tilde{p}|p_i)$ is weakly decreasing in p_i.

Case 4. $\tilde{p} \leq p_{i+1}(p_i,2)$: In this case, $\Pr(p_{i+1} < \tilde{p}|p_i) = 0$ regardless of the value of p_i.

From these cases, $\Pr(p_{i+1} < \tilde{p}|p_i)$ is weakly decreasing in p_i. □

B.1.5 Proof of Proposition 3.3

(a) Without loss of generality, we focus on the case where $k = 1$. Lemma 3.3 directly shows that $\Pr(p_2 \geq \bar{p})$ is weakly increasing in p_1.

[1] When $x_i = 0$ is the off-equilibrium path, we ignore the case where $x_i = 0$.

Moreover, invoking Lemma 3.3 again, for each $\tilde{p} \in (0,1]$, $\Pr(p_2 < \tilde{p}|p_1)$ is weakly decreasing in p_1. Here,

$$\Pr(p_3 \geq \tilde{p}|p_1) = \sum_{p_2' \in \text{Supp}(p_2|p_1)} \left[\Pr(p_3 \geq \tilde{p}|p_2 = p_2') \cdot \Pr(p_2 = p_2'|p_1)\right], \tag{B.12}$$

where for $i \geq 2$, $\text{Supp}(p_i|p_1) \equiv \{p_i \in [0,1] | \Pr(p_i = p_i'|p_1) > 0\}$.[2] In addition, $\Pr(p_3 \geq \tilde{p}|p_2 = p_2')$ is non-decreasing in p_2' since from Lemma 3.3, for each $\tilde{p} \in (0,1]$, $\Pr(p_3 < \tilde{p}|p_2)$ is weakly decreasing in p_2. Compare $p_1 = p_H$ and $p_1 = p_L$ where $p_H > p_L$. From Lemma 3.3, $\Pr(p_2 < \tilde{p}|p_1 = p_H) \leq \Pr(p_2 < \tilde{p}|p_1 = p_L)$ for each $\tilde{p} \in (0,1]$, meaning that the distribution of p_2 under $p_1 = p_H$ first-order stochastically dominates that under $p_1 = p_L$. Hence, from the property of the first-order stochastic dominance, (B.12) is weakly increasing in p_1.[3] Thus, we have proven the assertion for $i = 2$.

The result for $i = 2$ directly implies that $\Pr(p_3 < \tilde{p}|p_1)$ is weakly decreasing in p_1. Having this result at hand, we can repeat the same argument for all $i \geq 3$ to show that

$$\Pr(p_{i+1} \geq \tilde{p}|p_1) = \sum_{p_i' \in \text{Supp}(p_i|p_1)} \left[\Pr(p_{i+1} \geq \tilde{p}|p_i = p_i') \cdot \Pr(p_i = p_i'|p_1)\right] \tag{B.13}$$

is weakly increasing in p_1.

(b) From (a), $\Pr(p_i \leq \bar{p}|p_2)$ is weakly increasing in p_2. Furthermore, $p_2(2) < p_2(1)$ and $p_2(2) < p_2(0)$. Hence, we have the first part of (b). Next, prove the second part.

Case 1. $\frac{1-q}{(b-1)q_L} \leq \bar{p}$: Consider $p_1 \in (0, \bar{p})$ that is sufficiently close to $\bar{p}$. Since $x_1 = 0$ is an off-equilibrium path, it suffices to show that $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = 1)$. For such p_1, $p_2(2, p_1) < \bar{p} < p_1(1, p_1)$. Thus, $\Pr(p_i \geq \bar{p}|x_1 = 2) < 1 = \Pr(p_i \geq \bar{p}|x_1 = 1)$.

Case 2. $\frac{1-q}{(b-1)q_L} > \bar{p}$: In this case, for any $p \in (0, \bar{p})$, (E2) equilibrium is realized. Hence, we need to prove both $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = 1)$ and $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = 0)$.

(i) $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = 1)$. Consider $p_1 \in (0, \bar{p})$ that is sufficiently close to $\bar{p}$. Then, as in Case 1, $\Pr(p_i \geq \bar{p}|x_1 = 2) < 1 = \Pr(p_i \geq \bar{p}|x_1 = 1)$.

(ii) $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = 0)$. Again, consider $p_1 \in (0, \bar{p})$ that is sufficiently close to $\bar{p}$. First, derive the upper bound of $\Pr(p_i \geq \bar{p}|x_1 = 2)$. There are three cases depending on the value of x_2. $\Pr(p_i \geq \bar{p}|x_1 = 2, x_2 = 1) \leq 1$. $\Pr(p_i \geq \bar{p}|x_1 = 2, x_2 = 0) = \Pr(p_{i-1} \geq \bar{p}|x_1 = 2)$ because $p_2(x_1 = 2) = p_3(x_1 = 2, x_2 = 0)$. Furthermore, $\Pr(p_i \geq \bar{p}|x_1 = 2, x_2 = 2) \leq \Pr(p_i \geq \bar{p}|x_1 = 2, x_2 = 0) = \Pr(p_{i-1} \geq \bar{p}|x_1 = 2)$. Here, the first inequality comes from (a). By combining these three cases, we have

$$\Pr(p_i \geq \bar{p}|x_1 = 2) \leq \Pr(x_2 = 1|x_1 = 2) + [1 - \Pr(x_2 = 1|x_1 = 2)] \cdot \Pr(p_{i-1} \geq \bar{p}|x_1 = 2). \tag{B.14}$$

Next, derive the lower bound of $\Pr(p_i \geq \bar{p}|x_1 = 0)$. There are three cases depending on the value of x_2. $\Pr(p_i \geq \bar{p}|x_1 = 0, x_2 = 1) = 1$ because $p_2 (= p_1)$ is sufficiently close to $\bar{p}$. $\Pr(p_i \geq \bar{p}|x_1 = 0, x_2 = 0) = \Pr(p_{i-1} \geq \bar{p}|x_1 = 0) \geq \Pr(p_{i-1} \geq \bar{p}|x_1 = 2)$. Here, the second inequality comes from the fact that $p_{i-1} \geq \bar{p}$ implies $p_i \geq \bar{p}$. In addition, $\Pr(p_i \geq \bar{p}|x_1 = 0, x_2 = 2) = \Pr(p_{i-1} \geq \bar{p}|x_1 = 2)$. By combining these three cases, we have

$$\Pr(p_i \geq \bar{p}|x_1 = 0) \geq \Pr(x_2 = 1|x_1 = 0) + [1 - \Pr(x_2 = 1|x_1 = 0)] \cdot \Pr(p_{i-1} \geq \bar{p}|x_1 = 2). \tag{B.15}$$

[2] This is a finite set.

[3] In our model, the distribution of p_2 is a discrete distribution. However, even in a discrete case, the property holds (Courtault, Crettez, and Hayek 2006).

Now, country 2 is in (E2) equilibrium so that $p_2(2) < p_2(1)$ implies $\Pr(x_2 = 1|x_1 = 2) < \Pr(x_2 = 1|x_1 = 0)$. Hence, the right-hand side of (B.14) is strictly smaller than that of (B.15). That is, $\Pr(p_i \geq \bar{p}|x_1 = 2) < \Pr(p_i \geq \bar{p}|x_1 = 0)$.

