Do politicians properly commit to policies combating climate change?

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Abstract

In the wake of climate change, governments use a wide variety of policies to encourage citizens and firms to invest in windmills, solar panels, nuclear power plants, or green cars. The return on such investments often depends on future policies, which can raise time-inconsistency problems. This paper examines whether politicians have incentives to choose the socially optimal degree of commitment. We show that politicians' distributional concerns can alleviate or aggravate the commitment problem. In turn, politicians either commit too heavily or not at all. This explains the existence of very long-term contracts on the one hand and lack of initiatives on the other. We also show that if both the social value of investment and uncertainty are high, politicians may achieve higher efficiency than a social planner.

1 Introduction

Governments use a variety of policies to encourage citizens to make investments. Subsidies, taxes, and regulation affect citizens' decisions to invest in renewable energy, keep livestock, isolate houses, buy heat pumps, acquire human capital, etc. In many cases, the returns to those investments depend on future policies. For example, in many countries, the government provides price certainty to investors in renewable energy sources.

Future governments may decide to change policies. The flexibility to change policies has benefits, as it allows for adjustment to changing circumstances and new information. It also comes at a cost. It is well-known that when investment decisions depend on future policies, commitment problems may arise (Kydland and

Prescott 1977). Anticipating the government's incentives to change policies, citizen and firms are reluctant to invest. Inactivism resulting from commitment problems is not a theoretical issue. Policy uncertainty remains an important obstacle to green investment (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.*" (p18-19).

The literature on environmental and energy economics discusses various ways to overcome the commitment problem, ranging from earmarking funds to contracting and to the establishment of an independent climate authority (see e.g. Marsiliani and Renström 2000, Helm et al. 2003, Brunner et al. 2012, Chiappinelli and Neuhoff 2017, Klenert et al. 2018).[1] This literature indicates that inactivism is not the result of lack of commitment devices but the result of unwillingness to use them.

The ability to commit to future policy raises a question that, so far, has received surprisingly little attention:[2] Do governments have proper incentives to choose the optimal degree of commitment? This question is highly relevant as, in the wake of climate change, governments increasingly aim to spur investments by citizens and firms in e.g. windmills, solar panels, hydrogen technology, or green cars.

To answer this question, we employ a simple two-period model, in which a decision-maker uses a price subsidy to encourage citizens to make an investment from which all citizens benefit. Citizens differ in their cost of investment. In the first period, the decision-maker promises a subsidy to encourage citizens to invest. After the citizens have made their investment decisions, the decision-maker chooses the level of the subsidy that citizens who invested actually receive. The subsidies are financed by a distortionary tax. How much the tax distorts is uncertain. This uncertainty gives a need for flexibility.[3]

In the absence of a commitment device, even a social planner who maximizes the sum of citizens' utilities is not able to induce citizens to invest. Citizens anticipate that after their investments, the social planner would reduce the subsidy to lower

[1]In the example of subsidies on renewable energy, contracts provide commitment. Strikingly, these contracts are often long-lasting. Twenty-year contracts are no exception.

[2]Pani and Perroni (2018) is a notable exception, as discussed below.

[3]In our model, investments are encouraged by subsidies. Our results are equally valid if governments use other policies that affect the future return on green investments, including (emission) taxes, emission trading schemes, and complementary investments in infrastructure.

the cost of distortionary taxation. When commitment is possible, the optimal level of commitment trades-off credibility and flexibility.[4]

To study the government's incentive to commit, we assume that at the beginning of the game elections are held between two candidates. Both candidates solely care about winning the elections. In equilibrium, the winning candidate tries to promote the median voter's interest. The key feature of our model is that after citizens have made their investment decisions, a subsidy redistributes income from those who did not invest to those who did. One implication of this feature is that for the *ex post* decision on the level of the subsidy, it matters whether a majority or minority of the citizens has invested. We show that the distributional concerns of the median voter can alleviate or aggravate the commitment problem and, in turn, affect the incentive to commit.

When in equilibrium a minority of the citizens invests, the median voter in period 2 has stronger incentives than the social planner to reduce the subsidy. In addition to limiting distortionary taxation, the median voter wants to avoid redistribution. The stronger incentive to renege forces the median voter to choose a higher level of commitment in period 1 than the social planner. This comes at the cost of less flexibility. We show that this cost can be so high that the median voter prefers no commitment, leading to no investment. Thus, the presence of commitment devices does not solve the commitment problem in this setting. From a social perspective, it either leads to a too strong level of commitment or to no investment at all. When a minority of the citizens invests, the subsidy and, hence, investment is always lower than its socially-optimal level. The median voter takes the adverse distributional consequences of the subsidy into account.

When in equilibrium a majority of the citizens invests, distributional concerns give the median voter an incentive to increase the subsidy in period 2. This provides credibility even in the absence of commitment: when citizens anticipate a positive subsidy because ex post the median voter wants to redistribute income to those who invested, more citizens are willing to invest. In this situation, the level of the subsidy

[4] We study how commitment to future policies affects investment. 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) for a discussion of *ex ante* versus *ex post* subsidies.

is independent of efficiency concerns and, hence, can be too high or too low from a social perspective. From the *ex ante* perspective of the median voter, however, the level of the subsidy is too high. If fewer citizens invest, the median voter would benefit more from *ex post* redistribution. Hence, unless the cost of reduced flexibility is too high, the median voter uses commitment to *reduce* the subsidy.

On the basis of the parameters of the model, we can distinguish between two kinds of environments: one in which the cost of investing is low and one in which it is high. When the cost is high, the model has a unique equilibrium. In this equilibrium, investment requires commitment. If the cost of investing is low, the model may have two equilibria, which can differ in both commitment and investment. The existence of multiple equilibria explains why otherwise similar countries conduct different climate policies.

