Soothing politics*

Raphaël Levy†

Abstract

We consider a political agency model where voters learn information about some policy-relevant variable, which they can ignore when it impedes their desire to hold optimistic beliefs. Voters' excessive tendency to sustain optimism may result in inefficient political decision-making because political courage does not pay off when voters have poor information. However, voters infer information from policies and incentives to ignore bad news decrease when policy-making is more efficient. This generates multiple equilibria: an equilibrium where voters face up to the reality and politicians have political support to implement optimal policies, and another where they shy away from reforms to cater to the electorate's demand for soothing policies.

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†Mannheim University

1 Introduction

The recent debt crisis in the euro zone has evidenced the coexistence of what has been presented as two models, epitomized by the tale "The grasshopper and the ant": as Northern countries ("the ants") were implementing structural reforms, Southern countries ("the grasshoppers"), who had made a significant adjustment effort to enter the eurozone, allegedly enjoyed good times while turning a blind eye to alarming signals about their debt burden and consistently delaying structural adjustment reforms.[1] Although the grasshopper-ant typology is somewhat crude and overlooks the idiosyncrasies of each country in the crisis, political outcomes in the latest decades hint that some countries seem to have been more "reform-minded" than others.[2]

In this paper, we argue that these cross-country differences reflect the existence of multiple political equilibria where the electorate's awareness/ignorance and political courage/feebleness are mutually reinforcing. The premise is that voters experience anticipatory utility, i.e. prefer (ceteris paribus) to hold rosy beliefs, which leads them to sometimes disregard worrisome signals they might observe, such as the need for structural reforms. Meanwhile, as reforms themselves remind them of bad news, investing in ignorance is profitable only when politicians shy away from reforming. Because voter information improves political discipline, this is all the more likely as voters are worse informed. Therefore, informational complementarities arise endogenously between voter awareness and the efficiency of politics, possibly leading to multiple equilibria: a "Realpolitik" equilibrium in which voters face facts and politicians have political support to implement difficult policies; a "soothing politics" equilibrium in

[1] See for instance Alan Greenspan's declarations in November 2011: "The "Club Med" ethic - a vacation-centric mentality that prizes enjoyment and easy living over production and hard work - that characterizes countries such as Greece and Italy was never abandoned once they adopted a common currency. Meanwhile, countries such as Germany (...) continued to save and made the northern economies more competitive." See http://blogs.wsj.com/economics/2011/11/10/greenspan-europes-debt-crisis-comes-down-to-north-vs-south/

[2] For instance, in the "Lisbon agenda scorecard" published in 2010, the five best performers were three Scandinavian countries, the Netherlands and Austria, while Spain, Portugal, Greece and Italy ranked 19th, 20th, 22nd and 24th respectively. See http://www.cer.org.uk/publications/archive/report/2010/lisbon-scorecard-x-road-2020.

which political courage does not pay off because of voters being "in denial". We establish that policy-making is less efficient when voters are a priori more optimistic, which may explain why it is easier to implement reforms in times of crisis and why it often takes several attempts before reforms take place: each try paves the way for future reforms by increasing awareness, until voters are "ripe" for reforms. We also show that equilibrium multiplicity is more likely on issues which involve large risks, and for which uncertainty is unlikely to resolve in the near future. Natural illustrations of our theory include pension and labour market reforms, as well as the issue of climate change.

On pensions, Boeri *et al.* (2001) documents "a systematic overestimation of benefits and underestimation of costs of public pension systems" in France, Germany, Italy and Spain. Strikingly, only 40% of the Spanish citizens surveyed expected that a reform of pensions would be necessary in the 10 years to come. This dramatic rate of ignorance parallels the absence of any significant reform of Spanish pensions.[3] Conversely, in Germany, France, and Italy, where pension reforms have been implemented over the same period, citizens were mostly aware that their pension systems were not sustainable. The high awareness rate in these countries can be related to previous reforms (or reform attempts), confirming the idea (featured in the model) that policies have a feedback effect (Pierson, 1993): voters do learn from policies and attempts to reform, whether successful or not, do result in a change in voters' attitudes.[4] As regards labour markets, the wide variety of industrial relations traditions across European countries, going from "statist market economies" (France and Mediterranean countries), to "liberal market economies" (the UK), and "coordinated market economies" (Scandinavian and German-speaking countries), illustrates how different regimes, characterized by different policies, outcomes, and beliefs, can emerge as different political equilibria: on the one hand, indicators hint that coordinated market economies seem to do better

[3]Annual reports of the IMF or the OECD in the 2000's have repeatedly urged the Spanish government to stop delaying the reform of its pension system.

[4]In Germany, Boeri *et al.* (2002) shows that the Riesler reform, which happened in 2001, i.e. between two consecutive surveys by the same authors, resulted in a change of beliefs, with citizens being on average better informed.

in terms of labour market performance and to implement more reforms than statist market economies;[5] on the other hand, there are important variations in beliefs on the role of the state in industrial relations across regimes.[6] Finally, on the issue of climate change, our results are in line with Steves and Teytelboym (2013), which evidences that countries where the public is more aware of global warming implement more effective climate policies. The level of awareness on climate change is for instance significantly lower in the US than in other developed countries, and this lower awareness goes hand in hand with the US lagging behind in terms of climate change mitigation policies. In addition, there is evidence suggesting that climate change "denial" is an important concern in the US, in particular among conservative citizens (and politicians), who appear to be more prone to discarding scientific evidence on global warming. Finally, time-series variations in aggregate climate change concerns and in political partisanship on environmental issues have followed similar patterns in the US, suggesting that different equilibria may alternate over time.[7]

Voter information has always been a central topic in political science: "Political information is to democratic politics what money is to economics: it is the currency of citizenship".[8] But while what being informed means is rather clear, it is important to distinguish between different forms of failures to be informed. Kuklinski *et al.* (2003) notably stresses the difference between "uninformed" and "misinformed" voters. Uninformed voters make individual mistakes, which average out at the aggregate level. In addition, uninformed voters use heuristics which are shown to work pretty well on average. Voter uninformation thus does not seem to be so much of an issue. However,

[5]For instance, Brandt *et al.* (2005) documents that countries like Italy, Spain or France have undertaken rather minor labour market reforms, either in terms of breadth or intensity; on the other side, Finland, Denmark, the Netherlands, and, to a lesser extent, Germany, have implemented more significant and broader reform packages.

[6]In a 1996 survey of the International Social Survey Programme (ISSP), the share of respondents who agreed that "The government should control wages by law" was 65% in Italy, 67% in Spain, versus 27% in (West) Germany and 28% in Sweden, while France and the UK were situated between these two poles (50% and 38%).

[7]Section 4 is dedicated to the issue of climate change, and offers a more detailed account of these arguments.