From cases 1 and 2, we obtain the second part of (b). □

B.1.6 Proof of Proposition 3.5

Our starting point is showing that voters' beliefs almost surely converge to a single point. By applying Martingale Convergence Theorem to our scenarios, we can show that there exists $p^* \in [0,1]$, such that $\Pr(\lim_{N\to\infty} p_N = p^*) = 1$ (Chamley 2004: Proposition 2.7).

(a) Prove by contradiction. Suppose that there exists $p^* \neq 1$, such that $\Pr(\lim_{N\to\infty} p_N = p^*) = 1$. If this gives us a contradiction, $\Pr(\lim_{N\to\infty} p_N = 1) = 1$.

Case 1. $p^* \in (0,1)$: Since almost sure convergence implies convergence in probability, the following must hold: $\forall \varepsilon > 0, \forall \delta > 0, \exists N^*(\varepsilon,\delta)$ s.t.

$$\forall N \geq N^*(\varepsilon,\delta)\ \ \Pr(|p_N - p^*| \geq \varepsilon) < \delta. \tag{B.16}$$

Let

$$\theta_1(\varepsilon) \equiv \min\left\{\frac{1+(b-1)(p^*-\varepsilon)}{b}, \frac{(p^*-\varepsilon)(q_L+(1-q))}{(p^*-\varepsilon)q_L+(1-q)}, \frac{p^*-\varepsilon}{(p^*-\varepsilon)q+(1-q)}\right\}.$$

Fix $\delta = \frac{q_L}{1+q_L}$ and ε, such that $\theta_1(\varepsilon) \geq p^* + \varepsilon$.[4] Consider $N \geq N^*(\varepsilon,\delta)$. Then, Theorem 3.1 implies that when $|p_N - p^*| < \varepsilon$, the updated belief is $p_{N+1}(1) > \theta_1(\varepsilon) \geq p^* + \varepsilon$. Since the probability that policy 1 is realized is at least q_L, $\Pr(|p_{N+1} - p^*| \geq \varepsilon) \geq (1-\delta)q_L \geq \delta$, which contradicts (B.16).

Case 2. $p^* = 0$: First, observe that when $\omega = 1$, $p_N > 0$ always holds. Hence, for $N \geq 2$, $p_N(1) > 0$. In particular, $p_N(1) > 1/b$ from the proof of Proposition 3.4. Furthermore, at least with probability q_L, $x_N = 1$ for any $p_N \in (0,1]$. Hence, $\Pr(p_N > 1/b) \geq q_L$ for all N, meaning that $\Pr(\lim_{N\to\infty} p_N \geq 1/b) > 0$.

From cases 1 and 2, $p^* \neq 1$ leads to a contradiction. That is, $p^* = 1$.

(b) Prove by contradiction. Suppose that there exists $p^* \neq 0$, such that $\Pr(\lim_{N\to\infty} p_N = p^*) = 1$.

Case 1. $p^* \in (0,1)$: As in case 1 of (a), the following must hold: $\forall \varepsilon > 0, \forall \delta > 0, \exists N^*(\varepsilon,\delta)$ s.t. (B.16).

Let

$$\theta_2(\varepsilon) \equiv \max\left\{1 - \frac{(1-(p^*+\varepsilon))q}{(1-(p^*+\varepsilon))q_L + q_H}, 1 - \frac{(1-(p^*+\varepsilon))q}{q-(b-1)(1-q)}, 0\right\} > 0.$$

Fix $\delta = \frac{q_L}{1+q_L}$ and ε, such that $\theta_2(\varepsilon) \leq p^* - \varepsilon$.[5] Consider $N \geq N^*(\varepsilon,\delta)$. Then, Theorem 3.1 implies that when $|p_N - p^*| < \varepsilon$, the updated belief is $p_{N+1}(2) < \theta_2(\varepsilon) < p^* - \varepsilon$ i.e., $|p_{N+1}(2) - p^*| > \varepsilon$. Since the probability that policy 2 is realized is at least q_L, $\Pr(|p_{N+1} - p^*| \geq \varepsilon) \geq (1-\delta)q_L \geq \delta$, which contradicts (B.16).

Case 2. $p^* = 1$: As in case 1 of (a), the following must hold: $\forall \varepsilon > 0, \forall \delta > 0, \exists N^*(\varepsilon,\delta)$ s.t. (B.16). Fix $\varepsilon = 1 - \bar{q}$ and $\delta = \frac{q_L}{1+q_L}$. Consider $N \geq N^*(\varepsilon,\delta)$. Then, Theorem 1 implies that

[4] Such $\varepsilon > 0$ exists because $\theta_1(\varepsilon)$ is continuous with respect to ε and $\theta_1(0) > p^*$.
[5] Such $\varepsilon > 0$ exists because $\theta_2(\varepsilon)$ is continuous with respect to ε and $\theta_2(0) < p^*$.

when $|p_N - 1| < \varepsilon$, $p_{N+1} = 0$ with at least probability q_L. This is because $p_N \geq \bar{q}$ and thus the congruent type L takes policy 2. Hence, $\Pr(|p_{N+1} - 1| \geq \varepsilon) \geq (1-\delta)q_L \geq \delta$, which contradicts (B.16).

From cases 1 and 2, $p^* \neq 0$ leads to a contradiction. That is, $p^* = 0$. □

B.1.7 Proof of Proposition 3.4

First of all, $p_i > 0$ since $\omega = 1$. Thus, when $p_i(x_1,...,x_{i-1}) < \bar{p}$, $p_{i+1}(x_1,...,x_{i-1},1) = [1+(b-1)p_i]/b > 1/b$. Here, when $(b-1)b \leq q/(1-q)$, $1/b > \bar{p}$. Hence, if the probability that $x_i = 1$ is positive for any $p_i \in (0,1]$, the proposition holds.[6] Indeed, when $\omega = 1$, this probability is always positive because the congruent type L chooses 1; thus, the probability of $x_i = 1$ is greater than or equal to $q_L > 0$. □

B.1.8 Proof of Proposition 3.6

(a) First, observe that (3.3) is increasing in p_i because p^*_{i+1} is increasing in p_i when $p_i < \bar{p}$. Hence, the necessary and sufficient condition for (a) is equivalent that when $p_i = \bar{p}$, $p_{i+1} \leq \bar{p}$ holds.

Case 1. $\frac{1-q}{(b-1)q_L} \leq \bar{p}$: $p_{i+1} \leq \bar{p}$ can be rewritten as

$$\begin{aligned} p_{i+1}(\bar{p},1) \leq \bar{p} &\Leftrightarrow \frac{\bar{p}q_L + \bar{p}(1-q)}{\bar{p}q_L + 1 - q}(\theta_1 + \theta_2 - 1) + 1 - \theta_2 \leq \bar{p} \\ &\Leftrightarrow q_L\bar{p}^2 + [(2-\theta_1-\theta_2)(1-q) - \theta_1 q_L]\bar{p} - (1-q)(1-\theta_2) \geq 0. \qquad \text{(B.17)} \end{aligned}$$

Here, the left-hand side of (B.17) is

$$q_L \frac{1-\theta_2}{2-\theta_1-\theta_2}\left(\frac{1-\theta_2}{2-\theta_1-\theta_2} - \theta_1\right) = q_L \frac{1-\theta_2}{(2-\theta_1-\theta_2)^2}(\theta_1+\theta_2-1)(\theta_1-1) < 0$$

when $\bar{p} = p_S$ while it is $-(\theta_1+\theta_2-1)(\theta_1-1) > 0$ when $\bar{p} = \theta_1$. Hence, there exists $p_E \in (p_S, \theta_1)$, such that if and only if $\bar{p} \geq p_E$, (B.17) holds.