The median voter's distributional concerns generally lead to inefficiencies. There is one exception. If both the benefits of investment and the cost of reduced flexibility are high, the outcome generated by the median voter can be *more* efficient than the outcome of the social planner. Where the social planner needs commitment to induce citizens to invest, citizens trust the median voter to set a high subsidy (for distributional reasons) even in the absence of commitment. Hence, the median voter maintains full flexibility. Democracy may solve commitment problems more efficiently than a social planner.[5]

At the heart of our model lies a credibility problem. In the seventies and eighties, credibility problems were examined in the context of monetary policy. In this literature, policy makers have incentives to create inflation surprises to boost the economy. As agents anticipate policy makers' incentives to surprise, these incentives lead to an inflationary bias (Barro and Gordon, 1983). To reduce this bias, policymakers must tie their hands through, for example, building a reputation (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). Methodologically, our paper deviates from this literature. The literature on credibility problems in the realm of monetary

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

policy focuses on how commitment could be achieved. Credibility problems were studied from a normative perspective. Our approach is positive. We try to explain why governments in some areas choose long-run contracts, while in other areas, credibility problems lead to inactivism.

As discussed earlier, the literature on credibility problems in the realm of environmental policy also takes a normative perspective. Pani and Perroni (2018) is an exception. They 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. We model commitment as a continuous choice rather than a binary option, and show how concerns for efficiency, flexibility, and redistribution within one policy domain affect politicians' *marginal* incentive to commit.

Our positive approach generates two predictions that are consistent with empirical observations. First, redistributive concerns induce politicians to choose a (very) high level of commitment. Thus, our model explains the existence of (very) long contracts in the renewable energy sectors.[6] Second, when a subsidy induces a majority of citizens to invest, ex post redistribution may give credibility to the subsidy. An example of a subsidy 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 stopping the tax benefit. The

[6] Countries that use long-run contracts to accelerate investment in renewable energy include Canada, Germany, Japan, the Netherlands, South Africa, and Spain. Germany launched the Renewable Energy Sources Act in 2000. Under this act, investors in renewable energy received a guaranteed feed-in tariff for 20 years, financed by a surcharge on consumers' electricity prices. Investments rose substantially, and so did the surcharge (Andor et al. 2017). To prevent further increases in the surcharge, the German government reduced the tariffs for new installations several times between 2009 and 2020. In 2020, facing the imminent expiration of the tariffs for early installations, the Germany government offered these investors options for extending their tariffs. It also partially replaced the surcharge by financing from the federal budget.

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

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.

The main premise of our approach is that governments have means to commit themselves. Acemoglu and Robinson (2001) argue that commitment problems are particularly severe in democracies, as an intrinsic feature of democracy is the temporary authority of politicians. Our model shows that redistributional 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 institutions and their rules, enabling politicians to commit themselves. We are aware that this makes our approach less valid for countries with weaker institutions.[8]

2 The Model

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 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.

[8] 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.

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[9]

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

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 the case 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.

The subsidies are financed by a lump-sum tax, $\tau = \kappa s$. Citizen i's disposable income equals

$$y_i^d = y - \tau - \frac{1}{2}\alpha\left(s - b\right)^2 + \left(s - c_i\right)e_i.$$

The term $\frac{1}{2}\alpha\left(s-b\right)^2$ represents the distortionary costs of the subsidy, where 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 $E\left(b\right) = 0$ and its variance equals $Var\left(b\right) = h^2/3 \equiv \sigma^2$. After the election but before subsidy s is determined, b is observed. Through b, we model, in an *ad hoc* way, the need for flexibility. For analytical tractability, we assume that the case of no commitment, $\phi = 0$, provides full flexibility. The government can fully adjust s to b, irrespective of the level of s.[10]

Citizen i's preferences are represented by the utility function

$$\begin{aligned} u_i &= y_i^d + \gamma\kappa - \frac{1}{2}\phi\left(s - s^p\right)^2 \\ &= y - \kappa s - \alpha\frac{1}{2}\left(s - b\right)^2 + \left(s - c_i\right)e_i + \gamma\kappa - \frac{1}{2}\phi\left(s - s^p\right)^2. \qquad (1) \end{aligned}$$

Equation (1) shows that u_i consists of three parts: citizen i's disposable income, the

[9] 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 compensation that is financed by taxes.

[10] 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.

benefit of the public good, and the policy adjustment costs.

Politics

We first determine the decisions on ϕ, s^p and s a social planner would make. We assume that the social planner maximizes the sum of all citizens' utilities. Next, we assume that the decisions on ϕ, s^p and s are made by the median voter, who is characterized by $c_m = \frac{1}{2}c$. 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. Finally, we replace the assumption that the median voter makes the decisions on the degree of commitment, ϕ, and the promised subsidy level, s^p, by the assumption that at the beginning of the game, elections are held between two candidates, who propose platforms on these decisions. In equilibrium, candidates propose platforms that serve the median voter's interest. By modeling elections instead of assuming that the median voter makes decisions, we ensure that equilibrium values of σ and s^p are Condorcet winners.[11]

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 $s^a(\phi, s^p)$ 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. When elections are explicitly modeled, candidates' proposals on ϕ and s^p are Condorcet winners.

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

[11] As discussed in Section 4.3, replacing the assumption that the median voter makes the decision on s by the assumption that two office-motivated parties propose platforms on s does not affect our results.

chooses the subsidy citizens who invested actually receive. When choosing s, social welfare equals

$$\frac{1}{c}\int_{0}^{s^a}\left(y-\frac{s^a s}{c}-\alpha\frac{1}{2}\left(s-b\right)^2+\left(s-c_i\right)+\gamma\frac{s^a}{c}\right)dc_i+$$
$$\frac{1}{c}\int_{s^a}^{c}\left(y-\frac{s^a s}{c}-\alpha\frac{1}{2}\left(s-b\right)^2+\gamma\frac{s^a}{c}\right)dc_i-\frac{1}{2}\phi\left(s-s^p\right)^2. \quad (2)$$

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

$$s=\frac{\phi s^p+\alpha b}{\alpha+\phi}. \quad (3)$$

Equation (3) shows that in case of no commitment, $\phi=0$, s only responds to b. As $E\left(b\right)=0$, $s=0$, and no citizen would invest. This illustrates the familiar result that also a social planner, who lacks a commitment device, faces a commitment problem.