[8]Carpini and Keeter (1997), quoted by Kuklinski *et al.* (2003)

"misinformed" voters suffer from systematic biases. Kuklinski *et al.* (2003) documents how voter beliefs are often skewed in the direction of their preferences. This may generate adverse effects on politicians and policies.[9] One may suspect misinformation to be pervasive in democratic politics, as no voter is ever pivotal, making the instrumental value of information tiny. The literature actually documents different rates of awareness of objective facts across partisan groups. For instance, Sweeney and Gruber (1984) shows that President Nixon's supporters knew less about the Watergate investigative committee than other citizens. In the same spirit, Bartels (2002) provides evidence that Democrat citizens were underestimating the decrease in unemployment and inflation rates under the Reagan administration (as a mirror image, most Republicans were ignorant of the budget deficit reduction during the Clinton presidency). Nalder (2010) documents Californian citizens misinformation on Proposition 13, a measure which imposes a tax cap on property: a third of respondents only were aware that the cap equally applies to residential and commercial property. Interestingly, unawareness was stronger among homeowners, suggesting self-serving beliefs: citizens who do enjoy low taxes do not want to know that large corporations benefit from the same tax treatment.[10] Finally, the literature in social and cognitive psychology has also provided plenty of experimental evidence of manipulation of beliefs for self-serving motives.[11]

In economics, Akerlof and Dickens (1982) shows that workers in a dangerous job may prefer to remain ignorant of the exact risk they face at work, despite the instrumental value of this information. Modeling beliefs explicitly, Carrillo and Mariotti (2000) shows that strategic ignorance may help a time-inconsistent agent overcome his procrastination problem. Bénabou and Tirole (2002) introduces a memory management

[9]Bartels (1996) for instance shows that uninformed voters are more likely to support incumbents, and argues that such misinformation accounts for a nontrivial fraction of the incumbency advantage in US Presidential elections.

[10]Notice also that respondents which are usually better informed on politics (the more educated and wealthier citizens) also held less accurate beliefs, reinforcing the suspicion of self-serving beliefs.

[11]For instance, Brock and Balloun (1967) exposed believers and atheists to a recording attacking Christianity. The tape had an annoying static, which subjects were given the option to remove so as to better understand the message. While most atheists picked this option, most believers deliberately chose to listen to the garbled message. A similar experience with smokers and non-smokers essentially gave similar results.

game in which an agent who needs to be confident about his ability chooses whether to repress discouraging news, and shows that individuals may end up in self-traps. Other papers, in which belief manipulation is driven by anticipatory utility, include Caplin and Leahy (2001), Brunnermeier and Parker (2005), Kőszegi (2010), and Bénabou and Tirole (2011).

Our paper also relates to the literature on the political economy of reforms, particularly to papers based on asymmetric information: when there is uncertainty about their ability or preferences, policy-makers in office use policies to signal desirable traits to the electorate in the hope of boosting their reelection prospects. Career concerns of policy-makers may have a disciplining effect on "bad politicians", like in this paper, but can also induce "good" policy-makers to posture, sometimes at the expense of social welfare (Maskin and Tirole, 2004; Canes-Wrone *et al.*, 2001). A critical feature of these models is that how much political behavior is "distorted" by career concerns (whether this is good or bad for welfare) depends on the amount of voter uncertainty, as stressed by Acemoglu *et al.* (2014) and Bonfiglioli and Gancia (2011). In this paper, we explicitly model optimal awareness strategies and therefore endogenize voter uncertainty. Few economic papers have focused on the impact of behavioral decision-making on politics. Notable examples are Bénabou and Tirole (2006) and Schuett and Wagner (2011). The former considers agents manipulating information in order to sustain desirable beliefs on the relative impact of luck and effort on outcomes, and shows that two political equilibria with different levels of taxation and redistribution may coexist. The latter considers hindsight-biased voters and shows that the bias disciplines politicians, and sometimes enhances social welfare.

2 The model

We consider a model of political agency in which a policy-maker tries to develop a reputation for being congruent with the electorate in order to increase his chances of reelection. His reputational incentives depend on voter beliefs on the optimal policy,

which they can manipulate in order to sustain optimism. There are two periods and two states of the world: $\omega \in \{H, L\}$, with $\Pr(\omega = H) = q$. In each period, the policy-maker in office, who has private information on ω, chooses to undertake a reform ($X = 1$) or not ($X = 0$). ω is i.i.d. across periods. To simplify the notation, we do not use subscripts for period 1 variables and denote period 2 variables ω_2 and X_2.

2.1 Voters

There is a mass 1 of identical voters. From the point of view of the electorate, the reform has a cost c and yields a state-dependent benefit $b \in \{b_L, b_H\}$, with $b_L > c > b_H$: reform is the socially optimal policy in the bad state ($\omega = L$) only. On top of the utility from reform, voters get a state-dependent utility a_ω, so that a voter's payoff-relevant utility $u(\omega, X)$ is given by:

	$\omega = H$	$\omega = L$
$X = 1$	$a_H + b_H - c$	$a_L + b_L - c$
$X = 0$	a_H	a_L

2.1.1 Awareness management: the demand side

Beside this outcome utility u, voters experience anticipatory utility, i.e. emotional utility (savoring or anxiety) derived from the expectation of their future outcome utility (Elster and Loewenstein, 1992). Technically, the utility voters derive from period 1's reform decision $u(\omega, X)$ is obtained with delay (i.e. in period 2), and they experience in period 1 savoring utility equal to a fraction s of the expectation of this utility $sE_\omega u(\omega, X)$. We assume $a_L + b_L < a_H + b_H$, implying that utility is always higher in the good state regardless of the reform decision. Since emotional utility then increases with the perceived probability that $\omega = H$, utility from beliefs generates a demand for rosy beliefs, hence provides an incentive to disregard potential "bad news" on ω.[12]

[12] In a similar spirit, Loewenstein (1987) shows that anticipatory utility can lead to delay the enjoyment of events in order to savor them, or to hurry dreadful events to avoid anxiety.

2.1.2 Awareness management: the supply side

Our modeling of awareness management is based on Bénabou and Tirole (2002): voters have access to some exogenous source of information on ω, modeled as a signal $\tilde{\sigma}$, which perfectly reveals a bad state $\omega = L$. More precisely, $\tilde{\sigma} \in \{\varnothing, L\}$ with $Pr(\tilde{\sigma} = L|\omega = L) = Pr(\tilde{\sigma} = \varnothing|\omega = H) = 1$. Voters have imperfect memory and can repress bad news $\tilde{\sigma} = L$, by pooling good and bad signals. Formally, they choose the conditional distribution of the recollection $\sigma \in \{\varnothing, L\}$ they retain from the original signal $\tilde{\sigma} = L$, i.e. $\lambda = \Pr(\sigma = L|\tilde{\sigma} = L)$, choosing between the two polar cases of complete avoidance of conflicting information ($\lambda = 0$) and full awareness ($\lambda = 1$). As Figure 1 shows, while bad news can be transformed into good news, the opposite is impossible: $Pr(\sigma = \varnothing|\tilde{\sigma} = \varnothing) = 1$. We assume that censoring a signal $\tilde{\sigma} = L$ has an exogenous positive

