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The Political Economy of Commitment to Policies

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The Political Economy of Commitment to Policies

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Abstract

IPCC (2022) documents a looming gap between climate goals and implemented policies and points to a lack of political commitment. We study policymakers' incentives to commit. A policymaker decides on a policy to encourage citizens to make investments and determines the degree of flexibility to change the policy after investments have been made. This adds redistributive concerns to the trade-off between commitment and flexibility. When a majority of citizens invest, redistributive concerns alleviate the time-inconsistency problem. When a minority of citizens invest, redistributive concerns aggravate the time-inconsistency problem. Then, the policymaker either commits too strongly or refrains from commitment altogether.

JEL codes: D72, D78, H23, Q52

Key words: commitment, flexibility, redistribution, median voter, climate.

1 Introduction

The Intergovernmental Panel on Climate Change (IPCC 2022) urgently calls for increased efforts to mitigate climate change and its consequences. Recognizing increased awareness among citizens, the IPCC documents a looming gap between the goals of climate policies, as agreed upon in the Paris Agreement, and currently implemented measures to achieve those goals. As measures often require upfront investments by citizens and firms while benefits accrue only in the medium-to-long run, political commitment to climate policies is seen as a key prerequisite. In turn,

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political commitment requires support from citizens. This paper develops a political-economic model to study the decision to commit to future policies.

When governments want to spur private investments, they face a tradeoff between commitment and flexibility. Future governments may decide to change policies.[1] The flexibility to change policies has benefits, as it allows for adjustment to changing circumstances, changing preferences, and new information. However, it comes at a cost. When investment decisions depend on future policies, time-inconsistency problems may arise (Kydland and Prescott 1977). Anticipating the government's incentives to change policies, citizens and firms are reluctant to invest. Policy uncertainty has been flagged as an important obstacle to green investment for many years (OECD/IEA 2007, Brunner et al. 2012). In the words of Stern (2022): "*[As] circumstances change and learning occurs, ...policy will be revised; but it should occur in ways that are 'predictably flexible'. ... Government-induced policy risk is one of the major deterrents to investment worldwide.*" (p.1271).

Policy uncertainty is not always due to a lack of commitment devices.[2] For instance, in many countries, the government provides price certainty to investors in renewable energy sources. Germany launched the Renewable Energy Sources Act in 2000. Under this Act, investors in renewable energy received a feed-in tariff -a guaranteed (above market) price- for 20 years. After introduction of this price subsidy, investments rose substantially (Andor et al. 2017).[3] Public investments can also serve as commitment. Norway's investment in public chargers from 2009 onwards increased the value of driving an electric car in subsequent years and was followed by increased adoption of electric cars (Schulz and Rode 2022). When commitment is possible, the relevant question is: do policymakers have proper incentives to commit

[1] As a case in point, Australia abolished its Carbon Pricing Mechanism in 2014, after introducing it in 2012 (Worldbank, 2016).

[2] The literature on environmental and energy economics discusses various ways to overcome the time-inconsistency problem by using commitment devices, ranging from earmarking funds to contracting and from building a reputation to establishing an independent climate authority (see e.g. Marsiliani and Renström 2000, Helm et al. 2003, Brunner et al. 2012, Klenert et al. 2018, Chiappinelli and Neuhoff 2020, Chiappinelli and May 2022). Harstad and Battaglini (2020) discuss whether and when international treaties provide commitment.

[3] In 2020, facing the imminent expiration of the tariffs for early installations, the German government offered these investors options for extending their tariffs. Other countries that use long-run contracts to accelerate investment in renewable energy include Canada, Japan, the Netherlands, South Africa, and Spain.

to future policies?[4]

To answer this question, we develop a political-economic model in which citizens' investment decisions depend on future policy. A key feature of our model is that the median voter *ex ante* determines the degree of flexibility to change the policy *ex post*. This adds redistributional concerns to the trade-off between commitment and flexibility. Flexibility allows the median voter to *ex post* adjust policy to circumstances. Moreover, it provides the median voter with the oppportunity to use the policy to enhance redistribution toward the majority. Anticipation thereof affects both citizens' investment decisions and the median voter's incentive to commit.

We derive three main results. First, we show that redistributive concerns can allow an elected politician to generate higher social welfare than a social planner. If a majority of citizens invests in equilibrium and thus benefits from the announced policy *ex post*, redistributive concerns *are* the commitment device. There is no need to limit flexibility in order to spur investments. Importantly, redistributive concerns as a commitment device are a mixed blessing. It can also lead to inefficiencies. We discuss below how in the Netherlands, redistributive concerns made an *inefficient* subsidy to homeowners politically sustainable.

Our second main result is that redistributive concerns can lead to too much commitment and too little flexibility. For example, suppose the median voter anticipates that, in equilibrium, a minority of citizens will invest. She anticipates that redistributive concerns reinforce incentives to reduce the policy's benefits for citizens who invested. In this situation, redistributive concerns aggravate the time-inconsistency problem. Strong commitment is required to prevent a majority from cutting the benefits. This result explains extensive commitments, such as feed-in tariffs guaranteed for 20 years.

Our third main result is related to the second. The tendency to choose excessive commitment reduces the expected benefits of encouraging investments. This can induce the median voter to refrain from implementing the policy altogether. In this way, the redistributive concerns inherent to politics become an obstacle to green investment.

[4]Harstad (2020) discusses how, in the absence of commitment, politicians can alleviate time-inconsistency problems with current policies, see also Ulph and Ulph (2013). Fabrizio (2012) and Lim and Yurukoglu (2018) provide evidence that governments can mitigate the time-inconsistency problem.

A large part of the literature on time-inconsistency in climate policies discusses whether and how the government should commit from a normative perspective, see Habermacher and Lehmann (2020) and the references in footnote 2.[5] Policymakers' incentives to commit has received less attention. Pani and Perroni (2018) consider an incumbent politician who can choose to commit to future policy in a specific domain. Despite being efficiency-enhancing, the incumbent may refrain from commitment if voters favor him in this domain over electoral contestants. Commitment would reduce his re-election probability, as elections would then revolve around other policy domains. Battaglini and Harstad (2020) show that politicians may deliberately refrain from making international treaties enforceable, such that executing the treaty remains a salient topic in national elections. We also study how electoral concerns affect the choice to commit but abstract from partisan politics and intrinsic policy preferences. Instead, we study how redistributive concerns inherent to majoritarian decision-making affects politicians' incentive to commit.[6]

We find that the equilibrium in which redistribution provides commitment is never a unique equilibrium. It coexists with either an equilibrium without commitment and investment or with an equilibrium with full commitment. Multiple equilibria can explain why countries in similar situations adopt different policies. This relates to Besley and Persson (2022), who show that multiple equilibria can exist in a dynamic setting when citizens' preferences for green products and firms' choice of production technology are complements and coevolve endogenously. Absent com-

[5]Following Kydland and Prescott (1977), time-inconsistency problems were extensively studied in the literature on monetary policy, mostly focusing on how commitment could be achieved. To reduce the inflationary bias stemming from the time-inconsistency problem, policymakers can tie their hands through, for example, building a reputation (Barro and Gordon 1983, Backus and Driffill 1985), following rules with escape clauses (Persson and Tabellini, 1990), or delegating monetary policy to a conservative banker who is more inflation averse than the policymakers (Rogoff, 1985). Instead, we assume commitment devices are available and try to explain why governments use them in some situations but not in others.

[6]Kalkuhl et al. (2020) study how lobbing by firms affects carbon taxes depending on whether the government can or cannot commit to future taxes, but does not consider the choice to commit. Bueno de Mesquita and Friedenberg (2011) and Ghosh and Tripathi (2012) consider an election between an ideologist, who fully commits to a promise, and a pragmatist, whose platform responds to the state. Like us, these papers show that citizens may prefer ideologists to pragmatists. Neither of these studies, however, allow for partial commitment. Moreover, our mechanism is different. In our model, redistributive motives affect the benefits of commitment. In Ghosh and Tripathi (2012), pivotal voting is responsible for the result that citizens may vote for full commitment. In Bueno de Mesquita and Friedenberg (2011), candidates have better information than voters about the state. This makes it more difficult for voters to discipline pragmatists.

mitment to future policies, the transition to green production is sub-optimally slow. Delfgaauw and Swank (2023) argue that multiple equilibria can explain differences in gasoline taxes and the composition of the car fleet between the US and Europe. Neither of these papers allows for commitment. We show that multiple equilibria can also arise in case commitment is possible, and that these equilibria can also differ in the degree of commitment.