Case 2. $\frac{1-q}{(b-1)q_L} > \bar{p}$: The condition $p_{i+1} \leq \bar{p}$ can be rewritten as

$$\begin{aligned} p_{i+1}(\bar{p},1) \leq \bar{p} &\Leftrightarrow \frac{1+(b-1)\bar{p}}{b}(\theta_1+\theta_2-1) + 1 - \theta_2 \leq \bar{p} \\ &\Leftrightarrow \bar{p} \geq p_E \equiv \frac{\theta_1+\theta_2-1+b(1-\theta_2)}{\theta_1+\theta_2-1+b(2-\theta_1-\theta_2)}. \qquad \text{(B.18)} \end{aligned}$$

Here, we can easily verify that $p_E \in (p_S, \theta_1)$.

From cases 1 and 2, we have (a).

(b) From (a), when $p < \bar{p}$, $\Pr(p_N < \bar{p}) = 1$ for all N.

Next, consider $p \geq \bar{p}$. From (a), $\Pr(p_N < \bar{p}) = \Pr(\exists i \leq N : p_i < \bar{p})$. Hence, it suffices to show that $\lim_{N\to\infty}\Pr(\forall i \leq N : p_i \geq \bar{p}) = 0$. Observe that when $p_i \geq \bar{p}$ and $x_i = 2$, $p_{i+1}(2) = 1 - \theta_2 < p_S < \bar{p}$. In addition, $x_i = 2$ at least with probability $(1-\theta_1)q_L$. Thus,

$$\Pr(\forall i \leq N : p_i \geq \bar{p}) \leq [1-(1-\theta_1)q_L]^N.$$

This goes to zero as $N \to \infty$. Hence, $\lim_{N\to\infty}\Pr(\forall i \leq N : p_i \geq \bar{p}) = 0$.

[6] The belief p_{i+1} is also larger than $1/b$ when the equilibrium is (E1). To observe this, note that the belief when $p_i = \frac{1-q}{(b-1)q_L}$ is larger than $1/b$ and p_{i+1} is increasing in p_i in (E1) equilibrium.

(c) (i). Prove that $\frac{\partial p_E}{\partial \theta_1} > 0$. Consider case 1, first. Applying the implicit function theorem to (B.17) with equality yields

$$\frac{\partial p_E}{\partial \theta_1} = -\frac{-q_H p_E}{2q_L p_E + (2-\theta_1-\theta_2)(1-q) - \theta_1 q_L}.$$

Here, since $p_E[q_L p_E + (2-\theta_1-\theta_2)(1-q) - \theta_1 q_L] = (1-q)(1-\theta_2)$ holds, the denominator is positive. In addition, the numerator is negative. Hence, $\frac{\partial p_E}{\partial \theta_1} > 0$.

Next, consider case 2.

$$\frac{\partial p_E}{\partial \theta_1} = \frac{b(1-\theta_1)}{[\theta_1+\theta_2-1+b(2-\theta_1-\theta_2)]^2} > 0.$$

From cases 1 and 2, we have $\frac{\partial p_E}{\partial \theta_1} > 0$.

(ii). Prove that p_E is weakly increasing in q_L. $\frac{1-q}{(b-1)q_L}$ is decreasing in q_L so that there exists $\bar{q}_L$, such that case 2 holds for $q_L < \bar{q}_L$, while case 1 holds for $q_L \geq \bar{q}_L$. Furthermore, p_E under case 2 when $q_L \to \bar{q}_L$ is equal to p_E under case 1 when $q_L = \bar{q}_L$.

Hence, it suffices to prove that $\frac{\partial p_E}{\partial q_L} \geq 0$ for $q_L \geq \bar{q}_L$. Applying the implicit function theorem to (B.17) with equality yields

$$\frac{\partial p_E}{\partial q_L} = -\frac{p_E(p_E-\theta_1)}{2q_L p_E + (2-\theta_1-\theta_2)(1-q) - \theta_1 q_L}.$$

Here, the denominator is positive. In addition, the numerator is negative since $p_E < \theta_1$ from (a). Hence, $\frac{\partial p_E}{\partial q_L} > 0$ for case 1. □

B.1.9 Proof of Proposition 3.7

(a) Observe that when $p_i \geq \bar{p}$ and $x_i = 2$, $p_{i+1}(2) = 1-\theta_2 < \bar{p}$. In addition, $x_i = 2$ at least with probability $(1-\theta_1)q_L$. Thus,

$$\Pr(\forall i \text{ s.t. } M \leq i \leq N : p_i \geq \bar{p}) \leq [1-(1-\theta_1)q_L]^{N-M}.$$

This goes to zero as $N \to \infty$. Hence, we have (a).

(b) Case 1. $\frac{1-q}{(b-1)q_L} > \bar{p}$. Consider how many times $x = 1$ must be observed at most to reach $p_i \geq \bar{p}$. Define

$$p_C \equiv \frac{b[\bar{p}-(1-\theta_2)]}{(b-1)(\theta_1+\theta_2-1)} - \frac{1}{b-1},$$

Note that $p_C < \bar{p}$ holds since $\bar{p} < p_E$ by the assumption.

(i) Suppose that $p_i \geq p_C$. Then, $p_{i+1}(1) \geq \bar{p}$.

(ii) Suppose that $p_i < p_C$. Then,

$$\begin{aligned} p_{i+1} - p_i =& \frac{\theta_1+\theta_2-1+b(1-\theta_2) - p_i[\theta_1+\theta_2-1+b(2-\theta_1-\theta_2)]}{b} \\ \geq& \frac{\theta_1+\theta_2-1+b(1-\theta_2) - \bar{p}[\theta_1+\theta_2-1+b(2-\theta_1-\theta_2)]}{b} > 0. \end{aligned}$$

Here, the first inequality comes from the fact that the function is decreasing in p_i and the last inequality comes from the assumption that $\bar{p} < p_E$. Thus, when $(x_i,...,x_{i+K^*-1}) = (1,....,1)$,

$p_{i+K^*} \geq \bar{p}$ holds, where K^* is the smallest integer K satisfying

$$K\frac{\theta_1+\theta_2-1+b(1-\theta_2)-\bar{p}[\theta_1+\theta_2-1+b(2-\theta_1-\theta_2)]}{b} > \bar{p}.$$

Hence, when $(x_i,...,x_{i+K^*-1}) = (1,....,1)$, $p_{i+K^*} \geq \bar{p}$.