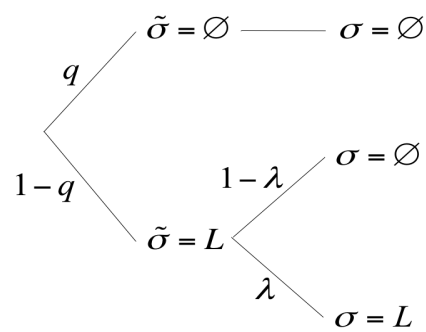

Figure 1: The game of selective memory (adapted from Bénabou and Tirole (2002))

cost $\tilde{m}$, which captures the physical or opportunity cost of denial (repression may require active efforts to ignore facts, or stopping valuable activities to avoid negative cues), but also possibly the instrumental value of information (decision-making is less efficient). However, since each single voter is atomistic and cannot be pivotal in the election, there is no instrumental cost of voting for the "wrong" candidate.

2.2 Policy-makers

2.2.1 Preferences

There are two types of politicians $\theta \in \{C, B\}$ characterized by their preference for reform. Let us normalize to 0 the utility from sticking to the status quo for all types, and denote by γ_ω^θ the net cost for type θ of reforming in state ω. Type $\theta = C$ is said to be "congruent" with the electorate, in that he has the same preference ordering over policies as voters: $\gamma_L^C < 0 < \gamma_H^C$. However, type $\theta = B$ is "biased" towards the status quo: $\gamma_H^B > \gamma_L^B > 0$.[13] The prior probability that the policy-maker is congruent is denoted by π. Beside this intrinsic preference, the politician gets utility δ in case of reelection, where δ measures the importance of his career concerns, for instance the private benefits from being in office ("ego rents", perks...). We only restrict δ to be nonnegative, and assume for simplicity that δ is independent of θ. We also assume that $\min\left\{-\gamma_L^C, \gamma_H^C\right\} > \delta > \gamma_L^B > 0$. Consequently, type $\theta = C$ behaves like a "commitment type," and always implements the socially optimal action, as the intrinsic benefit he gets from doing so dwarfs his reelection concerns. However, type $\theta = B$ would always stick to the status quo absent reputational concerns, but may go against this intrinsic bias if it significantly increases his reelection probability (disciplining effect).

2.2.2 Electoral competition

The incumbent policy-maker runs for reelection at the end of period 1. At this stage, he faces an opponent whose prior probability of being congruent is denoted $\tilde{\pi}$, where $\tilde{\pi}$ is drawn from the uniform distribution on $[0, 1]$. Let us now precise the timing of the game.

[13] The bias may come from some private benefit the policy-maker has to forego when reforming. This private benefit could represent a non-monetary opportunity cost of effort or stem from the monetary contribution received from some anti-reform lobby.

2.3 Timing

Period 1

1a. The random variables $\omega \in \{H, L\}$ and $\theta \in \{C, B\}$ are independently realized and privately observed by the policy-maker.

1b. Voters observe $\tilde{\sigma} \in \{L, \varnothing\}$. Upon observing $\tilde{\sigma} = L$, each voter chooses the probability λ of recalling bad news.

1c. The policy-maker selects $X \in \{0, 1\}$.

1d. The recollections $\sigma \in \{L, \varnothing\}$ are realized.

1e. Voters observe X and σ and experience anticipatory utility $s.E_{\omega}[u(\omega, X)|\sigma, X]$.

1f. $\tilde{\pi}$, the probability that the challenger is congruent, is realized and learnt by voters.

1g. The election opposing the incumbent policy-maker and the challenger takes place.

Period 2

2a. The elected politician observes the period-2 state ω_2 and selects X_2.

2b. Voters obtain their period 1 and period 2 utilities $u(\omega, X)$ and $u_2(\omega_2, X_2)$.

Notice that the repression strategies of other voters do not affect the marginal benefit of forgetting bad news for a single voter, which only depends on how likely a reform is expected. As a consequence, all voters play the same strategy in equilibrium.[14] For simplicity, we assume that the recollections σ are perfectly correlated across voters.[15]

[14] Notice that we implicitly rule out social learning, i.e. the possibility for a voter to be reminded of bad news by other (aware) voters. Perfect social learning would predict that voters are all informed, which is at odds with evidence from the political science literature (see the Introduction). However, the question of how incentives to become misinformed vary across social networks (and incidentally shape social groups) is an interesting question, which we leave for future research.

[15] Alternatively, one could assume that realizations are independent across voters, without affecting the results. See Section 3.3.2 for more details.

3 Political equilibrium

3.1 Voting behavior and reelection probabilities

At the time of the election, voters observe the policy X, the challenger's probability of being congruent $\tilde{\pi}$, and their recollection σ, but not the underlying state ω. They compare the expected congruence of the incumbent and that of the challenger. Let $\hat{\pi}_{\sigma,X} \equiv \Pr(\theta = C|\sigma, X)$ denote a voter's beliefs on the incumbent's type conditional on policy X and his recollection σ. We focus on the equilibrium in which all voters vote sincerely, i.e. vote for the incumbent if and only if $\hat{\pi}_{\sigma,X} \geq \tilde{\pi}$.[16] This equilibrium is the only symmetric equilibrium in weakly undominated strategies: voters are indeed policy-motivated and anticipate that the winner will implement his preferred policy in period 2 because he no longer has reelection concerns. Due to perfect correlation, all voters have the same recollection σ and, for a given (σ, X), the politician's reelection probability is simply equal to his reputation $\hat{\pi}_{\sigma,X}$.[17]

3.2 Equilibrium definition

As the congruent politician always selects the optimal policy, we only need to focus on the behavior of the biased type. Let x and y denote the probabilities that the biased policy-maker reforms in states $\omega = L$ and $\omega = H$, and $\hat{q}_{\sigma,X} \equiv \Pr(\omega = H|\sigma, X)$ voters' posterior beliefs on ω conditional on observing σ and X. A perfect Bayesian equilibrium is a triple (x^*, y^*, λ^*) such that x^* and y^* maximize the biased politician's expected utilities in state L and H given voters' strategies λ^* and Bayesian beliefs $\hat{\pi}_{\sigma,X}$, and λ^* maximizes a voter's expected savoring utility given x^*, y^* and $\hat{q}_{\sigma,X}$. Notice that we make the Bayesian assumption that voters are aware of their incentives to forget

[16] Given that there is a continuum of atomistic voters, any strategy profile is an equilibrium.