Our approach generates two predictions that are consistent with empirical observations. First, redistributive concerns can induce politicians to choose either a (very) high level of commitment or no commitment at all. Thus, our model can explain the existence of (very) long contracts in the renewable energy sectors on the one hand, and the observation that policy uncertainty is an obstacle to green investment (OECD/IEA 2007, Brunner et al. 2012, Stern 2022) on the other. Second, when a policy induces a majority of citizens to invest, ex post redistribution may give credibility to the policy. An example of a policy that owes its credibility to redistributive motives is the tax benefit to homeowners. In the Netherlands, mortgage interest deduction was introduced to encourage households to buy houses.[7] Homeowners were assumed to invest more in their houses and their neighborhood than renters. The tax-benefit did not stop when a majority of households had bought houses. The opposite occurred. While the tax benefit created large distortions in the housing market, it was deemed political suicide to even talk about reducing, let alone abolishing the tax benefit. The investment program had turned into a redistribution program. Redistribution, from a minority of house renters to a majority of house owners, gave credibility to the program.[8]

The main premise of our approach is that governments have means to commit themselves. Acemoglu and Robinson (2001) argue that credibility problems are particularly severe in democracies, as an intrinsic feature of democracy is the temporary authority of politicians. Our model shows that redistributive concerns in democracies can provide credibility, and potentially more efficiently so than benevolent autocrats. For explicit commitment devices to work, the strength of political and judicial institutions matters. In this paper, we assume that politicians respect these

[7] Other countries that allow some form of mortgage interest deduction include Belgium, Denmark, Ireland, Norway, Switzerland, and the United States.

[8] Anderberg and Perroni (2003) also point out that ex post distributive concerns can alleviate commitment problems.

institutions and their rules, enabling politicians to commit themselves. We are aware that this makes our approach less valid for countries with weaker institutions.[9]

2 The Model

We want our model to help our thinking about the forces that drive politicians' decisions to commit themselves. A key feature of our model is a trade-off between credibility and flexibility. In our model, a credibility problem exists because the policy that should induce agents to invest is determined *after* agents have made their investment decisions.[10] To keep the model simple, we *assume* that commitment reduces the flexibility to adjust the policy to realisations of uncertainty. Finally, in our model, politicians' decisions to commit themselves affect their chances of winning elections because the policy has distributive effects. To emphasize the distributive effects, in our model the policy is a subsidy received by citizens who have invested. Hence, the subsidy redistributes income from citizens who did not invest to citizens who did.[11] To focus on these distributive effects of the policy, we abstract from other reasons to redistribute income.

Policies and Preferences

Consider a society with a large number of citizens of mass 1 indexed by i. Citizens have the same initial income y. Each citizen i can make an investment that benefits all citizens, $e_i \in \{0, 1\}$, where $e_i = 1$ denotes that citizen i makes the investment and $e_i = 0$ denotes that he does not. If share κ of citizens invests, the benefit of the public good to each citizen equals $\gamma\kappa$, where $\gamma > 0$. Across citizens, the cost of investment c_i is uniformly distributed on $[0, c]$. Citizen i's decision on e_i is

[9] Klenert et al. (2018) show that across countries, carbon prices are positively correlated with trust in politicians, suggesting that trust correlates with governments' ability to enact policies with long-term benefits.

[10] Current policies can also affect investment, such as a subsidy on building windmills or a ban on the use of diesel oil. Credibility problems arise only if investment decisions depend on expectations about future policies. For this reason, our model revolves around a subsidy on the returns of investments rather than a subsidy on the investment itself. The decision between the use of current and future policies is beyond the scope of this paper; see Boadway et al. (1996) and Abrego and Perroni (2002) for a discussion of *ex ante* versus *ex post* subsidies. Aldy et al. (2023) find that among producers of wind energy, a subsidy on output is more cost-effective than a subsidy on investment.

[11] Our results carry over to other policies with similar distributive effects, including complementary public investments and corrective taxes.

verifiable. His cost of investment, c_i, is not verifiable. Throughout, we assume that c is sufficiently high, such that in any equilibrium there are some citizens who do not invest.

To encourage investment, the government offers a subsidy to citizens who invest. The timing of the model is important. Before citizens make their investment decisions, the politician in office *promises* a level of subsidy, s^p, that citizens who invest will receive. After citizens have made their investment decisions, elections are held. The elected politician chooses the level of subsidy citizens who invested actually receive, s. We assume that s can deviate from s^p at a cost, borne by society, as given by[12]

$$\Psi(\phi) = \frac{1}{2}\phi\left(s - s^p\right)^2.$$

The case that $\phi \to \infty$ describes a situation of full commitment where the politician in office before the election determines s after the election, $s = s^p$. The case that $\phi = 0$ describes a situation of no commitment. The winner of the election can freely choose s. Cases in which ϕ is finite and higher than zero describe situations of partial commitment. We assume that the degree of commitment is a choice made by the policy-maker, jointly with promise s^p before the election. In the context of the German renewable energy policies as discussed in the Introduction, the duration of the price guarantees reflects the degree of commitment. A two-year contract involves weaker commitment than a 20-year contract.[13]

We assume that the subsidy program involves bureaucratic costs, $F = \frac{1}{2}\theta s^2$ with $\theta > 0$, such as the costs associated with processing subsidy applications and fraud prevention. The subsidies and the bureaucratic costs are financed by a lump-sum tax, $\tau = \kappa s + \frac{1}{2}\theta s^2$. In our model, the bureaucratic costs create the time-inconcistency problem. Once citizens have made their investment decisions, the politician has an incentive to lower bureaucratic costs by reducing s. The parameter θ measures the importance of the credibility problem.

[12] We assume that the adjustment costs are equally distributed over all citizens. An alternative assumption would be that the incumbent predominantly bears the adjustment costs. In the examples we have in mind (such as contracts), reneging on promises usually involves costly judicial disputes.

[13] Throughout, we assume that politicians can choose any level of commitment, ranging from no commitment at all to full commitment. Limits to the feasible range of commitment, both at low and at high levels of commitment, are easily incorporated in our model.

Combining the elements above, citizen i's disposable income equals

$$y_i^d = y - \tau + (s - c_i)\, e_i.$$

Citizen i's preferences are represented by the utility function

$$\begin{aligned} u_i &= y_i^d + \gamma\kappa - \frac{1}{2}\phi\,(s - s^p)^2 + bs \\ &= y - \kappa s - \frac{1}{2}\theta s^2 + (s - c_i)\, e_i + \gamma\kappa - \frac{1}{2}\phi\,(s - s^p)^2 + bs. \end{aligned} \tag{1}$$

Through the last term of (1), we model a desire for flexibility. Generally, uncertainty about future circumstances raises a desire for flexibility.[14] To keep the model tractable, we model the desire for flexibility in a simple way. We assume that b is a stochastic term that realizes after the election. Before the election, it is common knowledge that b is drawn from the uniform distribution on $[-h, h]$, so that the expected value of b equals $E(b) = 0$ and its variance equals $Var(b) = h^2/3 \equiv \sigma^2$. After the election but before subsidy s is determined, b is observed. The realization of b is not verifiable. Hence, while ex post, policies can be adjusted to b, it is not possible to commit ex ante to a policy rule that makes s contingent on b.[15] This creates the trade-off between commitment and flexibility in our model. The parameter σ denotes the importance of flexibility. Equation (1) shows that u_i consists of four parts: citizen i's disposable income, the benefit of the public good, the policy adjustment costs, and the desire for flexibility.

Politics

We first determine the decisions on ϕ, s^p and s that a social planner would make. We assume that the social planner maximizes the sum of all citizens' utilities. Next,

[14]For instance, the need for flexibility could stem from uncertainty about the marginal cost of public funds or about government's borrowing cost. In a dynamic model where a fraction of citizens gets the opportunity to invest only after the election, the need for flexibility could also stem from uncertainty about the external benefits of investing. A recent example of an unanticipated event was the invasion of Russia in Ukraine. This led many countries to aspire to reduced energy dependence on Russia, increasing the benefits of policies that spur investments in energy-efficiency.

[15]For analytical tractability, we assume that after the election, the government can choose to adjust s to b, irrespective of the level of s. Basically, we assume that the need for flexibility does not depend on s. For values of s close to zero, this assumption is not natural because in reality negative subsidies are not always possible. A more natural assumption is adding the condition that $s \geq 0$. However, this would make expressions much longer without yielding important new insights.

we assume that the decisions on ϕ, s^p and s are made by the median voter, who is characterized by $c_m = \frac{1}{2}c$. We do not explicitly model the electoral process; any Condorcet method yields the policies preferred by the median voter (Cox, 1987). The main difference between the social planner and the median voter is that the median voter cares about the distributive consequences of the subsidy, while the social planner does not. To determine the median voter's decisions, two cases have to be distinguished: one in which the median voter invests, and one in which he does not.