From (i) and (ii), $p_{i+K^*} \geq \bar{p}$ holds for all $p_i \in (0,1)$ when $(x_i,...,x_{i+K^*-1}) = (1,....,1)$.

Here, divide $\{M,...,N\}$ into subgroups $\{M,..,M+K^*-1\},\{M+K^*,...,M+2K^*-1\},...,\{M+(L+1)K^*,....,N\}$, where L is the quotient when $N-M+1$ is divided by K^*. Then, from the above discussion,

$$\begin{aligned}
&\Pr(p_i < \bar{p}\ \forall i \text{ s.t. } M \leq i \leq N) \\
&\leq \Pr(\forall k \in \{0,...,L-1\}, \exists i \in \{kK^*+M,...,M+(k+1)K^*-1\}; x_i \neq 1) \\
&\leq (1-(1-\theta_2)q_L^{K^*})^L. \qquad \text{(B.19)}
\end{aligned}$$

The first inequality comes from the fact that when $(x_i,...,x_{i+K^*-1}) = (1,....,1)$, $p_{i+K^*} \geq \bar{q}$. The second inequality comes from the fact that at least with probability $(1-\theta_2)q_L$, $x_i = 1$.

Therefore, $\lim_{N\to\infty}\Pr(\forall i \text{ s.t. } M \leq i \leq N : p_i < \bar{p}) = 0$ because $L \to \infty$.

Case 2. $\frac{1-q}{(b-1)q_L} \leq \bar{p}$. Similarly, we have $\lim_{N\to\infty}\Pr(\forall i \text{ s.t. } M \leq i \leq N : p_i < \bar{p}) = 0$. □

B.1.10 Proof of Fact 3.5

Prove that $\frac{\partial p_E}{\partial \theta} > 0$. Consider case 1 in the proof of Proposition 3.6, first. Applying the implicit function theorem to (B.17) with equality yields

$$\frac{\partial p_E}{\partial \theta} = -\frac{-[2(1-q)+q_L]p_E+1-q}{2q_L p_E+2(1-\theta)(1-q)-\theta q_L}.$$

Here, since $p_E[q_L p_E+2(1-\theta)(1-q)-\theta q_L] = (1-q)(1-\theta)$ holds, the denominator is positive. In addition, the numerator is negative since it can be rewritten as $(1-q)(1-2p_E)-p_E q_L$ and $p_E > 1/2$. Hence, $\frac{\partial p_E}{\partial \theta} > 0$ in case 1.

Next, consider case 2.

$$\frac{\partial p_E}{\partial \theta} = \frac{b}{[2\theta-1+2b(1-\theta)]^2} > 0.$$

□

B.2 Additional Discussions

B.2.1 Further Discussion on the Domino Effect of Extremism

The interpretation of the domino effect different from that in section 3.5.3 is that a sudden shock in country 1 induces the extremism equilibrium, and it has a contagion effect on subsequent countries.

We first consider the shock on the value of b as an exogenous shock that makes country 1 be in the extremism equilibrium. The benchmark case is that $b = \underline{b}$, such that $p_1 \geq \bar{p}(\underline{b})$.[7] In this case, extremism never arises in all countries. Next, as a hypothetical situation, suppose that only country 1's b, denoted by b_1, changes from $\underline{b}$ to $\bar{b}$. We assume that $\bar{b}$ is sufficiently large so that $p_1 < \bar{p}(\bar{b})$. This is

[7] $\bar{p}$ is increasing in b.

the case wherein country 1 receives an exogenous shock that makes only country 1 face the extremism equilibrium.[8] This exogenous shock has a domino effect.

Proposition B.1. *Suppose* $\omega = 1$. *There exists* $\hat{p} \in (\bar{p}(\underline{b}), 1)$ *such that for* $p_1 \in (\bar{p}(\underline{b}), \hat{p})$,

$$\Pr(p_i \geq \bar{p} | b_1 = \underline{b}) = 1 > \Pr(p_i \geq \bar{p} | b_1 = \bar{b})$$

holds for each $i \neq 1$.

Proof. It suffices to show that the inequality holds when p_1 is sufficiently close to, but strictly greater than $\bar{p}(\underline{b})$. First, when $p_i < \bar{p}$, the congruent type H chooses policy 2, and $p_{i+1}(2) < p_i$. Hence, $\Pr(p_i \geq \bar{p} | b_1 = \bar{b}) \leq q_H^{i-1} \in (0,1)$. On the contrary, when $p_i \geq \bar{p}$, policy 2 is never chosen so that $p_{i+1} \geq \bar{p}$ always holds. Hence, $\Pr(p_i \geq \bar{p} | b_1 = \underline{b}) = 1$. Combining them, we have the proposition. □

Another exogenous shock is the shock on the value of q. Since smaller q means that voters distrust politicians more, this is the exogenous schock on political distrust in country 1. The benchmark case is that $q = \bar{q}$, such that $p_1 \geq \bar{p}(\bar{q})$. In this case, extremism never arises. Next, as a hypothetical situation, suppose that only country 1's q, denoted by q_1, changes from $\bar{q}$ to $\underline{b}$. We assume that $\underline{q}$ is sufficiently large so that $p_1 < \bar{p}(\underline{q})$. This exogenous shock has a domino effect as the shock about b does.

Proposition B.2. *Suppose* $\omega = 1$. *There exists* $\hat{p} \in (\bar{p}(\bar{q}), 1)$ *such that for* $p_1 \in (\bar{p}(\bar{q}), \hat{p})$,

$$\Pr(p_i \geq \bar{p} | q_1 = \bar{q}) = 1 > \Pr(p_i \geq \bar{p} | q_1 = \underline{q})$$

holds for each $i \neq 1$.

B.2.2 Long-Run Distribution in the Markovian Environment

The probability of the implementation of each policy in period i depend on p_i, which is a continuous variable. Hence, the relevant states are infinite. Still, under the following assumption, we obtain the steady state distribution by adequately aggregating states into finite partitions.[9]

Assumption B.1. *The following conditions are satisfied: (i) the condition for Proposition 3.4, (ii)* $\frac{1-q}{(b-1)q_L} < \bar{p}$, *(iii)* $1 - \theta_2 > \frac{1-q}{(b-1)q_L}$, *and (iv)* $\overline{p} < p_E$.

(i) implies that one moderate policy is enough to stop extremism, (ii) implies that the first case of Theorem 1 applies, (iii) implies that (E2) equilibrium never occurs, and (iv) implies that the convergence to extremism does not occur.Parameters satisfying all of these conditions exist.[10] Under these conditions, on the one hand, irrespective of the belief p_i, the extremism equilibrium ends when policy 1 is implemented, while it continues in other cases. On the other hand, the non-extremism equilibrium ends if and only if policy 2 is implemented.[11] Moreover, the probability that each policy is implemented is independent of p_i. There properties are helpful in aggregating the states.

We classify each state into four categories: the non-extremism equilibrium under $\omega = 1$ (we refer to this as state 1), the extremism equilibrium under $\omega = 1$ (state 2), the non-extremism equilibrium under $\omega = 2$ (state 3), the extremism equilibrium under $\omega = 2$ (state 4). Thus, we essentially work on four states, each of which aggregates infinitely many states differing in belief p_i.