[17] The fact that a congruent politician selects the optimal policy in period 2 is an artifact of the two-period modeling, while the equality between the politician's reelection probability and his reputation comes from the uniform distribution of $\tilde{\pi}$. In both cases, what matters is only that the reelection probability increases with perceived congruence, which would be true in more general settings.

bad news, and appropriately discount the reliability of a rosy recollection $\hat{q}_{\varnothing,X}$.[18]

3.3 Best response analysis

Before turning to the full analysis of optimal strategies, we derive the following Lemma:

Lemma 1. *In any equilibrium, $y^* = 0$: the biased policy-maker never reforms in the good state $\omega = H$. Since the congruent policy-maker never reforms in the good state either, observing a reform fully reveals the bad state $\omega = L$.*

The proof lies in the Appendix. Intuitively, if the biased politician reforms with positive probability when it is least needed, he a fortiori reforms in state L. This implies that the electoral cost of not reforming is small, as no reform is then likely to come from a congruent politician in state H, so the biased politician should never reform.

3.3.1 Voter optimal awareness strategies

When choosing λ, a voter does not know how optimistic he will end up being upon repressing bad news, as this also depends on the policy X. Since a reform perfectly identifies $\omega = L$, forgetting bad news increases savoring utility only when no reform is undertaken, i.e. with conditional probability $(1-\pi)(1-x)$. Therefore, the marginal expected benefit from repression is $s(1-\pi)(1-x)\left(\hat{q}_{\varnothing,0} - \hat{q}_{L,0}\right)(a_H - a_L) \geq 0$. This benefit is traded against the cost of repression $\tilde{m}$. Consequently, the optimal level of awareness only depends on the ratio $\frac{\tilde{m}}{s(a_H - a_L)}$, which we denote m. From Bayes' rule, $\hat{q}_{\varnothing,0} = \frac{q}{q+(1-q)(1-\pi)(1-\lambda)(1-x)}$ and $\hat{q}_{L,0} = 0$, so one derives

$$\lambda^* \in \underset{\lambda \in [0,1]}{\operatorname{argmax}} (1-\lambda)\left[\frac{q(1-\pi)(1-x)}{q+(1-q)(1-\pi)(1-\lambda^*)(1-x)} - m\right] \tag{1}$$

[18] The fact that voters suffer from a systematic tendency to manipulate their beliefs and are in the same time sophisticated enough to discount good news may sound surprising at first glance. In the spirit of Bénabou and Tirole (2002), we consider this Bayesian assumption as a benchmark: allowing voters to "forget that they forget" would reinforce the results, in that political inefficiencies would then be stronger.

The expected benefit from repressing bad news is increasing in q and decreasing in x, so the optimal awareness rate λ^* is nondecreasing in x and nonincreasing in q (more details can be found in the Appendix): when voters expect the biased policy-maker to reform more often, they have fewer incentives to forget bad news, as they are likely to be reminded of this bad news by the reform itself; besides, a higher q makes rosy beliefs $\hat{q}_{\varnothing,0}$ more valuable, and therefore increases incentives to forget.

3.3.2 Political incentives

Since a reform reveals the bad state anyway (Lemma 1), the reputation of a reformist does not depend on σ : $\hat{\pi}_{L,1} = \hat{\pi}_{\varnothing,1} = \frac{\pi}{\pi+(1-\pi)x^*}$. In addition, when voters are aware of the bad state ($\sigma = L$), no reform perfectly identifies the biased politician, so $\hat{\pi}_{L,0} = 0$. Defining $\gamma \equiv \frac{\gamma_L^B}{\delta} < 1$, x^* must satisfy

$$x^* \in \underset{x\in[0,1]}{\text{argmax}}\ x\left[-\gamma + \frac{\pi}{\pi+(1-\pi)x^*} - (1-\lambda)\frac{\pi q}{q+(1-q)(1-\pi)(1-\lambda)(1-x^*)}\right] \tag{2}$$

This marginal benefit from reforming is increasing in λ and decreasing in q. Therefore, the optimal reform probability x^* is nondecreasing in λ and nonincreasing in q.[19] When voters are more optimistic about ω (because of a higher q, a lower λ, or both), the reputational cost for the incumbent of selecting the status quo decreases, as voters perceive it to be more likely to be the right decision. This disciplines the biased politician to a lesser extent, thus making reform less likely.

Remark 1. In (2), we made use of the assumptions that voters' recollections are perfectly correlated and unobserved by the policy-maker to derive that the expected reelection probability after no reform equals $\lambda\hat{\pi}_{L,0} + (1-\lambda)\hat{\pi}_{\varnothing,0} = \frac{(1-\lambda)\pi q}{q+(1-q)(1-\pi)(1-\lambda)(1-x^*)}$. None of these two assumptions is actually crucial: it is possible to relax both of them by assuming instead that voters' recollections are independent. Independence of recollections raises a discontinuity issue at $\lambda = 1/2$ (the majority group, i.e. "optimists" if $\lambda < 1/2$, and "pessimists" if $\lambda > 1/2$, is pivotal), but we can obviate it by assuming a

[19] More technical details, including how we deal with the issue of out-of-equilibrium beliefs, can be found in the Appendix.

stochastic incumbency advantage, i.e. that the incumbent gets reelected if his obtains a vote share larger than some random η. This allows to keep reelection probabilities smooth. Indeed, assuming that a fraction x_i of the electorate holds posterior beliefs on the incumbent's type $\hat{\pi}_i$ for $i = 1, ...N$, with $0 \leq \hat{\pi}_1 \leq \hat{\pi}_2 \leq ... \leq \hat{\pi}_N \leq 1$, we obtain the following expected reelection probability (assuming independence of η and $\tilde{\pi}$) :

$$\hat{\pi}_1 \Pr(\sum_{i=1}^{N} x_i \geq \eta) + (\hat{\pi}_2 - \hat{\pi}_1) \Pr(\sum_{i=2}^{N} x_i \geq \eta) + ... + (\hat{\pi}_N - \hat{\pi}_{N-1}) \Pr(x_N \geq \eta) \qquad (3)$$

Assuming η uniform on $[0, 1]$, this reelection probability becomes $\sum_{i=1}^{N} x_i \hat{\pi}_i$, which is precisely the expected reelection probability we obtain under perfect correlation.[20]

Remark 2. Relatedly, assuming independent recollections allows to relax the assumption of homogenous voters. Indeed, (3) holds for any discrete N, and one can consider heterogeneous voters with different beliefs over the incumbent's type (whether this difference comes from different preferences, technologies, or prior beliefs). The analysis is simply more complex, as the politician's best reply function then has more than one argument. However, one can easily deal with the case where a fraction z of the electorate is perfectly informed, for instance because they have a preference for awareness. With this simple form of heterogeneity, we obtain a fraction $z + (1 - z)\lambda$ of aware voters, and a fraction $(1 - z)(1 - \lambda)$ of optimistic voters. x^* remains a simple function of λ, and our results qualitatively go through.

3.4 Equilibrium

The best response analysis reveals that best reply functions are both nondecreasing, so that voters' and the politician's actions are strategic complements. This complementarity of incentives is naturally conducive to multiple equilibria, as Proposition 1 shows:

[20]Notice that, with independent recollections, the assumption that the policy-maker does not observe voter recollections becomes irrelevant, as the distribution of posterior beliefs in the population then coincides with the prior distribution, by the law of large numbers.