Citizens anticipate how the social planner will respond to ϕ, s^p and b. They observe ϕ and s^p but must form an expectation about b:

$$s^a=\frac{\phi s^p}{\alpha+\phi}. \quad (4)$$

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

$$SW=\frac{1}{2h}\int_{-h}^{h}\left(\begin{array}{c}\frac{1}{c}\int_{0}^{s^a}\left[y-\frac{s^a}{c}s^*-\frac{1}{2}\alpha\left(s^*-b\right)^2+\left(s^*-c_i\right)+\gamma\frac{s^a}{c}\right]dc_i\\ \frac{1}{c}\int_{s^a}^{c}\left[y-\frac{s^a}{c}s-\frac{1}{2}\alpha\left(s^*-b\right)^2+\gamma\frac{s^a}{c}\right]dc_i-\frac{1}{2}\phi\left(s^*-s^p\right)^2\end{array}\right)db. \quad (5)$$

Substituting (3) and (4) into (5), differentiating with respect to s^p, and solving the first-order condition yields

$$s^p=\frac{\alpha+\phi}{\phi+\alpha c\phi+\alpha^2 c}\gamma. \quad (6)$$

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

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

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

$$\kappa_{full} = \frac{\gamma}{c(1+\alpha c)}.$$

Clearly, in 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 inefficient 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

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

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

$$\alpha c \sigma < \gamma < (1+\alpha c)\,\sigma. \tag{9}$$

On the basis of these inequalities and the *ex ante* payoffs in case that $\phi = 0$ and $\phi \to \infty$, three ranges of γ can be distinguished. For γ below γ_{low}, the flexibility motive dominates. The social planner wants to be fully flexible in period 2 and thus chooses $\phi = 0$. For γ higher than γ_{high}, 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 tradeoff between credibility and flexibility. Using the expressions for s, s^p, and ϕ, one can show that the subsidy level equals

$$s\left(s^P, \phi\right) = \gamma - \alpha c \sigma^2 + \frac{(1+\alpha c)\,\sigma - \gamma}{\sigma} b \tag{10}$$

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

Proposition (1) summarizes the discussion above.

Proposition 1 *Suppose that a social planner makes all policy decisions.*
1. If $\gamma < \alpha c\sigma$, she chooses full flexibility: $\phi = 0$ and $s = b$.
2. If $\gamma > (1+\alpha c)\,\sigma$, she chooses full commitment: $\phi \to \infty$ and $s = \frac{\gamma}{1+\alpha c}$, which satisfies the Samuelson condition for an efficient public good provision.
3. If $\alpha c\sigma < \gamma < (1+\alpha c)\,\sigma$, 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).

4 The Median Voter

We now assume that the median voter makes the decisions on ϕ, s^p, and s.

4.1 The Median Voter Does Not Invest

We first consider the case that in equilibrium, the median voter does not invest. Then, in period 2, the median voter maximizes

$$y - \frac{s^a}{c}s - \frac{1}{2}\alpha\,(s-b)^2 + \gamma\frac{s^a}{c} - \frac{1}{2}\phi\,(s - s^p)^2$$

with respect to s, yielding

$$s = \frac{c\,(\alpha b + \phi s^p) - s^a}{c\,(\alpha+\phi)}. \tag{11}$$

A comparison between (3) and (11) 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.

When making their investment decisions, citizens form expectations about s: $s^a = E\,(s) = \frac{c\phi s^p - s^a}{\alpha c + c\phi}$, implying

$$s^a = \frac{\phi c s^p}{1 + c\,(\alpha+\phi)}. \tag{12}$$

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 (11) and (12), maximizing

$$\frac{1}{2h}\int_{-h}^{h}\left(y-\frac{s^a}{c}s-\frac{1}{2}\alpha\left(s-b\right)^2+\gamma\frac{s^a}{c}-\frac{1}{2}\phi\left(s-s^p\right)^2\right)db \tag{13}$$

with respect to s^p yields

$$s^p=\frac{1+c\left(\alpha+\phi\right)}{\left(1+\alpha c\right)^2+\phi c\left(2+\alpha c\right)}\gamma. \tag{14}$$

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 full commitment, $\phi\to\infty$, or no commitment, $\phi=0$. $\phi=0$ yields an expected utility equal to y. In case of full commitment, we have that $s=s^p=s^a=\frac{\gamma}{2+\alpha c}$, yielding an expected utility equal to

$$U_{MV}\left(\phi\to\infty\right)=y+\frac{\gamma^2-\alpha c\left(2+\alpha c\right)\sigma^2}{2c\left(2+\alpha c\right)} \tag{15}$$

Hence, full commitment gives a higher payoff than no commitment if

$$\gamma>\sigma\sqrt{\left(1+\alpha c\right)^2-1}.$$

This brings us to the next proposition.

Proposition 2 *Suppose that the median voter makes policy decisions, and that* $\frac{\gamma}{2+\alpha c}<\frac{1}{2}c$.
1. If $\gamma\leq\sigma\sqrt{\left(1+\alpha c\right)^2-1}$, *the median voter chooses* $\phi=0$, *and* $s=b$.
2. If $\gamma>\sigma\sqrt{\left(1+\alpha c\right)^2-1}$, *the median voter chooses* $\phi\to\infty$, *and* $s=s^p=s^a=\frac{\gamma}{2+\alpha c}<s_{full}$.
A range of γ *exists where redistributive concerns prevent the investment in a public good that is socially desirable. Another range of* γ *exists where redistributive concerns lead to too much inflexibility.*

The condition at the beginning of Proposition 2 guarantees that the median voter does not invest in equilibrium. Proposition 2 presents three main results. First, a median voter who does not invest tend 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 provision of the public good into account, while the median voter does. In the present case, the provision of the public good involves a redistribution from citizens who did not invest to citizens who did. Since 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 commitment 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.