[8]All the players (including those in other countries) know the value of b_1.

[9]Peck and Yang (2011) also face the same difficulty and restrict their attention to a special case in order to obtain the analytical solutions.

[10]For example, $l = 4$, $b = 2.1$, $q = 0.8$, $q_L = 0.7$, $\theta_1 = 0.95$, and $\theta_2 = 0.6$.

[11]$\bar{p} < p_E$ guarantees that the non-extremism equilibrium never ends so long as policy 1 is implemented.

For $j,k \in \{1,2,3,4\}$, let t_{jk} be the transition probability from state j to k. Then, the transition matrix $T \equiv (t_{jk})_{j,k\in\{1,2,3,4\}}$ is given by

$$T = \begin{pmatrix} \theta_1 & 0 & 1-\theta_1 & 0 \\ \theta_1(1-q_H) & \theta_1 q_H & (1-\theta_1)(1-q_H) & (1-\theta_1)q_H \\ (1-\theta_2)(1-q) & (1-\theta_2)q & \theta_2(1-q) & \theta_2 q \\ (1-\theta_2)(1-q) & (1-\theta_2)q & \theta_2(1-q) & \theta_2 q \end{pmatrix}. \tag{B.20}$$

Since this is aperiodic and irreducible, the Markov chain governed by this transition matrix converges to the unique steady state distribution. Let $f(k)$ be the steady-state probability that state k occurs and let $\boldsymbol{f} \equiv (f(1), f(2), f(3), f(4))$. By solving $\boldsymbol{f}T = \boldsymbol{f}$, we obtain

$$f(1) = \frac{q\theta_2 - q - q_L\theta_1\theta_2 + q_L\theta_1 - \theta_2 + 1}{q_H\theta_1^2 + q_H\theta_1\theta_2 - 2q_H\theta_1 - \theta_1 - \theta_2 + 2}; \tag{B.21}$$

$$f(2) = \frac{q(\theta_1\theta_2 - \theta_1 - \theta_2 + 1)}{q_H\theta_1^2 + q_H\theta_1\theta_2 - 2q_H\theta_1 - \theta_1 - \theta_2 + 2}; \tag{B.22}$$

$$f(3) = \frac{(1-\theta_1)\left[q(1-\theta_2)(1-q_H) + (1-q)(1-q_H\theta_1)\right]}{(2-\theta_1-\theta_2)(1-q_H\theta_1)}; \tag{B.23}$$

$$f(4) = \frac{q(1-\theta_1)\left[(1-\theta_1)q_H + \theta_2(1-q_H)\right]}{(2-\theta_1-\theta_2)(1-q_H\theta_1)}. \tag{B.24}$$

By differentiating the expression for $f(2)$, we immediately obtain the following:

Proposition B.3. *In the steady state, the frequency of the extremism equilibrium under $\omega = 1$ is increasing in q (holding q_L fixed) and is decreasing in q_L (holding q fixed).*

Intuitively, larger q implies that the congruent type H frequently appears, which prolongs extremism under $\omega = 1$. In this case, extremism always ends with only one moderate policy since the condition behind Proposition 3.4 is assumed to be satisfied. Thus, the effect that $p^*_{i+1}(2)$ is increasing in q_H, which curbs extremism, is absent. Consequently, larger q_H always implies more frequent extreme policy under $\omega = 1$, and so more frequent extremism equilibrium under the moderate state. Larger q_L enhances the learning of the correct state, and curbs extremism under $\omega = 1$.

We next analyze the comparative statics about the stability of the moderate state. By using the above characterization of the steady state probability distribution, a straightforward but tedious calculation yields the following property (the formal proof is available upon request):

Proposition B.4. *Suppose that θ_1 is sufficiently close to 1. In the steady state, the frequency of the extremism equilibrium ($f(2) + f(4)$) is decreasing in θ_1. The frequency of the extremism equilibrium under $\omega = 1$ ($f(2)$) is also decreasing in θ_1.*

This indicates that the higher θ_1 induces the smaller fraction of the extremism equilibrium. Note that this result is not about the duration of populism, defined in the main text as the average number of consecutive countries in the extremism equilibrium. Rather, Proposition B.4 states the average number of countries that are not necessarily consecutive is decreasing in θ_1, the stability of the moderate state.

B.2.3 Discussions on Reputation Concerns

Equilibrium with Moderate Reputation Concerns

So far, we have assumed that $b > 2$. In this subsection, we explore the equilibrium in the single-country model when this does not necessarily hold.

First, assume that $b \in (1,2)$. Then, we have the following result.

Proposition B.5. *(i) When $p \geq \frac{1-q}{(b-1)q}$, $\alpha^*(\omega;\omega) = 1$; and $\beta^*(1) = 1$.*

(ii) When $p < \frac{1-q}{(b-1)q}$, $\alpha^*(\omega;\omega) = 1$; and $\beta^*(1) = \frac{(b-1)pq}{1-q}$ and $\beta^*(0) = 1 - \beta^*(1)$.

Proof. Since $b < 2$, (E1), (E2), and (E3) equilibria do not exist from the proof of Proposition 3.1. Furthermore, from the proof of Proposition 3.1 (d), the condition for the existence of (NE) equilibrium is replaced with $p \geq \frac{1-q}{(b-1)q}$. Lastly, the equilibrium (II-2) in the proof of Proposition 3.1 (e) (Step 2) exists if and only if $p \leq \frac{1-q}{(b-1)q}$. Combining these arguments yields the theorem. □

Hence, when $b < 2$, only the non-extremism equilibria exist and $b > 2$ is needed to analyze interesting cases.

However, one might think that this is restrictive because the congruent type H might have only moderate reputation concerns $b \in (1,2)$. This is not the case. To see this, let us allow b_i of the congruent type H to be different from that of the non-congruent type. Let b_i of the congruent type H (the non-congruent type) be b_C (b_N) and assume that $b_C, b_N > 1$. Then, under a certain condition, we obtain a result that is significantly close to that of the previous analysis. Furthermore, this result yields the following proposition, which is similar with that in the basic model.

Proposition B.6. *Suppose that $(b_N - 1)/b_N > 1/b_C$. Then, the non-extremism equilibrium exists if and only if*

$$p \geq \bar{p}' \equiv \max\left\{ \frac{1-q}{(b_N-1)q}, \frac{(b_C-1)(1-q)}{q} \right\}.$$

Proof. By replacing b in Proposition 3.1 appropriately, we obtain the proposition. □

In many contexts, it is reasonable that the non-congruent type exhibits high reputation concerns while the congruent type H exhibits moderate reputation concerns. For instance, the non-congruent type might have more intense office-seeking motivations that influences the development of their preferred policy or engagement in bribery.[12] Thus, the condition for the existence of extremism equilibria is not very restrictive.