Proposition 1. *The game generically admits one or three equilibria:*

- *If* $\pi \geq \gamma(1-m)$, *there is an equilibrium with perfect recall* $\lambda^* = 1$ *and* $x^* = \max\left(\frac{\pi}{1-\pi}\frac{1-\gamma}{\gamma}, 1\right)$.
  - *If* $\pi \geq \min\left(1-m, \frac{\gamma(1-m)}{m}\right)$, *this perfect recall equilibrium is unique,*
  - *If* $\gamma(1-m) \leq \pi < \min\left(1-m, \frac{\gamma(1-m)}{m}\right)$, *there exists* $\overline{q} \in (0,1)$ *such that the perfect recall equilibrium is unique if and only if* $q < \overline{q}$. *If* $\overline{q} < q \leq 1$, *there exist exactly two other equilibria involving imperfect recall* $\lambda^* < 1$ *and imperfect discipline* $x^* < 1$,
- *If* $\pi < \gamma(1-m)$, *there is a unique equilibrium with imperfect recall* $\lambda^* < 1$ *and imperfect discipline* $x^* < 1$.

Proof. In the Appendix. □

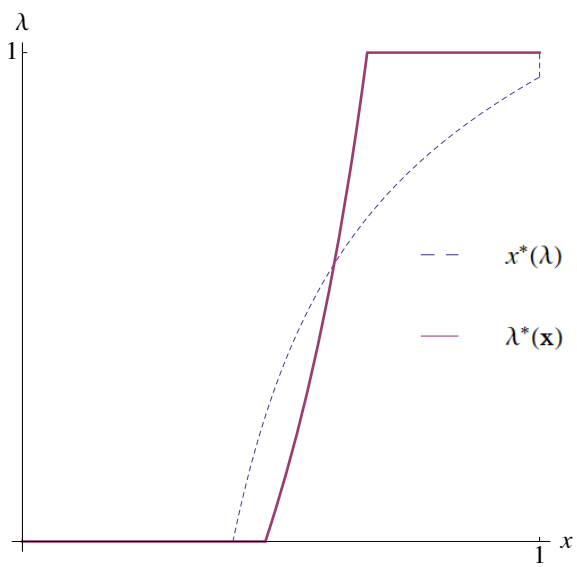

Figure 2: Three equilibria

Figure 2 depicts a configuration with three equilibria. In the perfect recall equilibrium ($\lambda^* = 1$), voters refrain from forgetting bad news, as they anticipate a likely

reform. This in turn disciplines the biased policy-maker, who reforms with a high probability for fear of being ousted by informed voters in the subsequent election. Conversely, in a "soothing politics" equilibrium, voters are likely to be "in denial", which gives incentives to the politician to indulge his status quo bias, thereby deterring voters from facing facts.[21] This multiplicity of political equilibria is reminiscent of Bénabou and Tirole (2006), Dessi (2008) and Bénabou (2008), where motivated beliefs may result in different ideologies or political equilibria persisting over time. An important difference though is the role played here by politicians' actions in shaping voters' incentives to be informed, which creates a strategic complementary between voters and politicians.

Proposition 1 points that necessary conditions for equilibrium multiplicity are a large q and an intermediate value of π. Intuitively, multiplicity requires that voters' incentives are sufficiently sensitive to what they expect politicians to do, and conversely. On the voter side, this requires a high q. Indeed, when q is low, voters have little incentives to repress bad news regardless of how expected a reform is, because the benefit of ignorance is then tiny. Conversely, if q is large enough, voters' repression strategies critically depend on the probability of a reform. On the political side, this requires an intermediate π. This is because the difference in reelection probabilities following reform and no reform is then not only higher (more prior uncertainty), but also more sensitive to the accuracy of voter information.

[21] Notice that the result that there is insufficient reform should not be taken too literally. Our result rather points to the fact that voters' willingness to ignore realities distorts political incentives and generates inefficient policy-making. This inefficiency can take the form of an excessive tendency to stick to the status quo, as here, but also of excessive reform. For instance, one could have instead assumed that voters prefer to believe that a given reform has high benefits, with the biased policy-maker having a preference for this reform, and then also obtain multiple equilibria: a realistic politics equilibrium in which the biased politician abstains for reforming when the reform is welfare-decreasing, while voters are aware that the reform has low benefits; an inefficient equilibrium with too much reform, where the biased politician reforms even when the reform yields low benefits, with voters being wrongly convinced of the contrary. Generically, what generates equilibrium multiplicity is the fact that the biased politician's preferred action is the action socially optimal (and, as such, chosen by the congruent politician) in the state of the world preferred by voters.

3.5 Comparative statics

The comparative statics of x^* with respect to π is essentially ambiguous. To illustrate this, let us consider the two benchmark cases of no information (λ is fixed to 0) and perfect information ($\lambda = 1$). When $\lambda = 0$, the disciplining effect comes from the fact that a policy-maker with a low reputation π wants to enhance his reelection prospects by reforming. However, a politician with high enough a reputation never reforms, as the incremental electoral gain from reforming never exceeds the cost of reform. When $\lambda = 1$, the biased politician may be fully disciplined ($x^* = 1$) because voters are perfectly aware of the bad state and punish a politician who indulges his bias. This happens precisely when π is large, because more reputable politicians have more to lose from being caught misbehaving. Notice that there is never perfect discipline ($0 \leq x^* < 1$) when $\lambda = 0$, while there is always some discipline ($0 < x^* \leq 1$) when $\lambda = 1$. Our model nests these two benchmark cases and possibly features political equilibria with full discipline or no discipline at all. Since reputational incentives are different when λ is high (reputable politicians want to protect their reputations) and when λ is low (politicians with a reputational deficit want to build up a reputation), the impact of π on x^* is ambiguous.[22] However, we derive a clear comparative statics result on the impact of π on the total probability of a reform, as the first point in Proposition 2 shows.

Proposition 2. *Higher values of m and π, lower values of γ and q, make the equilibrium more efficient in the following sense:*

- *In any equilibrium, $\pi + (1 - \pi)x^*$ is nondecreasing in π,*
- *In the least efficient equilibrium, x^* is nondecreasing in m, and nonincreasing in γ and q,*
- *$\overline{q}$ is nondecreasing in m and nonincreasing in γ.*

[22] For the same reason, the comparative statics of $\overline{q}$ with respect to π is ambiguous as well.