We solve the model for subgame-perfect Nash equilibria. Given earlier decisions, s maximizes the median voter's payoff. Anticipating s, citizens' investment strategies can be represented by a single threshold. Citizen i invests if and only if the cost of investing is lower than the anticipated subsidy, $c_i \leq s^a(\phi, s^p)$, where $s^a(\phi, s^p) = E[s|\phi, s^p]$ denotes the anticipated subsidy, given ϕ and s^p. The share of citizens who invest equals $\kappa = s^a(\phi, s^p)/c$. To reduce notation, we write $s^a = s^a(\phi, s^p)$. Anticipating citizens' investment decision and the decision on s, ϕ and s^p maximize the median voter's payoff.

3 The Social Planner

In this section, we determine the decisions a social planner would make. After citizens have made their investment decisions, $e_i = 1$ for $c_i \leq s^a$, the social planner chooses the subsidy citizens who invested actually receive. When choosing s, social welfare equals

$$\begin{aligned}&\frac{1}{c}\int_0^{s^a}\left(y-\kappa s-\frac{1}{2}\theta s^2+(s-c_i)+\gamma\kappa\right)dc_i+\\&\frac{1}{c}\int_{s^a}^{c}\left(y-\kappa s-\frac{1}{2}\theta s^2+\gamma\kappa\right)dc_i-\frac{1}{2}\phi\left(s-s^p\right)^2+bs.\end{aligned} \tag{2}$$

The first line gives the expected payoff of the citizens who invested. The first expression on the second line gives the expected payoff of the citizens who did not invest. Maximizing (2) with respect to s yields

$$s = \frac{\phi s^p + b}{\phi + \theta}. \tag{3}$$

Equation (3) shows that in case of no commitment, $\phi = 0$, s only responds to b: $s = \frac{b}{\theta}$. As $E(b) = 0$, $s^a = 0$, and no citizen would invest. This illustrates the familiar result that also a social planner who lacks a commitment device faces a time-inconsistency problem.

When making their investment decisions, citizens observe ϕ and s^p but must form an expectation about b:

$$s^a = \frac{\phi s^p}{\phi + \theta}. \tag{4}$$

When choosing s^p, the social planner anticipates how s^p will affect citizens' investment decisions and how it will affect his final decision on s. The social planner chooses s^p so as to maximize social welfare

$$SW = \frac{1}{2h}\int_{-h}^{h}\left(\begin{array}{c} \frac{1}{c}\int_0^{s^a}\left[y - \frac{s^a}{c}s - \frac{1}{2}\theta s^2 + (s - c_i) + \gamma\frac{s^a}{c}\right]dc_i \\ \frac{1}{c}\int_{s^a}^{c}\left[y - \frac{s^a}{c}s - \frac{1}{2}\theta s^2 + \gamma\frac{s^a}{c}\right]dc_i - \frac{1}{2}\phi\left(s - s^p\right)^2 + bs \end{array}\right)db. \tag{5}$$

where we have used that $\kappa = s^a/c$. Substituting (3) and (4) into (5), differentiating with respect to s^p, and solving the first-order condition yields

$$s^p = \frac{\phi + \theta}{\phi + c\theta\left(\phi + \theta\right)}\gamma. \tag{6}$$

Setting $\phi \to \infty$ gives outcomes under full commitment

$$s_{full} = s^p = s^a = \frac{\gamma}{1 + c\theta}. \tag{7}$$

Equation (7) presents the Samuelson condition for an efficient provision of a public good from an *ex ante* perspective: the marginal benefit of the public good, γ, equals the marginal cost. The *ex ante* optimal fraction of citizens, κ_{full}, that invests equals

$$\kappa_{full} = \frac{\gamma}{c\left(1 + c\theta\right)}.$$

Clearly, in the case of full commitment, the social planner cannot respond to b. The cost of efficiency in the provision of the public good is lack of flexibility. A finite value of ϕ yields an inefficiently low level of the public good but gives flexibility to respond to b.

Let us now allow for partial commitment. In the appendix, we show that

$$\phi = \frac{\gamma - \sigma c}{\sigma(1 + c\theta) - \theta\gamma}\theta^2 \tag{8}$$

is a *possible* maximum of (5). Clearly, ϕ is negative unless

$$\sigma c < \gamma < \sigma c + \frac{\sigma}{\theta}. \tag{9}$$

On the basis of these inequalities and the *ex ante* payoffs in case that $\phi = 0$ and $\phi \to \infty$, three possible outcomes can be determined. For $\gamma < \sigma c$, the flexibility motive dominates. The social planner wants to be fully flexible in period 2 and thus chooses $\phi = 0$. For $\gamma > \sigma c + \frac{\sigma}{\theta}$, the credibility motive dominates. The social planner chooses full commitment, $\phi \to \infty$. For moderate values of γ and σ, the social planner chooses partial commitment (8). One can verify that, given (9), ϕ is increasing in γ and decreasing in σ. Thus, the more citizens value the public good or the lower is the need for flexibility, the more the social planner commits herself. These results demonstrate the usual trade-off between credibility and flexibility. Furthermore, ϕ increases in θ: if the time-inconsistency problem is more severe, the social planner chooses more stringent commitment. The final term in (9) shows that the range of γ for which the social planner chooses partial commitment rather than full commitment shrinks if the time-inconsisteny problem is stronger (i.e. if θ is larger).

Using the expressions for s, s^p, and ϕ, one can show that the subsidy level equals

$$s\left(s^P, \phi\right) = \gamma - \sigma c + \frac{\sigma\left(1 + c\theta\right) - \theta\gamma}{\theta\sigma} b \tag{10}$$

if the conditions in (9) hold. For $\gamma < \sigma c$, $s = \frac{b}{\theta}$, and for $\gamma > \frac{\sigma(1 + c\theta)}{\theta}$, $s = \frac{\gamma}{1+c\theta}$. Proposition (1) summarizes the discussion above.

Proposition 1. *Suppose that a social planner makes all policy decisions.*

1. If $\gamma < \sigma c$, she chooses full flexibility: $\phi = 0$ and $s = \frac{b}{\theta}$.

2. If $\gamma > \sigma c + \frac{\sigma}{\theta}$, she chooses full commitment: $\phi \to \infty$ and $s = \frac{\gamma}{1+c\theta}$, which satisfies the Samuelson condition for an efficient public good provision.

3. If $c\sigma < \gamma < \sigma c + \frac{\sigma}{\theta}$, she chooses partial commitment, with ϕ increasing in γ and *decreasing in σ as given by (8), and $s\left(s^P, \phi\right)$ is given by (10).*

Proposition 1 shows how a social planner trades off credibility and flexibility. The reason that the social planner does not achieve the first-best outcome is that she cannot commit to a policy rule that optimally combines credibility and flexibility: $s = s_{full} + \frac{c}{1+c\theta}b$.[16] The social planner can only improve credibility at the expense of flexibility. This result resonates with the well-known result from the central-banking literature that by delegating monetary policy to a conservative banker, a social planner improves credibility at the expense of flexibility.

4 Distributive Concerns Can Provide Commitment

This section presents the first two main contributions of our paper: distributive concerns may alleviate a time-inconsistency problem and the median voter can achieve higher social welfare than a social planner. To this end, we consider a situation where the median voter cannot commit himself, $\phi = 0$. As we discuss below, distributive concerns can only alleviate the time-inconsistency problem if a majority of citizens invest. Therefore, suppose that the median voter invests. Then, in period 2, the median voter maximizes

$$y - \kappa s - \frac{1}{2}\theta s^2 + s - \frac{1}{2}c + \gamma\kappa + bs$$

with respect to s, yielding

$$s = \frac{b + 1 - \kappa}{\theta}. \tag{11}$$

Comparing (11) to (3) with $\phi = 0$ shows that *ex post,* after having invested, the median voter has an incentive to increase s for distributional purposes. This incentive is stronger if the bureacratic costs θ are smaller and if κ, the fraction of citizens that has invested, is smaller.

[16] This is also the optimal level of s if all citizens would make their investment decision after the subsidy has been determined. If the social planner would also make the investment decisions on behalf of the citizens, the social planner chooses full flexibility, $\phi = 0$, lets all citizens with $c_i \leq \frac{\gamma}{1+c\theta}$ invest, and sets $s = \frac{b}{\theta}$ after b has realized.

When making their investment decisions, citizens anticipate (11):

$$s^a = E(s) = \frac{1-\kappa}{\theta}.$$

Using $\kappa = s^a/c$ and solving for s^a gives:

$$s^a = \frac{c}{1+\theta c}. \tag{12}$$

Substituting this expression into (11) yields

$$s = \frac{c}{1+c\theta} + \frac{b}{\theta}. \tag{13}$$

Equation (12) means that share $\kappa = \frac{1}{1+c\theta}$ of the citizens invests. We have now determined the subsidy and the anticipated subsidy in an equilibrium where, given $\phi = 0$, a majority of citizens invests. For this equilibrium to exist, a majority must invest: $\frac{1}{1+c\theta} \geq \frac{1}{2}$. This brings us to the next proposition.