General Formulation

Though we have assumed that $V(\pi) = \pi$ for simplicity, our result still holds under a general setting. To see this, assume that the function $V : [0,1] \mapsto [0,1]$ is strictly increasing, $V(0) = 0$, and $V(1) = 1$. Let us introduce some notations, which will be used in the following results:

$$\bar{v} \equiv V^{-1}\left(\frac{b-1}{b}\right); \; \underline{v} \equiv V^{-1}\left(\frac{1}{b}\right).$$

Note that these values are uniquely determined because V is strictly increasing and $(b-1)/b, 1/b \in (0,1)$. Then, we have the characterization of equilibria, which is almost the same as that of Theorem 3.1. Consequently, we obtain the following proposition:

Proposition B.7. *The non-extremism equilibrium exists if and only if $p \geq \bar{p}'' \equiv \frac{(1-q)\bar{v}}{q(1-\bar{v})}$.*[13]

Proof. We first have the following characterization of equilibria, which is almost the same as that of Theorem 3.1. To see this, for example, examine the existence of (E1) equilibrium. The congruent type H has no deviation incentive from 2 to 1 when $\omega = 1$ if and only if

$$-1 + b \geq bV\left(\frac{q_L p}{q_L p + (1-q)}\right) \Leftrightarrow p \leq \frac{\bar{v}(1-q)}{q_L(1-\bar{v})}. \tag{B.25}$$

[12] See a dynamic election model in section 3.7.2.

[13] This is increasing in b because $\bar{v}$ is increasing in b.

Note that the congruent type H obviously has no deviation incentive when $\omega = 2$.

Next, consider the non-congruent type. S/he has no incentive to deviate from 1 to 0 if and only if

$$-1 + bV\left(\frac{q_L p}{q_L p + (1-q)}\right) \geq 0 \Leftrightarrow p \geq \frac{\underline{v}(1-q)}{q_L(1-\underline{v})}. \tag{B.26}$$

This is because such deviation incentive is minimized when $\pi(0) = 0$. Combining (B.25) and (B.26) yield the condition. Similarly, we obtain those corresponding to Theorem 3.1. By using this characterization, we have the proposition.

□

B.2.4 Simultaneous Policymaking

In yardstick competition models, policymaking is simultaneous across countries (e.g., Besley and Case 1995). While we have not focused on simultaneous timing because our focus is sequential policymaking and associated dynamics, it might be more appropriate in other contexts. To analyze this game, suppose that ω is the same across countries. In contrast to the previous game, the non-congruent type's strategy depends on ω because it is now payoff-relevant: the policy implemented by the other country's politician, which is dependent upon ω, affects the reputation. To reflect this modification, let $\beta^*(x;\omega)$ be the probability of the non-congruent type choosing x given ω. Furthermore, denote the reputation of politician i given policies in the two countries by $\pi(x_i, x_{-i})$.

Though characterizing the whole set of equilibria is hard, we can derive the condition for the existence of the non-extremism equilibrium.

Proposition B.8. *Suppose Assumption 3.2. Then, there exists a non-extremism equilibrium for any $p \in (0,1)$.*

Proof. It suffices to prove that there is an equilibrium, such that $\alpha^*(\omega;\omega) = 1; \beta^*(1;1) = 1; \beta^*(1;2) = 0$. $(x_i, x_{-i}) = (1,2)$ is the off-path. Let us assume that $\pi(1,2) = 0$. Then, it is straightforward to verify that for any p, no deviation incentive exists (details are available upon request).

□

This is contrast to the results in the previous analysis. When a non-extremism equilibrium exists for some p in the single-country model, there always exists a non-extremism equilibrium independently of the prior belief p in the simultaneous policymaking model. The key is that the non-congruent type might not be able to pretend to be the congruent type when $\omega = 2$. In that case, the congruent type chooses policy 2, meaning that the non-congruent type fails to pretend to be the congruent type by implementing policy 1 so long as the incumbent in the other country is the congruent type. Note, however, that in the non-extremism equilibrium we constructed, the tyranny is severe so that the non-congruent type often takes policy 0 in this equilibrium. Hence, there is no guarantee that the non-extremism equilibrium is always the voter-optimal equilibrium.

Extremism can also arise. To illustrate this point, we focus on (E1) equilibrium wherein $\alpha^*(2;\omega) = 1$, and $\beta^*(1;\omega) = 1$. We show that this equilibrium remains for intermediate values of p.

Proposition B.9. *Suppose $\frac{q_L}{1-q_H} > \frac{1}{b}$. Then, there exists $\hat{p} \in (0,1]$ and $\check{p} \in (0,\hat{p})$, such that (E1) equilibrium exists if and only if $p \in [\check{p}, \hat{p}]$.*

Proof. We first analyze the congruent type H. When $\omega = 1$, it chooses policy 2 if and only if

$$b[(1-q_H)\pi(1,1) + q_H\pi(1,2)] \leq -1 + b. \tag{B.27}$$

Here,

$$\pi(1,1)=\frac{pq_L(1-q_H)}{p(1-q_H)^2+(1-p)(1-q)^2};\ \pi(1,2)=\frac{pq_Lq_H}{p(1-q_H)q_H+(1-p)(1-q)q},$$

where both of which are increasing in p. Note that there is no incentive to deviate when $\omega=2$.

The non-congruent type has no incentive to deviate when $\omega=1$ if and only if

$$-1+b[(1-q_H)\pi(1,1)+q_H\pi(1,2)]\geq 0. \tag{B.28}$$

Similarly, when $\omega=2$, the incentive compatibility condition for the non-congruent type is given by

$$-1+b[(1-q)\pi(1,1)+q\pi(1,2)]\geq 0. \tag{B.29}$$

The strategy constitutes an equilibrium if (B.27) (B.28), and (B.29) are jointly satisfied. Here, the left-hand side of (B.28) is less than that of (B.29) because $\pi(1,1)>\pi(1,2)$. Hence, (B.28) implies (B.29), meaning that (B.27) and (B.28) are the necessary and sufficient conditions for the existence of the equilibrium. Since the left-hand side of (B.27) is increasing in p, there exists $\hat{p}\in[0,1]$, such that (B.27) holds if and only if $p\leq\hat{p}$. Note that $\hat{p}>0$ because (B.27) holds with strict inequality when $p=0$. Similarly, there exists $\check{p}\in[0,1]$, such that (B.28) holds if and only if $p\geq\check{p}$. Note that $\check{p}>0$ because (B.28) never holds when $p=0$, and $\check{p}<1$ because $\frac{q_L}{1-q_H}>\frac{1}{b}$ is assumed. Furthermore, since $b>2$, $\hat{p}>\check{p}$. Combining these arguments yields the proposition. □

A natural question is whether the presence of the other country may facilitate the emergence of extremism. We obtain the following (the proof is available upon request):

Fact B.1. $\hat{p}<\frac{(b-1)(1-q)}{q_L}$ *holds.*[14]

Hence, the presence of the opponent country makes (E1) equilibrium less likely to exist. Although our result is restricted to (E1) equilibrium, yardstick competition may prevent extremism.