Third, since the median voter never chooses partial commitment, a range of γ exists for which a social planner provides the public good but the median voter does not. This occurs if $\gamma \in [\alpha c\sigma, \sigma\sqrt{(1+\alpha c)^2 - 1}]$ (see Figure 1). In addition, if $\gamma \in (\sigma\sqrt{(1+\alpha c)^2 - 1}, \sigma(1+\alpha c)]$, the median voter chooses full commitment while the social planner would choose partial commitment (see Figure 1). Thus, politics either leads to full flexibility and inactivism or to inflexibility. 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.

4.2 The Median Voter Invests

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

$$y - \frac{s^a}{c}s - \frac{1}{2}\alpha(s-b)^2 + s - \frac{1}{2}c + \gamma\frac{s^a}{c} - \frac{1}{2}\phi(s-s^p)^2$$

with respect to s, yielding

$$s = \frac{c\left(\alpha b + \phi s^p\right) - s^a + c}{c\left(\alpha + \phi\right)}. \tag{16}$$

The parameter c in the numerator shows that *ex post* the median voter has an incentive to increase s for distributional purposes. When making their investment decisions, citizens anticipate (16). Citizen i invests if $c_i \leq s^a$, with s^a given by:

$$s^a = \frac{c + c\phi s^p}{1 + c\left(\alpha + \phi\right)}. \tag{17}$$

Note that for $\phi = 0$, $s^a > 0$. This means that in the absence of a commitment device, share $\frac{1}{1+\alpha c}$ of the citizens invests. Distributional motives give credibility to a positive subsidy after citizens have made their investment decisions. This brings us to the next proposition.

Proposition 3 *Suppose that* $\frac{1}{1+\alpha c} \geq \frac{1}{2}$ *and that the median voter cannot commit himself in period 1,* $\phi = 0$*. Then, an equilibrium exists in which the median voter chooses* $s = \frac{c}{1+\alpha c} + b$ *in period 2 and invests in period 1.*

Proposition 3 presents an equilibrium in which efficiency concerns do not affect the expected value of the subsidy. Distributional motives fully drive the expected level of the subsidy. Hence, investment may be below or above the socially efficient level. As discussed in the introduction, an example of a subsidy that owes its persistence to distributional motives is the tax benefit to homeowners in several countries. Despite their distortions on the house market, these subsidies are politically sustainable because a majority of citizens benefits from them. Interestingly, in this equilibrium, a majority of citizens invests even though politicians provide no commitment.

Let us now allow for (partial) commitment. In the present setting, the median voter has two reasons to commit himself. First, the *ex post* optimal level of s generally does not lead to an efficient level of the public good. Second, the *ex post* optimal level of s is too high from a distributive point of view. From a solely distributive point of view, given that he invests, the politician would prefer to commit himself to $s = \frac{c}{2+\alpha c}$. Note that $\frac{c}{2+\alpha c} < \frac{1}{2}c$, meaning that for this value of s, the median voter does not invest. Thus, solely from a distributive point of view, the median voter wants to commit to $s = \frac{1}{2}c$. The *ex ante* optimal values of s^p and ϕ result from maximizing

$$\frac{1}{2h}\int_{-h}^{h}\left(y-\frac{s^a}{c}s-\frac{1}{2}\alpha\left(s-b\right)^2+s-\frac{1}{2}c+\gamma\frac{s^a}{c}-\frac{1}{2}\phi\left(s-s^p\right)^2\right)db \qquad (18)$$

with respect to s^p and ϕ, with s and s^a given by (16) and (17), respectively. For s^p this yields

$$s^p=\frac{\gamma+c\left(c+\gamma\right)\left(\alpha+\phi\right)}{\left(1+\alpha c\right)^2+c\left(2+\alpha c\right)\phi}. \qquad (19)$$

In the Appendix we show that the median voter never chooses partial commitment: he chooses either $\phi=0$ or $\phi\to\infty$. It immediately follows from (19) that with $\phi\to\infty$, s^p reduces to $s^p=\frac{c+\gamma}{2+\alpha c}$. This means that at the beginning of the game, the median voter faces a choice among three alternatives:

1. Full commitment focused on distribution: $s^p_{FC,D}=\frac{c}{2}$ and $\phi\to\infty$.
2. Full commitment with an eye on both distribution and efficiency: $s^p_{FC,D+E}=\frac{c+\gamma}{2+\alpha c}$ and $\phi\to\infty$.
3. No commitment: $s_{NC}=\frac{c}{1+\alpha c}$.

In the present setting where the median voter invests, $s^p_{FC,D}$ is the lowest level of s possible. One can verify that $s^p_{FC,D+E}<s_{NC}$ if $\gamma<\frac{c}{1+c\alpha}$.