Proof. In the Appendix. □

Before going further, let us remark that the comparative statics analysis is made complex by the multiplicity of equilibria, as the impact of a parameter on political efficiency depends on the equilibrium we consider. We focus on the equilibrium with the lowest level of recall. If the equilibrium is unique, this restriction is irrelevant. When there are multiple equilibria, the comparative statics is qualitatively similar in the high and the low recall equilibria, while it is reversed in the intermediate equilibrium. We therefore obtain results consistent with the comparative statics results in the perfect recall equilibrium coming from Proposition 1 . Proposition 1 shows that the existence of a perfect recall equilibrium is more likely when m and π are higher, when γ is lower, and does not depend of q. Proposition 2 complements and generalizes these comparative statics results, and establishes that a higher value m and lower values of γ and q make the equilibrium with the lowest recall more efficient, and make it more likely that the perfect recall equilibrium is unique, if it exists.

$\pi + (1 - \pi)x^*$ is the total probability of a reform in state $\omega = L$, and accordingly measures political efficiency. Even if an increase of π results in a lower x^*, as we have seen is possible, this effect is never strong enough to offset the increased probability that a reform coming from a congruent politician takes place. Unsurprisingly, efficient policy-making is more likely when the expected quality of politicians is higher. For instance, in France or Italy, where confidence in the disciplining virtue of elections is among the lowest in Europe (International Social Survey Programme, 1996), we might expect less efficient policy-making.

The parameter $m = \frac{\tilde{m}}{s(a_H - a_L)}$ captures different forces governing the cost and benefits of repression. First, one may think of $\tilde{m}$, the cost of repression, as being larger when a topic has received a lot of attention, from politicians or the media. This captures the idea that reforming is easier for politicians who have taken care of communicating, especially during the electoral campaign, and therefore have a mandate to reform.[23]

[23]OECD (2006) documents that a clear mandate to reform has a strong positive impact on reform scores. The pension reform in France in 2003, or the labour-market reform in Spain in 1997, are

Relatedly, $\tilde{m}$ captures the salience of information. Important revelations or scandals indeed ease reforms by drawing public attention to a topic and making voters aware that reforms can no longer be delayed.[24] This is consistent with the fact that policy-makers often let the situation deteriorate until they (or their successor) are forced to address problems. This strategy may sound electorally risky, but the model suggests that the electoral risk is small for politicians facing misinformed voters. Second, $s(a_H - a_L)$ captures the magnitude of emotional utility concerns, i.e. how dreadful bad news is. To interpret the savoring parameter s, let us consider the following twist of the model: with probability $1 - s$, period 1 utility is "normally" consumed in period 1 (say, after the election), so that there is no savoring utility; with probability s, it is consumed with delay (in period 2), and voters experience savoring in period 1. The expected savoring utility is then unchanged, but with this interpretation, s captures the timing of resolution of uncertainty: savoring concerns are higher on topics for which uncertainty is less likely to resolve early (higher s). As for the difference $a_H - a_L$, it measures the utility loss from being in the bad state, hence the seriousness of the issue. Overall, we should expect $s(a_H - a_L)$ to be high on issues like labour market reforms, pensions, structural adjustment, and climate change, which involve potential large payoff risks, and for which uncertainty is unlikely to resolve in the near future. These issues might accordingly be particularly prone to forgetfulness and inefficient politics, and henceforth, to multiple equilibria.

A higher γ lowers political efficiency. Quite naturally, a larger bias against reform γ_L^B decreases reform activity. For instance, Steves and Teytelboym (2013) shows that a strong carbon-intensive industry has a negative impact on the implementation of climate policies. In particular, the fact that little has been done in the US to tackle climate change can be related to the importance of the US energy lobby.

examples of success, while attempts to reform the labour market in France in 1994 and 2006 suggest that reforming with no mandate and without significant communication effort leads to backlash.

[24] For instance, the German labour market reforms ("Hartz reforms") took place right after a scandal involving data falsification at the Federal Labour Office (BA), which made it clear to the public that the status quo was unsatisfactory and hence called for an ambitious reform. See OECD (2006).

Finally, Propositions 1 and 2 point that a lower q improves efficiency: policy-making is more efficient on topics on which voters are a priori more pessimistic. Many studies indeed point that there are more reforms in times of crisis.[25] Similarly, a shock revealing bad news decreases optimism, and makes political courage worthwhile (notice that, both in the case of a shock or a crisis, the effect on q and $\tilde{m}$ go in the same direction of more awareness).[26] In addition, public opinion is more likely to be overly optimistic on issues for which the cost of the status quo is mostly an opportunity cost. The cost of foregone opportunities is indeed often underestimated (Thaler, 1980; Frey and Eichenberger, 1991). For instance, the costs that a strict employment protection legislation imposes, or the welfare loss caused by firms being unable to enter the market, are mostly hidden and therefore politically invisible (OECD, 2006). Our results suggest that such reforms whose prior benefits are underestimated may be difficult to implement.[27] Finally, our model hints at the importance of "reform ripeness": it takes time for ideas to get accepted and each try paves the way for future reforms by raising awareness. OECD (2006) suggests that "reforms are much more likely to advance where previous reforms have already been undertaken", especially for pensions and labour market reforms.[28] Relatedly, it may be wise to conduct reforms in steps, so that ideas are embedded gradually. For instance, while the OECD has recommended for long that comprehensive labour market reforms be preferred to "piece-meal" reforms, our model suggests that small steps could raise the acceptability of future reforms, both by moderating voter optimism and enhancing the reputation of politicians. Reducing

[25]For instance, OECD (2012) documents that an output gap below 4% increases the probability of a major structural reform by a third, as well as a strong responsiveness to OECD policy recommendations in Portugal, Greece and Ireland following the recent debt crisis.

[26]An interesting related question has to do with political incentives to *ex ante* affect the costs and benefits of repression, notably by playing on m (agenda-setting) or q (pedagogy or disinformation). The question of political propaganda and communication, i.e. how optimistic each type of politician would like voters to be, is a promising one, and we leave it for future research.

[27]Brandt *et al.* (2005) underlines that "a communication strategy aimed at informing the public of the costs of the status quo and of the short- and long-term benefits of reform was particularly important in paving the way for the German and Spanish labour-market reforms."

[28]For instance, the failed attempt to reform pensions in 1995 in France has contributed to more awareness of reform needs and has triggered a public debate, which has undoubtedly nurtured the 2003 reform.

employment protection legislation strictness on temporary contracts could accordingly crowd in reforms of permanent contracts. The complementarity of product market and labour market reforms provides another illustration of the virtues of gradualism: both the theoretical literature and empirical studies indeed provide support to the idea that product market reforms could pave the way for labour market reforms (see Brandt *et al.* (2005) for a discussion on these issues).