However, this argument requires a significant modification when politicians know each other's type as in Besley and Case (1995). Suppose that (E1) equilibrium arises in the single-country case.[15] When both countries follow this equilibrium strategy,

$$\pi(1,2)=\frac{pq_Lq_H}{p(1-q_H)q_H+(1-p)(1-q)q}<\pi(1)<\pi(1,1)=\frac{pq_L(1-q_H)}{p(1-q_H)^2+(1-p)(1-q)^2},$$

where $\pi(1)$ is the reputation of taking policy 1 in the single country case. In the single-country case, the incentive constraint for the congruent type H under $\omega=1$ is $\pi(1)<-1+b$. Since $\pi(1)$ is increasing in p, the incentive constraint may be violated when p is high. Thus, for high p, (E1) equilibrium is not supported. However, if the politician knows that the opponent is the congruent H type, $\pi(1)$ is replaced with $\pi(1,2)$, making the incentive constraint more likely to hold. Thus, the extremism in the foreign country may induce extremism. On the other hand, if the opponent is the non-congruent type or the congruent L type, $\pi(1)$ is replaced with $\pi(1,1)$, making the constraint less likely to hold. Thus, the foreign moderate policy may curb extremism. In Fact B.1, both of these forces are at work and one of them happens to be dominant.

Note that the case when the opponent is the congruent type H is similar to the case wherein the previous country implemented policy 2 in our main model. Under sequential choice, extremism of the foreign country makes voters believe that the optimal policy is more likely to be policy 2, and it induces another extremism. On the other hand, under simultaneous choice, extremism in foreign country

[14]The right-hand side is the upper bound of p for the existence of (E1) equilibrium.

[15]It constitutes an equilibrium even if we allow β to depend on ω.

prevents voters from identifying the non-congruent politicians, which induces extremism through signaling motives. The similar analogy holds for the case that the non-congruent type or the congruent L type is the opponent. Although this analysis is only suggestive, it implies that the presence of foreign countries might help the emergence of extremism even under the simultaneous policymaking.

Appendix C

Appendix for Chapter 4

C.1 Omitted Proofs

C.1.1 Proof of Fact 4.1

The inequality can be rewritten as

$$c \geq \delta \left(\frac{\tau_L}{\tau_1}\right)^{\alpha} \left[\left(\frac{\tau_M}{\tau_L}\right)^{\alpha} - 1\right].$$

Since the right-hand side is decreasing with τ_1, it suffices to consider the case where $\tau_1 = \tau_M$. In this case, the inequality is equivalent to

$$c \geq \delta \left[1 - \left(\frac{\tau_L}{\tau_M}\right)^{\alpha}\right],$$

which holds from Assumption 4.1. Hence, we obtain Fact 4.1. □

C.1.2 Proof of Lemma 4.4

First, observe that

$$K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} + \delta K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} > K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}(1-c) + \delta K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} a\frac{p_w}{\tau_L}$$

can be written as

$$a < \frac{\tau_L}{\delta p_w}(c+\delta). \tag{C.1}$$

In addition,

$$K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha} + \delta K\left(\frac{p_w}{\tau_2(\tau_1^A)}\right)^{-\alpha} > K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha}(1-c) + \delta K\left(\frac{p_w}{\tau_M}\right)^{-\alpha} a\frac{p_w}{\tau_M}$$

can be written as

$$a < \frac{\tau_M}{\delta p_w}\left[\delta + c\left(\frac{\tau_1^A}{\tau_M}\right)^{\alpha}\right]. \tag{C.2}$$

Here, the right-hand side of (C.2) is larger than the right-hand side of (C.1) and so (C.1) implies (C.2). Thus, when (C.1) holds, (4.8) is the same as

$$K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} + \delta K\left(\frac{p_w}{\tau_L}\right)^{-\alpha} < K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha} + \delta K\left(\frac{p_w}{\tau_M}\right)^{-\alpha},$$

which trivially holds. Hence, voters whose ability satisfies (C.1) vote for politician A in period 1.

Next, consider the other voters. For the other voters, (4.8) can be written as

$$\begin{aligned}&K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}(1-c)+\delta K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}a\frac{p_w}{\tau_L}\\&<\max\left\{K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha}+\delta K\left(\frac{p_w}{\tau_M}\right)^{-\alpha},K\left(\frac{p_w}{\tau_1^A}\right)^{-\alpha}(1-c)+\delta K\left(\frac{p_w}{\tau_M}\right)^{-\alpha}a\frac{p_w}{\tau_M}\right\}.\end{aligned}$$

This holds when

$$a<\max\left\{\frac{\tau_L}{\delta p_w}\left[\left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha}-(1-c)+\delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\right],\frac{1}{\delta p_w}\frac{\tau_1^{A\,\alpha}-\tau_L^{\alpha}}{\tau_L^{\alpha-1}-\tau_M^{\alpha-1}}(1-c)\right\}.$$

Hence, voters whose ability satisfy

$$a<\max\left\{\frac{\tau_L}{\delta p_w}(c+\delta),\frac{\tau_L}{\delta p_w}\left[\left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha}-(1-c)+\delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\right],\frac{1}{\delta p_w}\frac{\tau_1^{A\,\alpha}-\tau_L^{\alpha}}{\tau_L^{\alpha-1}-\tau_M^{\alpha-1}}(1-c)\right\}$$

vote for politician A in period 1. If and only if this amount is larger than $\frac{A}{2}$, politician A can win the election. This condition holds if and only if either of the following two inequalities hold:

$$c>\min\left\{\frac{\delta p_w}{\tau_L}a_M-\delta,\frac{\delta p_w}{\tau_L}a_M+1-\left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha}-\delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\right\}; \tag{C.3}$$

$$c<\underline{c}^1(\tau_1^A)=1-a_M\delta p_w\left[\frac{1}{\tau_L^{1-\alpha}}-\frac{1}{\tau_M^{1-\alpha}}\right]\frac{1}{\tau_1^{A\,\alpha}-\tau_L^{\alpha}}.$$

Here,

$$\frac{\delta p_w}{\tau_L}a_M-\delta-\left[\frac{\delta p_w}{\tau_L}a_M+1-\left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha}-\delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\right]=\left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha}-1+\delta\left[\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}-1\right]>0.$$

Therefore, (C.3) can be rewritten as

$$c>\frac{\delta p_w}{\tau_L}a_M+1-\left(\frac{\tau_1^A}{\tau_L}\right)^{\alpha}-\delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}=c^1(\tau_1^A).$$

In summary, either $c>c^1(\tau_1^A)$ or $c<\underline{c}^1(\tau_1^A)$ is the necessary and sufficient condition. □

C.1.3 Proof of Lemma 4.5

The last two inequalities trivially hold. We show only the first inequality. The first inequality is

$$\begin{aligned}&a_M\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\frac{\delta p_w}{\tau_M}-\delta\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}>a_M\left(\frac{\tau_H}{\tau_M}\right)^{\alpha}\frac{\delta p_w}{\tau_H}-\delta\left(\frac{\tau_H}{\tau_M}\right)^{\alpha}\\&\Leftrightarrow a_M\delta p_w\left[\frac{1}{\tau_L^{\alpha}\tau_M^{1-\alpha}}-\frac{1}{\tau_M^{\alpha}\tau_H^{1-\alpha}}\right]+\delta\left[\left(\frac{\tau_H}{\tau_M}\right)^{\alpha}-\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\right]>0.\end{aligned}$$

The first term is always positive and the second term is positive when $\tau_H\tau_L<\tau_M^2$. Thus, the inequality above holds. □

C.1.4 Proof of Theorem 4.1

(I) When $c^1(\tau_H) \leq c^2(\tau_H, \tau_M)$: To begin with, consider the condition under which (τ_H, τ_M) is supported by an equilibrium.