Proposition 4 *Suppose that the median voter makes policy decisions and that he invests. Then,*
1. The median voter chooses full commitment, $\phi\to\infty$*, focused on distribution,* $s=s^a=s^p=s^p_{FC,D}=\frac{c}{2}>s_{full}$*, if* $\gamma<\frac{1}{2}\alpha c^2$ *and* $\sigma^2<(1-c\alpha)\frac{2c-4\gamma(1+c\alpha)+c^2\alpha(1+c\alpha)}{4\alpha(c\alpha+1)^2}$.
2. The median voter chooses full commitment, $\phi\to\infty$*, with an eye on distribution and efficiency,* $s=s^a=s^p=s^p_{FC,D+E}=\frac{c+\gamma}{2+\alpha c}>s_{full}$*, if* $\gamma>\frac{1}{2}\alpha c^2$ *and* $\sigma^2<\frac{(\gamma(1+c\alpha)-c)^2}{\alpha c(2+c\alpha)(1+c\alpha)^2}$.
3. The median voter chooses no commitment, $\phi=0$ *and* $s=s_{NC}=\frac{c}{1+\alpha c}+b$ *if (i)* $\gamma>\frac{1}{2}\alpha c^2$ *and* $\sigma^2>\frac{(\gamma(1+c\alpha)-c)^2}{\alpha c(2+c\alpha)(1+c\alpha)^2}$ *and if (ii)* $\gamma<\frac{1}{2}\alpha c^2$ *and* $\sigma^2>(1-c\alpha)\frac{2c-4\gamma(1+c\alpha)+c^2\alpha(1+c\alpha)}{4\alpha(c\alpha+1)^2}$.
4. $s^p_{FC,D}<s^p_{FC,D+E}<s_{NC}$ *if* $\gamma<\frac{c}{1+c\alpha}$ *and* $s^p_{FC,D}<s_{NC}<s^p_{FC,D+E}$ *if* $\gamma>\frac{c}{1+c\alpha}$.

Proposition 4 shows that the median voter chooses for commitment focused on distribution only if both γ and σ are small. The intuition is straightforward. For low

γ, efficiency concerns are weak, such that the median voter can safely ignore them and set $s^p_{FC,D}$ so as to maximise his distributional gains. Once investment decisions have been made, the median voter has an incentive to increase s. Thus, a low level of s requires commitment. The cost of commitment is lack of flexibility. The higher is σ, the higher is the cost of giving up flexibility.

Obviously, lack of flexibility is also a cost of the other full commitment option, $s^p = \frac{c+\gamma}{2+\alpha c}$. As a result, this option also requires that σ is sufficiently small. Since $s^p_{FC,D} < s^p_{FC,D+E}$, $s^p_{FC,D+E}$ can only occur in equilibrium if γ is sufficiently high. Both $s^p_{FC,D}$ and $s^p_{FC,D+E}$ and, hence, investment are above their socially efficient levels given commitment.

The median voter chooses no commitment if σ is sufficiently high, to maintain flexibility. One can show that the threshold for which the median voter chooses no commitment instead of full commitment decreases in γ for $\gamma < \frac{c}{1+c\alpha}$ and increases in γ for $\gamma > \frac{c}{1+c\alpha}$. This is intuitive as no commitment leads to the highest level of s if $\gamma < \frac{c}{1+c\alpha}$. (see item 4 in Proposition 4). Remarkably, no commitment induces investment without constraining flexibility. From the perspective of social welfare, this is particularly appealing if both γ and σ are high. We return to this issue in the next section.

4.3 Equilibrium election outcomes

So far, we have been vague about the political process. We have simply assumed that the median voter makes decisions in period 1 and 2. In this section, we assume that at the start of the first period, an election is held with two candidates. Both candidates aim to maximise the probability of winning the election. Each candidate proposes a platform for decisions on commitment ϕ and promised subsidy s^p. After observing the platforms, each citizen votes. The candidate who receives the majority of the votes wins and implements his platform. This ensures that policies s^p and ϕ are Condorcet winners (see Lemma 1 below).

Our focus is on the decision about s^p and ϕ made at the beginning of period 1. Once the policies in period 1 have been set and citizens have made their investment decisions, the s preferred by the median voter in period 2 (either (11) or (16)) is the Condorcet winner.

Lemma 1 *The platform with policies ϕ and s^p preferred by the median voter is the Condorcet winner. In equilibrium, both candidates propose the platform that maximises the median voter's expected payoff.*

Hence, in any equilibrium, both candidates propose the same platform. As this platform maximises the median voter's expected payoff, Propositions 2 and 4 describe the five potential equilibria. The next Lemma shows that one of these, item 1 in Proposition 4, is not an equilibrium platform.

Lemma 2 *No candidate proposes a platform where $\phi \to \infty$ and $s^p = \frac{c}{2}$.*

This platform requires a sub-optimally high subsidy level to induce the median voter to invest. Yet, the subsidy merely covers the median voter's own cost of investment, implying that he (and all citizens with higher cost of investment) prefers commitment to a lower subsidy such that a minority invests.

Each of the remaining four platforms described in Propositions 2 and 4 is a possible equilibrium. The equilibrium can be unique. However, for certain parameter values, multiple equilibria exist.

Proposition 5 *For $\frac{1}{1+\alpha c} < \frac{1}{2}$, a unique equilibrium exists.*

Figure 2 depicts this equilibrium. 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.

Multiple equilibria can arise if the equilibrium where redistributional concerns provide commitment exists, as described in Proposition 3. This equilibrium can co-exist with another no-commitment equilibrium or with an equilibrium with full commitment, as described in the next two propositions, respectively.

Proposition 6 *For $\frac{1}{1+\alpha c} \geq \frac{1}{2}$ and sufficiently high values of σ, the following two equilibria exist:*

1. No commitment and $s = b$.

2. No commitment and $s = \frac{c}{1+\alpha c} + b$.

The median voter prefers the second equilibrium if $\gamma > \frac{1}{2}c\left(\frac{1}{(c\alpha+1)} + \alpha c\right)$.

If flexibility is important and the cost of investment is relatively small, two equilibria can co-exist. In both equilibria, both candidates offer a platform with no commitment, $\phi = 0$. In Figure 3, 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 6 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 3, 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 7.