Proposition 2. *Suppose that $\frac{1}{1+c\theta} \geq \frac{1}{2}$ and that the median voter cannot commit himself in period 1, $\phi = 0$. Then, an equilibrium exists in which a majority of citizens invests in period 1 and the median voter chooses $s = \frac{c}{1+c\theta} + \frac{b}{\theta}$ in period 2.*

Proposition 2 shows that distributional motives give credibility to a positive subsidy after citizens have made their investment decisions. The equilibrium described in Proposition 2 has three remarkable features. First, distributional motives fully drive the expected level of the subsidy. Efficiency concerns are irrelevant. As a consequence, investment may be below or above the socially efficient level. Second, despite the absence of commitment, investment takes place. Condition $\frac{1}{1+c\theta} \geq \frac{1}{2}$ in Proposition 2 implies that the equilibrium with investments exists if the bureaucratic costs, which generate the time-inconsistency problem, are sufficiently small. As discussed in the introduction, an example of a policy that owes its persistence to distributional motives is the tax benefit to homeowners in several countries. Despite the distorting effects on the housing market, this policy is politically sustainable if a majority of citizens benefits from it.

Corollary 2.1 describes the third remarkable feature of the equilibrium described in Proposition 2.

Corollary 2.1. *The equilibrium described in Proposition 2 yields higher social welfare than obtained by a social planner if both γ and σ are sufficiently high.*

The social planner cannot use distributional concerns to provide credibility. The planner's dilemma between investment and flexibility is most severe when both γ and σ are high. For efficiency reasons, she wants to induce many citizens to invest. However, this requires commitment, which is costly if uncertainty is high. The upshot of this corollary is that the distributional concerns in a democracy may be able to solve time-inconsistency problems more efficiently than a social planner. This can be seen as a distant relative of the theory of second-best (Lipsey and Lancaster 1956). In isolation, both the time-inconsistency problem and distributional concerns reduce social welfare. However, adding distributional concerns to a situation where time-inconsistency wreaks havoc can bring alleviation.

The equilibrium presented in Proposition 2 is not unique. Given $\phi = 0$, another equilibrium exists in which no citizen invests and $s = \frac{b}{\theta}$. In our model, multiple equilibria can arise because citizens' early investment decisions affect their later interests. We discuss multiple equilibria more in depth in Section 5.3.

5 Allowing for Commitment

In this section we present our third and fourth main result: distributive concerns can lead to too much commitment as well as to inactivism. We now assume that the median voter can choose any level of ϕ. Below, we first determine optimal policies if the median voter does not invest and subsequently the optimal policies if he does invest. Combining these allows us to determine the conditions under which these policies constitute an equilibrium.

5.1 The Median Voter Does Not Invest

Suppose the median voter does not invest. Then, in period 2, the median voter maximizes

$$y - \kappa s - \frac{1}{2}\theta s^2 + \gamma\kappa - \frac{1}{2}\phi\left(s - s^p\right)^2 + bs$$

with respect to s, yielding

$$s = \frac{\phi s^p + b - \kappa}{\phi + \theta}. \tag{14}$$

A comparison between (3) and (14) shows that *ex post* the median voter has a stronger incentive than the social planner to reduce s. The reason is that s redistributes income from those who did not invest to those who did. This implies that the median voter faces a stronger time-inconsistency problem than the social planner.

When making their investment decisions, citizens form expectations about s: $s^a = E(s) = \dfrac{\phi s^p - \kappa}{\phi + \theta}$. Using $\kappa = s^a/c$, we obtain

$$s^a = \frac{c\phi s^p}{1 + c(\phi + \theta)}. \tag{15}$$

Hence, in the absence of commitment ($\phi = 0$), citizen's expectation of the subsidy equals zero, which implies that no one invest.

At the beginning of the game, the median voter chooses s^p and ϕ. He anticipates citizens' investment decisions and his final decision on s. Using (14) and (15), maximizing the utility of the median voter given that he does not invest as given by

$$U_{MV}^{NI}(\phi) = \frac{1}{2h}\int_{-h}^{h}\left(y - \frac{s^a}{c}s - \frac{1}{2}\theta s^2 + \gamma\frac{s^a}{c} - \frac{1}{2}\phi(s - s^p)^2 + bs\right)db \tag{16}$$

with respect to s^p. This yields

$$s^p = \frac{1 + c(\phi + \theta)}{(c\theta + 1)^2 + c\phi(2 + c\theta)}\gamma. \tag{17}$$

Finally, consider the median voter's decision on ϕ. In the Appendix we show that in equilibrium, the median voter never chooses partial commitment. He opts for either no commitment, $\phi = 0$, or full commitment, $\phi \to \infty$. Under full commitment, we have that $s = s^p = s^a = \frac{\gamma}{2+c\theta}$. This yields Lemma 1.

Lemma 1. *Suppose that the median voter makes policy decisions and that the median voter does not invest. In equilibrium, the median voter chooses either of the following two policy combinations:*

1. No commitment $\phi = 0$ *and* $s = \frac{b}{\theta}$.

2. Full commitment $\phi \to \infty$ *and* $s = s^p = s^a = \frac{\gamma}{2+c\theta} < s_{full}$.

Lemma 1 presents two results. First, a median voter who does not invest tends to choose a lower level of s than the social planner. The reason for this result is that the social planner does not take the redistributive consequences of the policy into account, while the median voter does. In the present case, as the median voter does not invest, he wants to limit redistribution.

Second, the median voter never chooses partial commitment. Recall that for a range of γ, a social planner does choose partial commitment (see Item 3 in Proposition 1). Why does the median voter never choose partial commitment, while the social planner does? Three forces drive the decision on ϕ: flexibility, commitment, and adjustment costs. The need for flexibility cannot explain the difference between the social planner and the median voter, as they are equally concerned with flexibility. As the median voter wants to redistribute from those who invested to those who did not, he has stronger incentives than the social planner to decrease s, once citizens have made their investment decisions. To put it differently, the median voter faces a bigger credibility problem than the social planner. As a result, with partial commitment, the median voter would incur high adjustment costs. Adjustment costs can be avoided by either full commitment or full flexibility.

5.2 The Median Voter Invests

Now consider the case that the median voter invests in equilibrium. In period 2, the median voter maximizes

$$y - \kappa s - \frac{1}{2}\theta s^2 + s - \frac{1}{2}c + \gamma\kappa - \frac{1}{2}\phi\left(s - s^p\right)^2 + bs$$

with respect to s, yielding

$$s = \frac{\phi s^p + b + 1 - \kappa}{\phi + \theta}. \tag{18}$$

Comparing (18) with (3) and (14) shows that *ex post,* after having invested, the median voter has an incentive to increase s for distributional purposes.

Following the same steps as in Section 5.1, we obtain Lemma 2.

Lemma 2. *Suppose that the median voter makes policy decisions and that the median voter invests. In equilibrium, the median voter chooses either of the following two policy combinations:*

1. No commitment $\phi = 0$ and $s = \frac{c}{1+c\theta} + \frac{b}{\theta}$. This requires $\frac{1}{1+c\theta} \geq \frac{1}{2}$.

2. Full commitment $\phi \to \infty$ and $s = s^p = \frac{c+\gamma}{2+c\theta} > s_{full}$.

Item 1 in Lemma 2 corresponds to the equilibrium described in Proposition 2. Even if commitment is possible, the equilibrium where distributive concerns provide credibility can be attractive to the median voter. Investment takes place without the need to restrict flexibility.

Conditional on investment, the median voter has two reasons to commit himself. First, if the requirement in item 1 of Lemma 2 does not hold, commitment is neccesary to provide credibility. Without commitment, citizens would expect a subsidy that is too low to make a majority of citizens invest. Second, the *ex post* optimal level of s generally does not lead to the level of the public good that the median voter prefers *ex ante*. The *ex post* level ignores efficiency considerations. Furthermore, the *ex post* optimal level of s is too high from a distributive point of view, in the sense that it induces too many citizens to invest. Conditional on investment by a majority of citizens, the distributive effects of the subsidy are more benefical to the median voter if fewer citizens invest. This gives an incentive to commit to a *lower* level of s than the median voter would choose after investments have been made. Still, the median voter commits to a higher subsidy than the social planner, leading to too much investment from an efficiency perspective.

Similar to Lemma 1, Lemma 2 implies that a median voter who invests never chooses partial commitment. Compared to a social planner, the median voter has a stronger incentive *ex post* to deviate from his *ex ante* promise. This makes partial commitment less effective in inducing the proper level of investment and leads to high adjustment cost, which can be avoided by choosing either full commitment or full flexibility.

5.3 Commitment in equilibrium

Lemma's 1 and 2 provide four possible equilibrium policy combinations. By comparing the median voter's expected payoff from each of these policy combinations, we can characterise the equilibria. The equilibrium can be unique. However, for certain parameter values, multiple equilibria exist.