4 Illustration: the issue of climate change

The issue of climate change provides a nice illustration of our results. First, the theory predicts that multiplicity of equilibria is likely. Indeed, the welfare consequences of global warming are virtually very large, and uncertainty is not going to resolve in the near future, suggesting a large value of $s(a_H - a_L)$. In the particular case of the United States, the existence of a "denial machine" (Dunlap, 2013), composed of conservative think tanks, front groups established by the fossil fuels industry, contrarian scientists, conservative politicians and media, also facilitates selective exposure to anti-global warming messages, so one may expect a low repression cost.[29] On the data front, opinion polls show important cross-country differences in awareness. In particular, the average level of awareness is low in the US by international standards, and Americans place climate change among the least worrisome of all issues, while it is perceived as one of the major threats in most other parts of the world.[30] Steves and Teytelboym (2013) provides evidence that this lower awareness in the US is accompanied by less active policies to tackle climate change. They construct an index of climate change mitigation policies, where the US ranks only 45th, while European countries occupy the first 15 ranks. More generally, they establish that countries where the public is more aware of global warming implement more effective policies, suggesting multiple

[29]Selective exposure refers to the tendency of people to deliberately or unconsciously look for, select or recall information that bolsters their prejudices, self-esteem or political views.

[30]See http://www.pewglobal.org/2013/06/24/climate-change-and-financial-instability-seen-as-top-global-threats/

equilibria.[31]. They also regress the index on a measure of public awareness on global warming using an instrumental variable specification, and suggest that policies indeed feed back into public awareness, in line with our theory.

Beside these cross-country differences in awareness or concerns, there is also evidence of multiple equilibria within the US, where the question of climate change is a strong opinion polarizer: "Average Americans are now more polarized on the environment than at any other point in time or than on any other topic of political relevance" (Guber, 2013). A recent survey of the Pew Research Center notably documents important differences in beliefs about the very existence of climate change, and the role of human activity in its occurrence.[32] Strikingly, the percentage of Republican (25%), and especially Tea Party (41%), partisans asserting that global warming is "just not happening" suggests that climate change denial may be a significant concern. While this is no per se evidence of belief manipulation, as political orientation could be correlated with other variables, which possibly also affect awareness on climate, e.g. education, McCright and Dunlap (2011) shows that political partisanship has a significant impact on climate change concerns, in particular at the right of the political spectrum, even controlling for such other covariates. Relatedly, Leiserowitz *et al.* (2013) finds that awareness of the "Climategate" controversy reduced belief in global warming and trust in scientists, but mostly among those already ideologically prone to skepticism, in particular conservative voters.[33] This strong polarization of opinion actually reflects the polarization of political parties (Dunlap and McCright, 2008), evidenced by some politicians denying the very existence of global warming.[34]

[31]The fact for a given country to converge to a given equilibrium could be related to idiosyncratic conditions: for instance, Steves and Teytelboym (2013) remarks that people in countries with abundant fossil energy sources tend to think that energy is cheap. In particular, the illusion of cheap energy is widespread in the US.

[32]See http://www.people-press.org/2013/11/01/gop-deeply-divided-over-climate-change/

[33]In November 2009, right before the Copenhagen global climate Summit, emails from leading climate scientists were hacked and disclosed. These emails were instrumented by climate change critics who wanted to expose a scientific conspiracy.

[34]For instance, Rick Santorum: "There is no such thing as global warming", or Ron Paul: 'The greatest hoax I think that has been around for many, many years if not hundreds of years has been this hoax on [...] global warming".

Brulle *et al.* (2012) provides evidence on the impact of political activity on aggregate opinion. They construct a US Climate Change Threat Index using 74 separate surveys between 2002 and 2010, and regress this index on GDP, unemployment, media coverage, pro-climate change statements by Democrats and anti-environmental voting of Republicans. They show that the latter two variables, which reflect political activity, have the highest explanatory power, and constitute a rather accurate predictor of the variations in the index.[35] These variations (an increase in climate change concerns in 2006-07, followed by a sharp drop in 2007-2008) might accordingly be interpreted as changes from an equilibrium to another. Upward changes are associated with more Republican support for climate change mitigation actions (lower polarization). For instance, Republican Congressmen like John McCain or Newt Gingrich made public statements to advocate joint effort with the Democratic party to tackle climate change in 2006-07. One may speculate that Al Gore's documentary "An inconvenient truth" could have triggered such a switch to an equilibrium with more awareness. Conversely, the subsequent drop in the index parallels a reversal to more political polarization, possibly caused by the primary campaign of the Republican party, during which many candidates publicly took very strong anti-climate change stances. Overall, while none of the aforementioned relationships between citizens' awareness/concerns and climate change policies are necessarily causal in nature, and accordingly do not constitute a definitive test of the model, the fact that these variables tend to covary positively is fully consistent with our results. In addition, opinion polls showing that denial could be at play on the issue of climate change provide supportive evidence to our theory, and suggest that such a theory of policy-making, which takes into account voters' incentives to be misinformed, is warranted.

[35] However, media coverage per se has no significant impact, which suggests that the media are just a relay of the political debate.

5 Conclusion

Politicians often must take decisions based on private information that may worry the electorate. Indeed, structural reforms convey news that times are hard and that future prospects are dim. We construct a political agency model in which voters learn information on policy-relevant variables from two sources: an external signal and the political decision itself. As they have a desire to sustain optimistic beliefs, voters may repress worrying news coming from the signal. Because reelection concerns have less disciplining power on politicians facing worse informed voters, this may result in a "soothing politics" equilibrium, where voters are in denial and politicians shy away from reforms. This equilibrium coexists with a "Realpolitik" equilibrium, where voters face up to the reality, thereby giving political support to policy-makers to implement worrisome reforms. The example of climate change, on which we observe both important variations in awareness and policies, as well as signs of denial, shows that the effects uncovered in this paper are relevant and potentially helpful in understanding cross-country differences in political outcomes.

Appendix

Proof of Lemma 1

Since a congruent politician always reforms in state L, $\hat{\pi}_{L,0} = 0$ as long as $x^* < 1$. In an equilibrium in which $x^* = 1$, observing $\sigma = L$ and $X = 0$ is impossible on the equilibrium path, so Bayes' rule cannot apply. In this case, we consider out-of-equilibrium beliefs $\hat{\pi}_{L,0} = 0$.

The marginal incentive to reform for the biased type reads

- $-\gamma_H^B + \delta\hat{\pi}_{\varnothing,1} - \delta\hat{\pi}_{\varnothing,0}$ in state H
- $-\gamma_L^B + \delta\lambda\hat{\pi}_{L,1} + \delta(1-\lambda)\hat{\pi}_{\varnothing,1} - \delta(1-\lambda)\hat{\pi}_{\varnothing,0}$ in state L,

where

- $\hat{\pi}_{L,1} = \frac{\pi}{\pi+(1-\pi)x}$ as long as $\lambda > 0$,
- $\hat{\pi}_{\varnothing 1} = \frac{\pi(1-q)(1-\lambda)}{\pi(1-q)(1-\lambda)+(1-\pi)(qy+(1-q)(1-\lambda)x)}$,
- $\hat{\pi}_{\varnothing 0} = \frac{\pi q}{\pi q+(1-\pi)(q(1-y)+(1-q)(1-\lambda)(1-x))}$.