Proposition 7 *For $\frac{1}{1+\alpha c} \geq \frac{1}{2}$ and moderate values of σ, two equilibria exist: One with full commitment and one with no commitment. The equilibrium with full commitment exists even though the median voter prefers the equilibrium with no commitment.*

Consider the upper entry of multiple equilibria in Figure 3. 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.[12]

These results paint a rather pessimistic picture. Not only can politics lead to inactivism or inflexibility, it can lead to these outcomes even when more than half

[12] The case of multiple equilibria at the bottom of Figure 3 is analogous. Here, more than half of the citizens prefer the no commitment equilibrium without investment, but a platform with commitment wins the election if citizens anticipate that no commitment leads to the equilibrium with investment. Note also that if σ is sufficiently low, a unique equilibrium exists even if $\frac{1}{1+\alpha c} \geq \frac{1}{2}$, as depicted in Figure 3. This unique equilibrium always has full commitment.

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 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 ending up in different equilibria. For electric cars, across European countries, there are large differences in policies and uptake across 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 difference 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 chargers to remain problematic. If commitment is weak, expectations about future policies affect investment, which in turn affects future policies.

Propositions 6 and 7 show that the equilibrium where distributional concerns rather than commitment provide credibility is a mixed blessing. On the one hand, it allows for investment while maintaining flexibility. On the other hand, the possibility that redistributional motives provide commitment may lead to a sub-optimal equilibrium outcome. It may induce commitment even though most citizens would prefer no commitment.

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, he wants to induce many citizens to invest. However, this requires commitment, which is costly if uncertainty is high. Corollary 1 follows.

Corollary 1 *Suppose that in equilibrium, the median voter chooses for a platform with no commitment,* $\phi = 0$*, anticipating that a majority of citizens will invest.*

Social welfare can be higher in this equilibrium than under a social planner.

The upshot of this corollary is that the distributional concerns in a democracy may be able to solve commitment problems more efficiently than a social planner.

5 Conclusions

Devising policies to combat climate change, policymakers face a trilemma of credibility, flexibility, and redistributional concerns. A normative approach overlooks how redistributional 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 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), gives 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 median voter chooses $s = \frac{\phi s^p + \alpha b}{\alpha + \phi}$, implying $s^a = \frac{\phi s^p}{\alpha + \phi}$. When choosing s^p and ϕ, the social planner anticipates s and s^a. Expected social welfare $\Psi(\phi)$ equals

$$SW(\phi) = \frac{1}{2h}\int_{-h}^{h} \left(\begin{array}{c} \frac{1}{c}\int_0^{\frac{\phi s^p}{\alpha+\phi}} \left(y - \frac{\frac{\phi s^p + \alpha b}{\alpha+\phi}\frac{\phi s^p}{\alpha+\phi}}{c} - \alpha \frac{1}{2}\left(\frac{\phi s^p+\alpha b}{\alpha+\phi} - b\right)^2 + \left(\frac{\phi s^p+\alpha b}{\alpha+\phi} - c_i\right) + \gamma \frac{\frac{\phi s^p}{\alpha+\phi}}{c} \right) dc_i + \\ \frac{1}{c}\int_{\frac{\phi s^p}{\alpha+\phi}}^{c} \left(y - \frac{\frac{\phi s^p + \alpha b}{\alpha+\phi}\frac{\phi s^p}{\alpha+\phi}}{c} - \alpha \frac{1}{2}\left(\frac{\phi s^p+\alpha b}{\alpha+\phi} - b\right)^2 + \gamma \frac{\frac{\phi s^p}{\alpha+\phi}}{c} \right) dc_i \\ -\frac{1}{2}\phi \left(\frac{\phi s^p+\alpha b}{\alpha+\phi} - s^p\right)^2 \end{array} \right) db \tag{20}$$

Maximizing this expression with respect to s^p yields

$$s^{p*} = \frac{\alpha + \phi}{\phi + c\alpha^2 + c\alpha\phi}\gamma \tag{21}$$

Differentiating (20) with respect to ϕ, and solving the first-order condition using (21) and $\sigma^2 \equiv h^2/3$ yields

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

which is negative unless

$$\alpha c \sigma < \gamma < (1 + \alpha c)\sigma.$$

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

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

which holds for an interior solution for ϕ.

For an interior solution for ϕ, s equals

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

If $\gamma < \alpha c \sigma$ or $\gamma > (1 + \alpha c)\sigma$, there is no interior solution. No commitment, $\phi = 0$, implies $s^a = 0$ and $s = b$. Full commitment, $\phi \to \infty$, yields $s_{full} = s^p = s^a = \frac{\gamma}{1+\alpha c}$. Hence, using social welfare (20), we can determine the social planner's payoff in each of these cases:

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

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

A.2 Proof Proposition 2

Using (11), (12), and (14) as derived in the main text to substitute for s, s^a, and s^p, respectively, into the median voter's utility function (13) and maximising with respect to ϕ yields first-order condition

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

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

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

Hence, $\phi > 0$ requires $\sigma\left((1+\alpha c)^2 - 1\right) < \gamma(1+\alpha c) < \sigma(1+\alpha c)^2$. The second-order condition for a maximum at ϕ^* requires

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

However, substituting for ϕ^* shows that the second-order condition for a maximum at ϕ^* fails, implying that if $\phi^* > 0$ it is a minimum. This proves that a median voter who does not invest either chooses $\phi = 0$ or $\phi \to \infty$.