Proposition 3. *If* $\frac{1}{1+c\theta} < \frac{1}{2}$*, a unique equilibrium exists. In this equilibrium, the median voter either chooses* $\phi = 0$ *or* $\phi \to \infty$*.*

A unique equilibrium arises if the equilibrium where distributive concerns provide commitment does not exist. Depending on the relative importance of efficiency γ and flexibility σ, one of the other three policy combinations featured in Lemma's 1 and 2 is chosen by the median voter, as depicted in Figure 1.[17] In this equilibrium, investment requires commitment. For low values of σ, a majority of citizens prefers commitment. The subsidy is low (high) if the social value of investment γ is low (high). If flexibility is sufficiently important (i.e. σ is high), the equilibrium has no commitment and features no investment.

The following corollary compares the equilibrium of Proposition 3 to the choices made by a social planner, as presented in Proposition 1.

Corollary 3.1. *Suppose $\frac{1}{1+c\theta} < \frac{1}{2}$. A range of parameters exists where distributive concerns lead to too much inflexibility. Another range of parameters exists where distributive concerns lead to too little commitment and prevent socially desirable investments. This leads to strictly lower social welfare than obtained by a social planner if $\gamma > \sigma c$.*

The median voter's distributive concerns aggravate the time-inconsistency problem. After investments have been made, distributive concerns provide the median voter with stronger incentives to deviate from the promised level of subsidy s^p than the social planner. The median voter prefers a downward deviation if he did not invest and an upward deviation if he did invest. To spur investment without incurring large adjustment cost, the median voter opts for full commitment rather than partial commitment. However, the need to adopt an excessive degree of commitment makes it impossible to adjust the policy to new information. Hence, if flexibility is sufficiently important, the median voter refrains from commitment altogether, which implies that no investment takes place. Distributive concerns thus lead to lower social welfare by preventing the median voter from choosing partial commitment, leading to too much commitment or to inaction.[18] These outcomes are consistent with the observations made in the introduction that sometimes governments enter in long-lasting contracts, while other times governments remain very passive.

Now suppose that the equilibrium where distributive concerns provide commit-

[17]The exact conditions under which the median voter chooses each of the three possible policy combinations can be found in the proof to Proposition 3 in the Appendix.

[18]If the value of investment is sufficiently low, such that $\gamma < \sigma c$, the median voter makes the same policy decisions as the social planner ($\phi = 0$) and obtains the same outcomes.

ment exists, as described in Proposition 2. This has two implications. First, the median voter may still choose full flexibility in a situation where the social planner chooses (partial) commitment. However, if this leads to investment in equilibrium, social welfare can improve (Corollary 2.1). Second, if σ is sufficiently high, multiple equilibria arise. Intuitively, multiple equilibria can arise because absence of commitment in the first period, $\phi = 0$, can yield either a high level of investment or no investment at all. Depending on which of these equilibria is played, another equilibrium may exist. This could be either the other equilibrium without commitment (Proposition 4) or another equilibrium with commitment (Proposition 5). Figure 2 depicts the possible equilibria as a function of σ and γ.

Proposition 4. *For $\frac{1}{1+c\theta} \geq \frac{1}{2}$ and sufficiently high values of σ, the following two equilibria exist:*
1. $\phi = 0$ and $s = \frac{b}{\theta}$.
2. $\phi = 0$ and $s = \frac{c}{1+c\theta} + \frac{b}{\theta}$.
The median voter prefers the second equilibrium if $\gamma > \frac{1}{2}c\left(\frac{1}{1+c\theta} + c\theta\right)$.

If flexibility is important, the two equilibria without commitment can coexist. In Figure 2, this corresponds to the rightmost entry of multiple equilibria. In the first of these two equilibria, citizens expect no subsidy, leading to no investment. In the second equilibrium, voters anticipate that distributional concerns lead to a positive subsidy, as they expect more than half of the citizens to invest. The median voter prefers the equilibrium with investment if the social return of investment γ is sufficiently high. Yet, the equilibrium without investment can arise even if a majority of citizens prefers the equilibrium with investment, and vice versa.

Proposition 4 describes the situation where the median voter ranks both no-commitment equilibria above all platforms with full commitment. This requires a sufficiently high demand for flexibility. As depicted in Figure 2, multiple equilibria also exist for lower levels of σ. In these situations, the median voter ranks one of the no-commitment equilibria first and one of the full-commitment platforms second. This yields Proposition 5.

Proposition 5. *For $\frac{1}{1+c\theta} \geq \frac{1}{2}$ and moderate values of σ, two equilibria exist: One with full commitment ($\phi \to \infty$) and one with no commitment ($\phi = 0$). The equilib-*

rium with full commitment exists even though the median voter prefers the equilibrium with no commitment.

Consider the upper entry of multiple equilibria in Figure 2. Here, the median voter prefers a no-commitment platform if citizens anticipate that a majority of citizens will invest. However, if citizens anticipate that in equilibrium no commitment would lead to no investments, the median voter prefers a platform with commitment. Hence, full commitment can be an equilibrium outcome even if more than half of the citizens prefer an equilibrium with no commitment.[19]

The results in Propositions 4 and 5 paint a rather bleak picture. Not only can politics aggravate the time-inconsistency problem, leading to inactivism or to inflexibility, it can lead to these outcomes even when more than half of the citizens prefers a different outcome. Multiple equilibria can arise only if a majority of citizens may invest. This requires low cost of investment. Arguably, electric cars, heat pumps, and solar panels on roofs are good examples. For windmills and hydrogen technology, investment may only be feasible for a minority.

Our results suggest that cross-country differences in policies can be due to different cost and benefit of investment and flexibility as well as to countries with similar cost and benefits ending up in different equilibria. For electric cars, there are large differences in policies and uptake across European countries (Zsuzsa Lévay et al. 2017, European Environment Agency 2021). For instance, Norway committed to electrification of cars as of 1990 (Zhang et al. 2016). In 2020, more than 70% of all new cars were electric, far ahead of other countries. Most other countries were less committed. Still, there are differences in uptake of electric cars, with stands at 28% of new cars in The Netherlands, around 15% in France, Germany and UK, and around 6% in Spain and Italy. One main concern for potential buyers is availability of public chargers (Tran et al. 2012, McCollum et al. 2018). Many studies try to explain differences in adoption rates by current availability. Our model suggests that in countries where citizens expect good availability in the future, more citizens invest in electric cars as compared to countries where citizens expect availability of

[19] The case of multiple equilibria at the bottom of Figure 2 is analogous. Here, more than half of the citizens prefer the no commitment equilibrium without investment, but if citizens anticipate that no commitment leads to the equilibrium with investment, a majority prefers commitment. Note also that if σ is sufficiently low, a unique equilibrium exists even if $\frac{1}{1+c\theta} \geq \frac{1}{2}$, as depicted in Figure 2. This unique equilibrium always has full commitment, $\phi \rightarrow \infty$.

chargers to remain problematic. If commitment is weak, expectations about future policies affect investment, which in turn affects future policies.

Corollary 2.1, Proposition 4, and Proposition 5 imply that the equilibrium where distributive concerns rather than explicit commitment provide credibility is a mixed blessing. On the one hand, it allows for investment while maintaining flexibility. This can yield higher social welfare than obtained by a social planner. On the other hand, the possibility that distributive motives provide commitment may lead to a sub-optimal equilibrium outcome. For instance, it may induce commitment even though most citizens would prefer no commitment. In such situations, social welfare is lower under the median voter compared to the social planner, akin to the case discussed in Corollary 3.1.

6 Conclusions

In devising policies to combat climate change, policymakers face a trilemma of credibility, flexibility, and redistributive concerns. A normative approach overlooks how redistributive concerns affect politicians' incentive to deviate from policies ex post as well as their incentive to commit to policies ex ante. Our positive approach helps to understand why politicians refrain from commitment in some situations and opt for extensive commitment in others. It also shows that if different countries face the same situation, they may still have different policies and outcomes.

In the face of uncertainty, Stern (2022)'s call for predictably flexible policies may be more than our democracies can deliver. Distributive politics tend to worsen time-inconsistency problems and lead to inaction or to inflexibility. Remarkably, we find that if a majority of citizens can partake in climate investments, democracy itself can provide credibility to policies while maintaining flexibility.

In our model, citizens do not face electoral uncertainty. In equilibrium citizens can anticipate the median voter's preferences and, hence, his investment and policy decisions. Adding electoral uncertainty, as in e.g. Tabellini and Alesina (1990), can give an additional incentive to commit. If second-period decisions could be made by a different policymaker, the first-period policymaker can tie the hands of his successor with a stronger commitment. Our analysis shows that this extra commitment could be both beneficial and harmful to society.

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A Appendix

A.1 Proof Proposition 1.