(a) The condition under which politician A can win the elections in both periods when s/he chooses τ_H as the tariff rate in period 1: In period 1, politician A can win the election if and only if either $c > c^1(\tau_H)$ or $c < \underline{c}^1(\tau_H)$ holds from Lemma 4.4.

From Lemma 4.2, politician A can win the election in period 2 if and only if

$$\frac{\tau_M}{\delta p_w}\left[\delta + c\left(\frac{\tau_H}{\tau_M}\right)^{\alpha}\right] > a_M.$$

This can be rewritten as $c > c^2(\tau_H, \tau_M)$.

Here, since $c^1(\tau_H) \leq c^2(\tau_H, \tau_M)$, $c > c^1(\tau_H)$ holds when $c > c^2(\tau_H, \tau_M)$. Thus, $c > c^2(\tau_H, \tau_M)$ is the necessary and sufficient condition.

(b) The condition under which politician A cannot win the election in period 2 when s/he chooses τ_M as the tariff rate in period 1: From Lemma 4.1, politician B can win the election in period 2 if and only if

$$\frac{\tau_L}{\delta p_w}\left[\delta + c\left(\frac{\tau_M}{\tau_L}\right)^{\alpha}\right] \leq a_M.$$

This can be written as $c \leq c^2(\tau_M, \tau_L)$.

From (a) and (b), if and only if $c^2(\tau_H, \tau_M) < c \leq c^2(\tau_M, \tau_L)$, (τ_H, τ_M) is supported by an equilibrium.

From now on, we examine the highest pair of tariff rates when (τ_H, τ_M) cannot be achieved.

(a') $c > c^2(\tau_M, \tau_L)$: In this case, politician A chooses τ_M as the tariff rate in period 1 if s/he assumes power in period 1 because s/he can win the election in period 2 from the discussion above. Given this, politician A can win in the election of period 1 if and only if either of the following two inequalities hold from Lemma 4.4: $c > c^1(\tau_M)$ or $c < \underline{c}^1(\tau_M)$. This holds because we assume that $c^1(\tau_M) < c^2(\tau_M, \tau_L)$. Thus, when $c > c^2(\tau_M, \tau_L)$, (τ_M, τ_M) is supported by an equilibrium.

(b') $c \leq c^2(\tau_H, \tau_M)$: In this case, (τ_H, τ_M) cannot be supported by any equilibria from the arguments above.

In addition, it can be shown that (τ_M, τ_M) cannot be supported by any equilibria as follows. From Lemma 2, politician A can win the election in period 2 if and only if

$$\frac{\tau_M}{\delta p_w}\left[\delta + c\left(\frac{\tau_M}{\tau_M}\right)^{\alpha}\right] > a_M.$$

This can be written as $c > c^2(\tau_M, \tau_M)$. However, because $c^2(\tau_H, \tau_M) < c^2(\tau_M, \tau_M)$, politician A cannot win in period 2. Thus, (τ_M, τ_M) cannot be supported by any equilibria.

Then, the possible highest pair of tariff rates is (τ_M, τ_L). We show that this can be supported by an equilibrium. Because $c \leq c^2(\tau_M, \tau_L)$, politician B can win the election when politician A took powers and chose τ_M in period 1. When $\tau_2(\tau_M) = \tau_L$ and $\tau_1^A = \tau_M$, all the workers prefer τ_M to τ_L in period 1 from inequality (4.8). Thus, in period 1, politician A wins the election. Therefore, (τ_M, τ_L) is supported by an equilibrium.

(II) When $c^2(\tau_H,\tau_M) < c^1(\tau_H) < c^2(\tau_M,\tau_L)$ and $c^2(\tau_H,\tau_M) < \underline{c}^1(\tau_H)$: (i), (ii) and (v) can be shown using the exactly same way as that of the proof of (I). Thus, we show only (iii) and (iv).

(iii) $\underline{c}^1(\tau_H) \le c \le c^1(\tau_H)$: (τ_H,τ_M) cannot be supported by any equilibrium because politician A cannot win the election in period 1 from Lemma 4.4. In addition, (τ_M,τ_M) cannot be supported by any equilibrium because politician A cannot win the election in period 2 from the fact that $c \le c^2(\tau_M,\tau_M)$ holds. Last, as in (b') in the above, (τ_M,τ_L) is supported by an equilibrium. Thus, in this case, the highest pair of tariff rates is (τ_M,τ_L).

(iv) $c^2(\tau_H,\tau_M) < c < \min\{\underline{c}^1(\tau_H), c^2(\tau_M,\tau_L)\}$: Show that (τ_H,τ_M) is supported by an equilibrium. Since $c < \underline{c}^1(\tau_H)$ holds, politician A can win the election in period 1. In addition, since $c > c^2(\tau_H,\tau_M)$, politician A can win the election in period 1 after choosing τ_H as the tariff rate in period 1. Lastly, politician A chooses τ_H as the tariff rate in period 1 since s/he cannot win the next election when s/he chooses τ_M as the tariff rate from the fact that $c < c(\tau_M,\tau_L)$. Thus, (τ_H,τ_M) is supported by an equilibrium i.e., the highest pair of tariff rates is (τ_H,τ_M).

(III) When $c^2(\tau_H,\tau_M) < c^1(\tau_H) < c^2(\tau_M,\tau_L)$ and $c^2(\tau_H,\tau_M) \ge \underline{c}^1(\tau_H)$: The proof is exactly the same as the previous one. Thus, we omit the proof. □

C.1.5 Proof of Lemma 4.6

$$\frac{\gamma}{1-\gamma} > \frac{\tau_H^\alpha - \tau_L^\alpha}{A p_w}\left[\left(\frac{1}{\tau_L}\right)^{1-\alpha} - \left(\frac{1}{\tau_H}\right)^{1-\alpha}\right]^{-1}$$

implies that $\gamma\bar{v}_t + (1-\gamma)\underline{v}_t$ is decreasing in τ_t since the maximizerof $\gamma\bar{v}_t + (1-\gamma)\underline{v}_t$ is not interior. Hence, politician B's utility is maximized at $\tau_t = \tau_L$ since $\kappa_B = 0$. On the other hand, from $\kappa_A > K\left(\frac{p_w}{\tau_L}\right)^{-\alpha}$, politician A receives the penalty λ when $\tau_t = \tau_L$. Hence, politician A's utility is not maximizing at $\tau_t = \tau_L$ under sufficiently large λ. Instead, since $\kappa_A \le K\left(\frac{p_w}{\tau_M}\right)^{-\alpha}$ holds, politician A does not receive penalty when choosing τ_M. Therefore, politician A's utility is maximized at τ_M. □

C.1.6 Proof of Proposition 4.1

First, the setting of politicians' utility is the same as that of the basic model from Lemma 6. Second, the median voter is worker a_M as in the basic model. Hence, Theorem 4.1 holds since the same proof is applicable. □

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