Substituting for $\phi \to \infty$ into (11) and (14) yields $s = s^p = \frac{\gamma}{2+\alpha c}$. The median voter abstains from investment if this subsidy is smaller than his cost of investment: $\frac{\gamma}{2+\alpha c} < \frac{1}{2}c$. The proposition follows from the comparison in payoffs made in the main text. $\square$

A.3 Proof Proposition 3

The equilibrium is derived in the main text. Provided that $\phi = 0$, the median voter invests if $s^a > \frac{1}{2}c$. Using (17), this can be written as $\frac{c}{1+c\alpha} > \frac{1}{2}c$, which yields the condition in Proposition 3. Substituting for $\phi = 0$ in (16) yields $s = \frac{c}{1+\alpha c} + b$.□

A.4 Proof Proposition 4

The median voter in period 1 anticipates how in period 2 s responds to b, s^a, and s^p. Using (16), (17), and (19) as derived in the main text to substitute for s, s^a, and s^p, respectively, into the median voter's utility function (18) and maximising with respect to ϕ yields first-order condition

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

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

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

which is positive if $\gamma\left(1+c\alpha\right) > c$ and $\sigma\left(\left(1+\alpha c\right)^2-1\right) < \gamma\left(1+c\alpha\right)-c < \sigma\left(1+c\alpha\right)^2$. Second,

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

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

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

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 leaves us with three possible candidates for ϕ:

1. No commitment, $\phi = 0$. Using Proposition 3 and (18), this yields an expected

utility of the median voter equal to

$$U_{\phi=0}^{MV} = y - \frac{1}{2}c + \frac{1}{2}\frac{2\gamma(1+c\alpha)+c^2\alpha}{(c\alpha+1)^2} \tag{22}$$

2. Full commitment, $\phi \to \infty$, with $s_{full_1}^{MV} = \frac{c+\gamma}{2+\alpha c}$. Using $\sigma^2 \equiv h^2/3$, this yields an expected utility of the median voter equal to

$$U_{full_1}^{MV}\left(\frac{c+\gamma}{2+\alpha c}\right) = y - \frac{1}{2}c + \frac{(c+\gamma)^2}{2c(\alpha c+2)} - \frac{1}{2}\alpha\sigma^2 \tag{23}$$

3. Full commitment, $\phi \to \infty$, with $s_{full_2}^{MV} = \frac{1}{2}c$. Using $\sigma^2 \equiv h^2/3$, this yields an expected utility of the median voter equal to

$$U_{full}^{MV}\left(\frac{1}{2}c\right) = y - \frac{1}{4}c + \frac{1}{2}\gamma - \frac{1}{8}\alpha c^2 - \frac{1}{2}\alpha\sigma^2 \tag{24}$$

Comparing these ex ante payoff yields

1. $U_{full_1}^{MV}\left(\frac{c+\gamma}{2+\alpha c}\right) > U_{full}^{MV}\left(\frac{1}{2}c\right)$ if $\gamma > \frac{1}{2}c^2\alpha$.
2. $U_{full_1}^{MV}\left(\frac{c+\gamma}{2+\alpha c}\right) > U_{\phi=0}^{MV}$ if $\sigma^2 < \frac{(\gamma(1+c\alpha)-c)^2}{\alpha c(2+c\alpha)(1+c\alpha)^2}$.
3. $U_{full}^{MV}\left(\frac{1}{2}c\right) > U_{\phi=0}^{MV}$ if $\sigma^2 < (1-c\alpha)\frac{2c-4\gamma(1+c\alpha)+c^2\alpha(1+c\alpha)}{4\alpha(c\alpha+1)^2}$.

This leads to items 1 to 3 in Proposition 4. Item 4 is derived in the main text.□

A.5 Proof Lemma 1

Consider a platform with commitment ϕ and promised subsidy s^p. Citizens invest if the anticipated subsidy $s^a \geq c_i$. It follows that if the median voter invests, so do all citizens with lower cost of investment c_i. Similarly, if the median voter does not invest, neither do citizens with higher cost of investment. Using (1), the expected utility of this platform for citizens who invest equals

$$\frac{1}{2h}\int_{-h}^{h}\left(y - \frac{s^a}{c}s - \frac{1}{2}\alpha(s-b)^2 + s - c_i + \gamma\frac{s^a}{c} - \frac{1}{2}\phi(s-s^p)^2\right)db \tag{25}$$

The only difference in their payoffs between investing citizens is their cost of investment. All citizens who do not invest obtain the same expected utility, as given by

$$\frac{1}{2h}\int_{-h}^{h}\left(y-\frac{s^{a}}{c}s-\frac{1}{2}\alpha\left(s-b\right)^{2}+\gamma\frac{s^{a}}{c}-\frac{1}{2}\phi\left(s-s^{p}\right)^{2}\right)db \tag{26}$$

Now consider two different platforms. First, suppose that under both platforms, the median voter invests. It follows from (25) that the platform preferred by the median voter must be preferred by all citizens who invest. Second, suppose that under both platforms, the median voter does not invest. It follows from (26) that the platform preferred by the median voter must be preferred by all citizens who do not invest. Third, suppose that the median voter invests under one platform but not under the other. As (25) decreases in c_i and (25) is constant in c_i, it follows that (i) if the median voter prefers the platform where he does not invest, so do all citizens with higher cost of investment, and (ii) if the median voter prefers the platform where he does invest, so do all citizens with lower cost of investment. Hence, the platform preferred by the median voter is always the Condorcet winner. It follows that in equilibrium, both candidates propose the platform that maximises the expected utility of the median voter. Offering any other platform would imply losing the elections.

A.6 Proof Lemma 2

The median voter's payoff if $\phi\rightarrow\infty$ and $s=\frac{1}{2}c$ is given by (24). For any value of γ, this is lower than the median voter's payoff if $\phi\rightarrow\infty$ and $s=\frac{\gamma}{2+\alpha c}$, as given by (15). Furthermore, if $\gamma<\frac{1}{2}c\left(1+\alpha c\right)$, the median voter's payoff if $\phi\rightarrow\infty$ and $s=\frac{\gamma}{2+\alpha c}$ is larger than his payoff if $\phi\rightarrow\infty$ and $s=\frac{c+\gamma}{2+\alpha c}$, as given by (23). Hence, given $\phi\rightarrow\infty$, subsidy s is either strictly smaller or strictly larger than $\frac{1}{2}c$.$\square$