In the main text, we have shown that the social planner chooses $s = \frac{\phi s^p + b}{\phi + \theta}$ in period 2 and $s^p = \frac{\phi+\theta}{\phi + c\theta(\phi+\theta)}\gamma$ in period 1. Substituting for these expressions and for $s^a = \frac{\phi s^p}{\phi+\theta}$ into expected social welfare as given by (5) and maximising with respect to ϕ yields a first-order condition that can be solved for

$$\phi^* = \frac{\gamma - \sigma c}{\sigma(1 + c\theta) - \theta\gamma}\theta^2$$

where we have used that $\sigma^2 \equiv h^2/3$. This expression for ϕ^* is negative unless

$$c\sigma < \gamma < \sigma c + \frac{\sigma}{\theta}.$$

For ϕ^* to be a maximum, the second-order condition requires

$$\frac{\sigma^2}{\phi^3} - \frac{1+c}{(\phi(1+c)+c)^3}\gamma^2 < 0$$

which holds for an interior solution for ϕ.

Substituting for s^p and ϕ into the expression for s (3) implies that for an interior solution for ϕ, s equals

$$s(s^{p*}, \phi^*) = \gamma - \sigma c + \frac{\sigma(1 + c\theta) - \theta\gamma}{\theta\sigma} b.$$

If $\gamma < \sigma c$ or $\gamma > \sigma c + \frac{\sigma}{\theta}$, there is no interior solution. No commitment, $\phi = 0$, implies $s^a = 0$ and $s = b$. Full commitment, $\phi \to \infty$, yields $s_{full} = s^p = s^a = \frac{\gamma}{1+c\theta}$. Hence, using social welfare (5), we can determine the social planner's expected payoff in each of these cases:

1. No commitment, $\phi = 0$, yields $SW(0) = y + \frac{\sigma^2}{2\theta}$.
2. Full commitment, $\phi \to \infty$, yields $SW(\infty) = y + \frac{\gamma^2}{2c(1+c\theta)}$.
3. Partial commitment, $\phi > 0$, $SW(\phi) = y + \frac{\sigma^2}{2\theta} + \frac{(\gamma-\sigma c)^2}{2c}$.

Hence, $SW(\infty) > SW(0)$ if $\theta\gamma^2 - \sigma^2 c(1 + c\theta) > 0$. This always holds if $\gamma > \sigma c + \frac{\sigma}{\theta}$ and never holds if $\gamma < \sigma c$. $\square$

A.2 Proof Proposition 2

The equilibrium is derived in the main text. Provided that $\phi = 0$, the median voter invests if $s^a \geq \frac{1}{2}c$. Using (12), this can be written as $\frac{c}{1+c\theta} \geq \frac{1}{2}c$, which yields the condition in Proposition 2.□

A.3 Proof Corollary 2.1

Proposition 2 shows that in this equilibrium $s = \frac{c}{1+c\theta} + \frac{b}{\theta}$ such that $s^a = \frac{c}{1+c\theta}$. Using (5), this yields social welfare equals to $SW^{DEM} = y + \frac{2\gamma - c}{2(1+c\theta)} + \frac{\sigma^2}{2\theta}$. The equilibrium exists if $\frac{c}{1+c\theta} \geq \frac{1}{2}c$.

From Proposition 1, it follows that

1. If $\gamma < \sigma c$, the social planner chooses full flexibility: $\phi = 0$ and $s = \frac{b}{\theta}$, which yields $SW(0) = y + \frac{\sigma^2}{2\theta}$. $SW^{DEM} > SW(0)$ if $\gamma > \frac{1}{2}c$.
2. If $\gamma > \sigma c + \frac{\sigma}{\theta}$, the social planner chooses full commitment: $\phi \to \infty$ and $s = \frac{\gamma}{1+c\theta}$, which yields $SW(\infty) = y + \frac{\gamma^2}{2c(1+c\theta)}$. $SW^{DEM} > SW(\infty)$ if $\sigma^2 > \frac{\theta(c-\gamma)^2}{c(1+c\theta)}$.
3. If $c\sigma < \gamma < \sigma c + \frac{\sigma}{\theta}$, the social planner chooses partial commitment with $\phi = \phi^* = \frac{\gamma - \sigma c}{\sigma(1+c\theta) - \theta\gamma}\theta^2$, which yields $SW(\phi) = y + \frac{\sigma^2}{2\theta} + \frac{(\gamma - \sigma c)^2}{2c}$. In this case, $SW^{DEM} > SW(\phi)$ if $c(2\gamma - c) - (1 + c\theta)(\gamma - \sigma c)^2 > 0$.

In each of these cases, the parameters can be such that this equilibrium exists and that $SW^{DEM} > SW(\phi)$.□

A.4 Proof Lemma 1

Using (14), (15), and (17) as derived in the main text to substitute for s, s^a, and s^p, respectively, into the median voter's utility function (16) and maximising with respect to ϕ yields first-order condition

$$-\frac{h^2}{6(\phi + \theta)^2} + \frac{\gamma^2 (1 + c\theta)^2}{2\left((1 + c\theta)^2 + \phi c (2 + c\theta)\right)^2} = 0$$

Using $\sigma^2 \equiv h^2/3$, the only possible positive optimum for ϕ can be written as

$$\phi^* = -\frac{\sigma (1 + c\theta)^2 - \theta\gamma (1 + c\theta)}{c\sigma (2 + c\theta) - \gamma (1 + c\theta)}$$

The second-order condition for a maximum at ϕ^* requires

$$\frac{\sigma^2}{(\phi+\theta)^3} - \frac{c(1+c\theta)^2(2+c\theta)\gamma^2}{\left((1+c\theta)^2+\phi c(2+c\theta)\right)^3} < 0$$

However, substituting for ϕ^* shows that the second-order condition for a maximum at ϕ^* fails, implying that ϕ^* is a minimum. This proves that a median voter who does not invest either chooses $\phi = 0$ or $\phi \to \infty$. Substituting for $\phi = 0$ into (14) yields $s = \frac{b}{\theta}$. Substituting for $\phi \to \infty$ into (14) and (17) yields $s = s^p = \frac{\gamma}{2+c\theta}$. Given this subsidy, the median voter does not invest provided that $\frac{\gamma}{2+c\theta} < \frac{1}{2}$. Rewriting yields the condition in Lemma 1.□

A.5 Proof Lemma 2

When making their investment decisions, citizens anticipate (18). Using $\kappa = s^a/c$, citizen i invests if $c_i \leq s^a$, with s^a given by:

$$s^a = \frac{c\phi s^p + c}{1+c(\phi+\theta)}. \tag{19}$$

The *ex ante* optimal values of s^p and ϕ result from maximizing the utility of the median voter given that he invests as given by

$$U^I_{MV}(\phi) = \frac{1}{2h}\int_{-h}^{h}\left(y - \frac{s^a}{c}s - \frac{1}{2}\theta s^2 + s - \frac{1}{2}c + \gamma\frac{s^a}{c} - \frac{1}{2}\phi(s-s^p)^2 + bs\right)db \tag{20}$$

with respect to s^p and ϕ, with s and s^a given by (18) and (19), respectively. For s^p this yields

$$s^p = \frac{\gamma + c(\phi+\theta)(c+\gamma)}{c\phi(2+c\theta)+(1+c\theta)^2}. \tag{21}$$

Substituting (18), (19), and (21) for s, s^a, and s^p, respectively, into the median voter's utility function (20) and maximising with respect to ϕ yields first-order condition

$$-\frac{h^2}{6(\phi+\theta)^2} + \frac{(\gamma(1+c\theta)-c)^2}{2\left(\phi c(2+c\theta)+(1+c\theta)^2\right)^2} = 0$$

Using $\sigma^2 \equiv h^2/3$, there are two possible positive levels of ϕ that satisfy this condition. First,

$$\phi = -\theta \frac{\theta\left(\gamma\left(1+c\theta\right)-c\right)+\sigma\left(1+c\theta\right)^2}{\theta\left(\gamma\left(1+c\theta\right)-c\right)+\sigma\left(\left(1+c\theta\right)^2-1\right)}$$

which is positive if $\gamma\left(1+c\theta\right) < c$ and $\sigma\left(\left(1+c\theta\right)^2-1\right) < \left|\theta\left(\gamma\left(1+c\theta\right)-c\right)\right| < \sigma\left(1+c\theta\right)^2$

Second,

$$\phi = -\theta \frac{\theta\left(\gamma\left(1+c\theta\right)-c\right)-\sigma\left(1+c\theta\right)^2}{\theta\left(\gamma\left(1+c\theta\right)-c\right)-\sigma\left(\left(1+c\theta\right)^2-1\right)}$$

which is positive if $\gamma\left(1+c\theta\right) > c$ and $\sigma\left(\left(1+c\theta\right)^2-1\right) < \theta\left(\gamma\left(1+c\theta\right)-c\right) < \sigma\left(1+c\theta\right)^2$. The second-order condition for a maximum at ϕ requires that

$$\frac{\sigma^2}{\phi^3} - \frac{\left(\gamma\left(1+c\theta\right)-c\right)^2 c\left(2+c\theta\right)}{\left(\phi c\left(2+c\theta\right)+\left(1+c\theta\right)^2\right)^3} < 0$$

However, for both possible levels of ϕ, the second-order condition is not satisfied. Hence, there is no maximum in ϕ for $\phi > 0$. This proves that a median voter who invests either chooses $\phi = 0$ or $\phi \to \infty$. The case of $\phi = 0$ is described in Proposition 2. Substituting for $\phi \to \infty$ into (18) and (21) yields $s = s^p = \frac{c+\gamma}{2+c\theta}$.

A.6 Proof Proposition 3

If $\frac{1}{1+c\theta} < \frac{1}{2}$, the equilibrium described in Proposition 2 does not exist. Using Lemma's 1 and 2, this leaves the following three policy combinations that could be optimal for the median voter.

1. $\phi = 0$ and $s = \frac{b}{\theta}$. Substituting for these into the median voter's utility function (16) and using $s^a = 0$ yields an expected utility equal to

$$U_{MV}^{NI}\left(\phi = 0\right) = y + \frac{\sigma^2}{2\theta} \tag{22}$$

2. $\phi \to \infty$ and $s^p = s = \frac{\gamma}{2+c\theta}$. Substituting for these into (16) and using $s^a = \frac{\gamma}{2+c\theta}$ yields

$$U_{MV}^{NI}\left(\phi \to \infty\right) = y + \frac{\gamma^2}{2c\left(2+c\theta\right)} \tag{23}$$

3. $\phi \to \infty$ and $s^p = s = \frac{c+\gamma}{2+c\theta}$. Substituting for these into the median voter's utility function (20) and using $s^a = \frac{c+\gamma}{2+c\theta}$ yields

$$U^I_{full}\left(\frac{c+\gamma}{2+c\theta}\right) = y - \frac{1}{2}c + \frac{1}{2}\frac{(c+\gamma)^2}{c\,(2+c\theta)} \tag{24}$$

Comparing these payoffs, it follows that the median voter prefers
1) $\phi = 0$ and $s = \frac{b}{\theta}$ if (i) $\gamma^2 \leq \frac{1}{\theta}c\,(2+c\theta)\,\sigma^2$ and $\gamma < \frac{1}{2}c\,(1+c\theta)$ and if (ii) $\sigma^2 > \frac{\gamma(2c+\gamma)-c^2(1+c\theta)}{c(2+c\theta)}\theta$ and $\gamma > \frac{1}{2}c\,(1+c\theta)$,
2) $\phi \to \infty$ and $s^p = s = \frac{\gamma}{2+c\theta}$ if $\gamma > \frac{1}{\theta}c\,(2+c\theta)\,\sigma^2$ and $\gamma < \frac{1}{2}c\,(1+c\theta)$, and
3) $\phi \to \infty$ and $s^p = s = \frac{c+\gamma}{2+c\theta}$ if $\sigma^2 < \frac{\gamma(2c+\gamma)-c^2(1+c\theta)}{c(2+c\theta)}\theta$ and $\gamma > \frac{1}{2}c\,(1+c\theta)$.

Hence, there is always a unique equilibrium. □

A.7 Proof Corollary 3.1

The results on commitment follow from comparing the conditions in Proposition 1 with the conditions under which the median voter chooses each of the policy combinations in Proposition 3, as listed in the proof of Proposition 3. Item 1 in Propositions 1 and the conditions under which the median voter chooses item 1 of 3 show that if $\gamma < c\sigma$, the social planner and the median voter both choose $\phi = 0$ and $s = \frac{b}{\theta}$, yielding identical outcomes and social welfare. If $\gamma > c\sigma + \frac{\sigma}{\theta}$, the social planner and the median voter both choose $\phi \to \infty$, but the social planner chooses a smaller subsidy s^p than the median voter. Suppose $\gamma < \frac{1}{2}c\,(1+c\theta)$. For $\gamma \in (c\sigma, \sqrt{\frac{1}{\theta}c\,(2+c\theta)}\sigma]$, the median voter chooses $\phi = 0$ while the social planner chooses $\phi > 0$. For $\gamma \in [\sqrt{\frac{1}{\theta}c\,(2+c\theta)}\sigma, c\sigma + \frac{\sigma}{\theta})$, the median voter chooses $\phi \to \infty$, while the social planner chooses a lower level of commitment. Now suppose $\gamma > \frac{1}{2}c\,(1+c\theta)$. For $\gamma \in (c\sigma, \sqrt{\frac{c}{\theta}\,(\sigma^2+c\theta)\,(2+c\theta)} - c]$, the median voter chooses $\phi = 0$ while the social planner chooses $\phi > 0$. For $\gamma \in [\sqrt{\frac{c}{\theta}\,(\sigma^2+c\theta)\,(2+c\theta)} - c, c\sigma + \frac{\sigma}{\theta})$, the median voter chooses $\phi \to \infty$, while the social planner chooses a lower level of commitment.

The result on social welfare follows directly from the fact that the median voter's choices are also available to the social planner and yield the same outcomes. Hence, social welfare is higher under the social planner whenever she makes different policy choices than the median voter, which holds whenever $\gamma > \sigma c$ as shown above.□

A.8 Proof Proposition 4

The possible equilibrium platforms without commitment, $\phi = 0$, are derived in Lemma's 1 and 2. Both no-commitment equilibria exist if both platforms yield higher payoff to the median voter than any platform with full commitment. Platform $\phi = 0$ with $s = \frac{b}{\theta}$ yields payoff (22). Using $\sigma^2 \equiv h^2/3$, Proposition 2, and (20), $\phi = 0$ with $s = \frac{c}{1+c\theta} + \frac{b}{\theta}$ yields an expected utility of the median voter equal to

$$U_{MV}^{I}(\phi = 0) = y - \frac{1}{2}c + \frac{\gamma}{(1+c\theta)} + \frac{c^2\theta}{2(1+c\theta)^2} + \frac{\sigma^2}{2\theta}. \tag{25}$$

The maximum median voter's payoff under full commitment is given by either (23) or (24). Comparing these payoffs yields that both no commitment platforms yield higher payoff than any platform with commitment if $\sigma^2 \geq \theta\left(c + \frac{1}{c}\frac{\gamma^2}{2+c\theta} - \frac{2\gamma}{1+c\theta} - \frac{c^2\theta}{(1+c\theta)^2}\right)$ and (i) $\sigma^2 > \frac{\theta\gamma^2}{c(2+c\theta)}$ for $\gamma < \frac{1}{2}c(1+c\theta)$ and (ii) $\sigma^2 > \theta\frac{\gamma^2 + c(2\gamma - c(1+c\theta))}{c(2+c\theta)}$ for $\gamma > \frac{1}{2}c(1+c\theta)$.

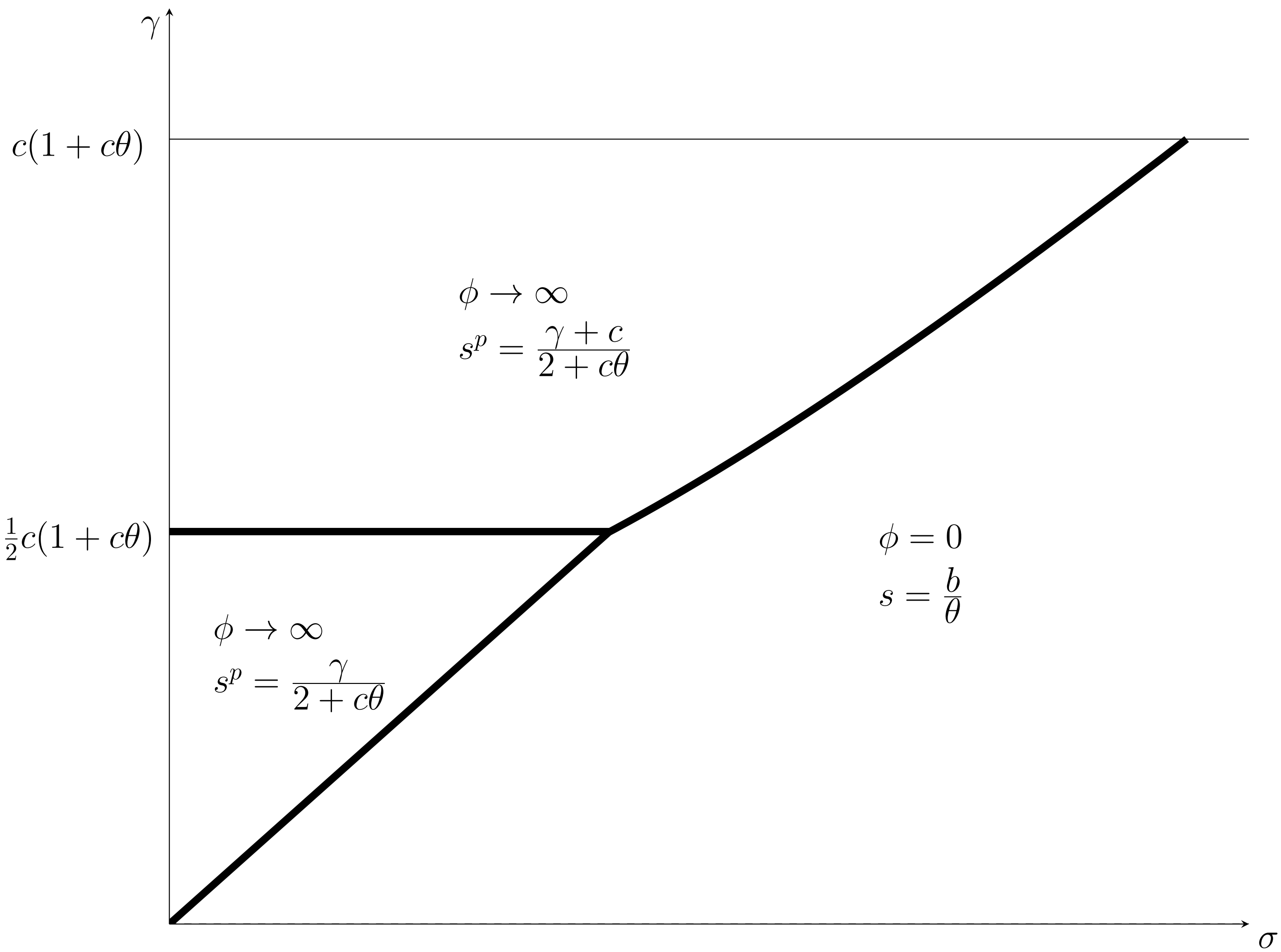
Comparing the median voter's payoffs in the two no-commitment equilibria, (22) and (25), yields the condition in the last line of Proposition 4.□