A.7 Proof Proposition 5

If $\frac{1}{1+\alpha c}<\frac{1}{2}$, the equilibrium described in Proposition 3 does not exist. Using Lemma 2, this implies that the only remaining possible equilibrium platform under which the median voter invests is given in item 2 of Proposition 4, where $\phi\rightarrow\infty$ and $s=\frac{c+\gamma}{2+\alpha c}$, yielding payoff (23). Proposition 2 describes two possible equilibrium platforms under which the median voter does not invest, one where $\phi = 0$ and $s = b$ yielding payoff y and one where $\phi \to \infty$ and $s = \frac{\gamma}{2+\alpha c}$, yielding payoff (15). Comparing these payoffs, it follows that the median voter prefers

1) $\phi = 0$ and $s = b$ if (i) $\gamma \leq \sqrt{(1+\alpha c)^2 - 1}\sigma$ and $\gamma < \frac{1}{2}c(1+\alpha c)$ and if (ii) $\sigma^2 > \frac{1}{\alpha}\left(c + \frac{1}{c}\frac{(c+\gamma)^2}{c\alpha+2}\right)$ and $\gamma > \frac{1}{2}c(1+\alpha c)$,

2) $\phi \to \infty$ and $s = \frac{\gamma}{2+\alpha c}$ if $\gamma > \sqrt{(1+\alpha c)^2 - 1}\sigma$ and $\gamma < \frac{1}{2}c(1+\alpha c)$, and

3) $\phi \to \infty$ and $s = \frac{c+\gamma}{2+\alpha c}$ if $\sigma^2 < \frac{1}{\alpha}\left(c + \frac{1}{c}\frac{(c+\gamma)^2}{c\alpha+2}\right)$ and $\gamma > \frac{1}{2}c(1+\alpha c)$.

Hence, there is always a unique equilibrium.□

A.8 Proof Proposition 6

The possible equilibrium platforms without commitment are derived in Propositions 2 and 3, respectively. 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 $s = b$ yields payoff y and platform $\phi = 0$ with $s = \frac{c}{1+\alpha c} + b$ yields payoff (22). The maximum median voter's payoff under full commitment is given by either (15) or (23). Comparing these payoffs yields that both no commitment platforms yield higher payoff than any platforms with commitment if $\sigma^2 > \frac{1}{\alpha}\left(c - \frac{1}{(c\alpha+1)^2}\left(2\gamma(c\alpha+1) + c^2\alpha\right) + \frac{1}{c}\frac{\gamma^2}{c\alpha+2}\right)$ and (i) $\gamma \leq \sqrt{(1+\alpha c)^2 - 1}\sigma$ and $\gamma < \frac{1}{2}c(1+\alpha c)$ or (ii) $\sigma^2 > \frac{1}{\alpha}\left(c + \frac{1}{c}\frac{(c+\gamma)^2}{c\alpha+2}\right)$ and $\gamma > \frac{1}{2}c(1+\alpha c)$.

Comparing the median voter's payoffs in the two no-commitment equilibria yields the condition in the last line of Proposition 6.□

A.9 Proof Proposition 7

First, suppose that $\gamma \leq \sqrt{(1+\alpha c)^2 - 1}\sigma$ and $\sigma^2 < \frac{1}{\alpha}\left(c - \frac{1}{(c\alpha+1)^2}\left(2\gamma(c\alpha+1) + c^2\alpha\right) + \frac{1}{c}\frac{\gamma^2}{c\alpha+2}\right)$. Using the median voter's payoff of commitment platforms (15) or (23) and his payoff from the no-commitment platforms y and (22), 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 $s^p = \frac{\gamma}{2+\alpha c}$. Hence, this is an equilibrium as well, despite that fact that more than half of the citizens prefers a different equilibrium.

Second, suppose that $\gamma \geq \frac{1}{2}c\left(1+\alpha c\right)$ and $\sigma^2 > \frac{(\gamma(1+c\alpha)-c)^2}{\alpha c(2+c\alpha)(1+c\alpha)^2}$ and $\sigma^2 < \frac{1}{\alpha}\left(c + \frac{1}{c}\frac{(c+\gamma)^2}{c\alpha+2}\right)$ or that $\frac{1}{2}c\left(\frac{1}{(c\alpha+1)} + \alpha c\right) < \gamma < \frac{1}{2}c\left(1+\alpha c\right)$ and $\sigma^2 > \frac{1}{\alpha}\left(c - \frac{1}{(c\alpha+1)^2}\left(2\gamma\left(c\alpha+1\right)+c^2\alpha\right) + \frac{1}{c}\frac{\gamma^2}{c\alpha+2}\right)$ and $\gamma > \sqrt{\left(1+\alpha c\right)^2 - 1}\sigma$. 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 $s = \frac{\gamma}{2+\alpha c}$ (if $\gamma < \frac{1}{2}c\left(1+\alpha c\right)$) or the platform with $s = \frac{c+\gamma}{2+\alpha c}$ (if $\gamma \geq \frac{1}{2}c\left(1+\alpha c\right)$). With either full commitment equilibrium platform, more than half of the citizens would be better off in the no-commitment equilibrium with investment.□

A.10 Proof Corollary 1

If in equilibrium a platform with commitment arises or if the equilibrium with no commitment and without investment is played, social welfare is always (weakly) lower than in case of decision-making by a social planner. Hence, for social welfare to be higher under democracy, this requires the equilibrium with no commitment with investment. Proposition 3 shows that in this equilibrium $s = \frac{c}{1+\alpha c} + b$ such that $s^a = \frac{c}{1+\alpha c}$. Using (20), this yields social welfare equals to $SW^{DEM} = y + \frac{1}{2}\frac{2\gamma - c}{c\alpha+1}$.

From Proposition 1, it follows that

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

The proofs of Propositions 6 and 7 give conditions under which the equilibrium with no commitment with investment may arise. It follows that in each of the three cases above, the parameters can be such that this equilibrium arises and that $SW^{DEM} > SW\left(\phi\right)$.□