A.9 Proof Proposition 5

First, suppose that $\gamma < \frac{1}{2}c\left(\frac{1}{1+c\theta} + c\theta\right)$ and $\frac{\theta\gamma^2}{c(2+c\theta)} < \sigma^2 < \theta\left(c + \frac{1}{c}\frac{\gamma^2}{2+c\theta} - \frac{2\gamma}{1+c\theta} - \frac{c^2\theta}{(1+c\theta)^2}\right)$. Using the median voter's payoff of commitment platforms (23) or (24) and his payoff from the no-commitment platforms (22) and (25), it follows that under these conditions, the median voter prefers the no-commitment platform provided that in equilibrium no one invests. Hence, no-commitment can be an equilibrium platform. However, now suppose that citizens anticipate that in equilibrium, after no-commitment the median voter will invest. Then, the median voter prefers the platform with full commitment $\phi \to \infty$ and $s^p = \frac{\gamma}{2+c\theta}$. Hence, this is an equilibrium as well, despite that fact that more than half of the citizens prefers a different equilibrium.

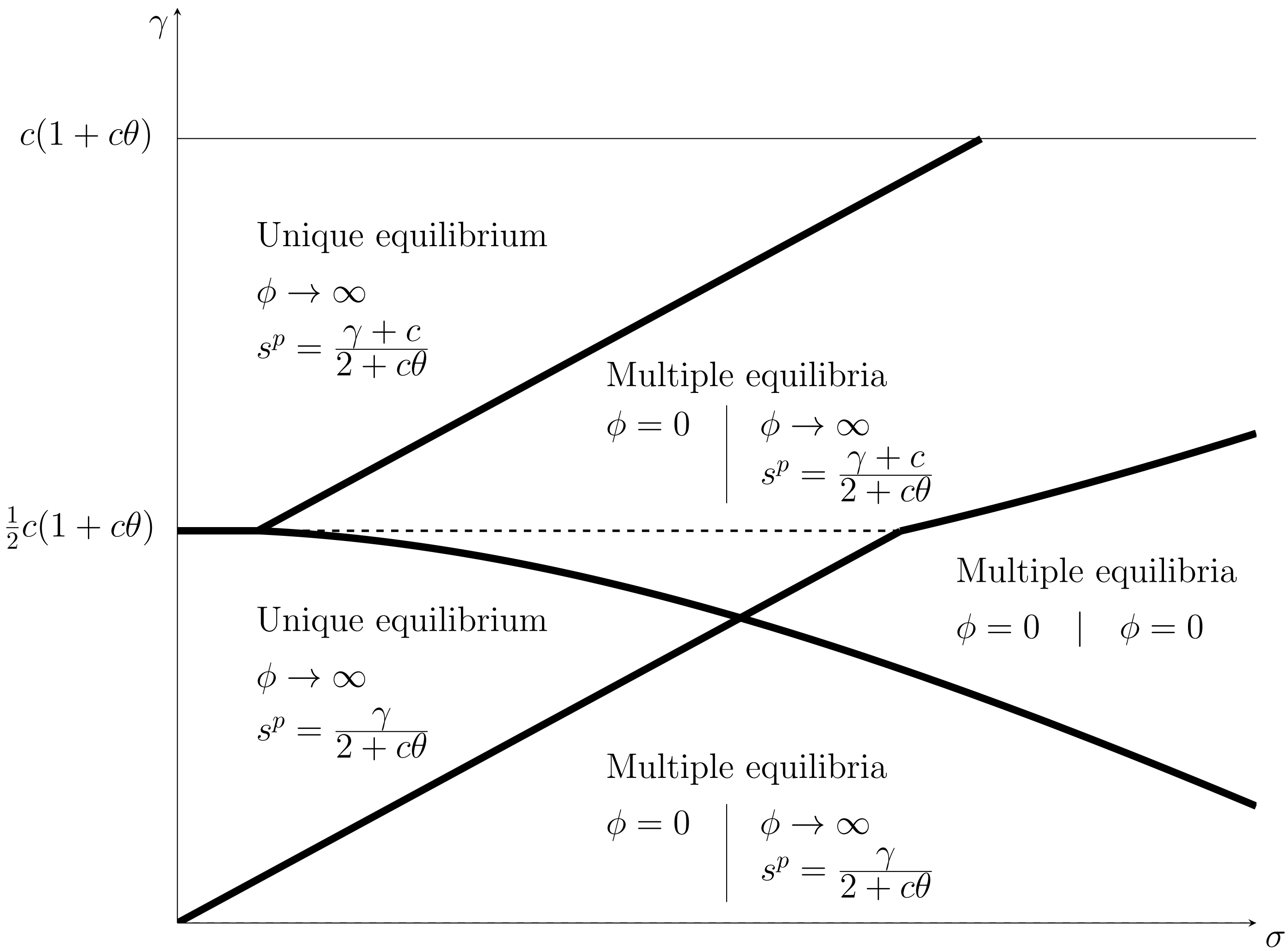
Second, suppose that $\frac{1}{2}c\left(\frac{1}{1+c\theta} + c\theta\right) < \gamma < \frac{1}{2}c(1+c\theta)$ and $\theta\left(c + \frac{1}{c}\frac{\gamma^2}{2+c\theta} - \frac{2\gamma}{(1+c\theta)} - \frac{c^2\theta}{(1+c\theta)^2}\right) \leq \sigma^2 \leq \frac{\theta\gamma^2}{c(2+c\theta)}$ or that $\gamma \geq \frac{1}{2}c(1+c\theta)$ and $\frac{\theta(\gamma(1+c\theta)-c)^2}{c(1+c\theta)^2(2+c\theta)} \leq \sigma^2 \leq \theta\frac{\gamma^2+c(2\gamma-c(1+c\theta))}{c(2+c\theta)}$. Under these conditions, the median voter prefers the no-commitment platform provided that in equilibrium more than half of the citizens invests. Hence, no commitment can be an equilibrium platform. However, if citizens anticipate that in equilibrium, after no-commitment no one will invest, the median voter prefers a platform with full commitment, $\phi \to \infty$. This is either the platform with $s = \frac{\gamma}{2+c\theta}$ (if $\gamma < \frac{1}{2}c(1 + c\theta)$) or the platform with $s = \frac{c+\gamma}{2+c\theta}$ (if $\gamma \geq \frac{1}{2}c(1 + c\theta)$). With either full commitment equilibrium platform, more than half of the citizens would be better off in the no-commitment equilibrium with investment.$\square$

Figure 1: Unique equilibrium



This figure depicts the equilibrium policy combinations, given that $\frac{1}{(1 + c\theta)} < \frac{1}{2}$.

Figure 2: Multiple equilibria



This figure depicts the equilibrium policy combinations, given that $\frac{1}{(1+c\theta)} > \frac{1}{2}$.
If $\gamma < \frac{1}{2}c(1+c\theta)$, an equilibrium with $\phi \to \infty$ has $s^p = \frac{\gamma}{2+c\theta}$.