The difference between the marginal benefit of reform in states H and L equals

$$\gamma_L^B - \gamma_H^B + \delta\lambda[-\hat{\pi}_{L,1} + \hat{\pi}_{\varnothing,1} - \hat{\pi}_{\varnothing,0}].$$

If $\lambda = 0$, we cannot pin down $\hat{\pi}_{L,1}$, but this difference then equals $\gamma_L^B - \gamma_H^B < 0$. Otherwise, since

$$\hat{\pi}_{\varnothing 1} = \frac{\pi(1-q)(1-\lambda)}{\pi(1-q)(1-\lambda) + (1-\pi)(qy + (1-q)(1-\lambda)x)}$$

is decreasing in λ and y, we derive that

$$\hat{\pi}_{\varnothing 1} \leq \frac{\pi}{\pi+(1-\pi)x} = \hat{\pi}_{L,1}.$$

This implies that $\gamma_L^B - \gamma_H^B + \delta\lambda[-\hat{\pi}_{L,1} + \hat{\pi}_{\varnothing,1} - \hat{\pi}_{\varnothing,0}] < 0$, so the equilibrium is monotonic: $y^* \leq x^*$ for all λ. Furthermore, $y^* > 0 \Rightarrow x^* = 1$ and $x^* < 1 \Rightarrow y^* = 0$.

Suppose that $y^* > 0$ for some λ. This implies that $x^* = 1$, so

$$\hat{\pi}_{\varnothing,1} - \hat{\pi}_{\varnothing,0} = \frac{\pi(1-q)(1-\lambda)}{\pi(1-q)(1-\lambda) + (1-\pi)(qy^* + (1-q)(1-\lambda))} - \frac{\pi}{\pi + (1-\pi)(1-y^*)}.$$

This difference is decreasing in y^*, hence is smaller than $\pi - \pi = 0$.

$\gamma_H^B < 0$, therefore $-\gamma_H^B + \delta\hat{\pi}_{\varnothing,1} - \delta\hat{\pi}_{\varnothing,0} < 0$ and, consequently, $y^* > 0$ cannot be optimal. A contradiction. □

Proof of Proposition 1

The proof involves different steps. First, we show that best reply functions are continuous, nondecreasing and convex in the other player's action, and that they are continuous and nonincreasing in q. We then infer the existence of a fixed point of the composition of best response functions, which ensures equilibrium existence. Finally, we derive conditions for uniqueness.

We restrict attention to $\pi \in (0,1)$ and $q \in (0,1)$. The degenerate cases are easy to solve. Let us first carefully examine the best reply functions.

Voters best response functions

The best response of a single voter has to satisfy

$$\lambda^* \in \underset{\lambda \in [0,1]}{\operatorname{argmax}} (1-\lambda) \left[\frac{q(1-\pi)(1-x)}{q + (1-q)(1-\pi)(1-\lambda^*)(1-x)} - m \right]$$

Since the term in brackets in increasing in λ^*, this problem admits a unique solution, which we denote $f(x,q)$. We have:

- $f(x,q) = 1$ if $m > (1-\pi)(1-x)$,
- $f(x,q) = 0$ if $m < \frac{q(1-\pi)(1-x)}{q+(1-q)(1-\pi)(1-x)}$,
- $f(x,q)$ is such that $\frac{q(1-\pi)(1-x)}{q+(1-q)(1-\pi)(1-x)(1-f(x,q))} = m$ otherwise.

Since $\frac{q(1-\pi)(1-x)}{q+(1-q)(1-\pi)(1-\lambda)(1-x)} - m$ is continuously differentiable in each variable on $[0,1]$, increasing in q and decreasing in x, it is clear that f is continuous in x and q on $[0,1]$, nondecreasing in x and nonincreasing in q.

Before we go further, we define a function which will prove useful in the remainder of the analysis: let $\tilde{x}(\lambda,q) = 1 - \frac{mq}{(1-\pi)[q-(1-q)(1-\lambda)m]}$ if this expression is in $[0,1]$, and 0 otherwise. Notice that, when $\tilde{x}(\lambda,q)$ is in $(0,1)$, $\tilde{x}(\lambda,q)$ is akin to the value of x such that a voter's best reply to x given q is λ. One easily checks that $\tilde{x}(\lambda,q)$ is continuous and nondecreasing in both arguments.

One then rewrites f as:

- $f(x,q) = 1$ if $x \geq \tilde{x}(1,q)$
- $f(x,q) = \tilde{f}(x) \equiv 1 - \frac{q[(1-\pi)(1-x)-m]}{(1-q)(1-\pi)(1-x)m} \in (0,1)$ if $x \in [\tilde{x}(0,q), \tilde{x}(1,q))$,
- $f(x,q) = 0$ if $x < \tilde{x}(0,q)$.

It is easy to see that $\tilde{f}(x,q)$ is increasing and strictly convex in x. Overall, f is continuous, nondecreasing and convex in x, continuous and nonincreasing in q.

The policy-maker's best response function

The best response of the policy-maker has to satisfy

$$x^* \in \underset{x\in[0,1]}{\text{argmax}}\ x\left[-\gamma + \frac{\pi}{\pi + (1-\pi)x^*} - (1-\lambda)\frac{\pi q}{q + (1-q)(1-\pi)(1-\lambda)(1-x^*)}\right]$$

Since the term in brackets is decreasing in x^*, this problem admits a unique solution, which we denote $g(\lambda, q)$. We have:

- $g(\lambda, q) = 1$ if $\gamma < \lambda\pi$,
- $g(\lambda, q) = 0$ if $\gamma > 1 - (1-\lambda)\frac{\pi q}{q+(1-q)(1-\pi)(1-\lambda)}$,
- $g(\lambda, q) = \tilde{g}(\lambda, q)$ such that $-\gamma + \frac{\pi}{\pi+(1-\pi)\tilde{g}(\lambda,q)} - (1-\lambda)\frac{\pi q}{q+(1-q)(1-\pi)(1-\lambda)(1-\tilde{g}(\lambda,q))} = 0$ otherwise.

Furthermore, since the term in brackets is continuously differentiable in each variable on $[0,1]$, increasing in λ and decreasing in q, it is clear that g is continuous in λ and q on $[0,1]$, nondecreasing in λ and nonincreasing in q.

Let us now define $\underline{\lambda}(q)$ such that $\underline{\lambda}(q) = 1 - \frac{(1-\gamma)q}{\pi q-(1-q)(1-\pi)(1-\gamma)}$ if this term is in $[0,1)$, and 0 otherwise. If $g(0,q) = 0$, $\underline{\lambda}(q)$ is the largest value of λ such that $g(\lambda, q) = 0$. If $g(0,q) = 0$, then $\underline{\lambda}(q) = 0$. It is easy to check that $\underline{\lambda}(q)$ is continuous and nondecreasing in q.

Overall, one rewrites:

- $g(\lambda, q) = 1$ if $\lambda > \min(\frac{\gamma}{\pi}, 1)$,
- $g(\lambda, q) = \tilde{g}(\lambda, q) \in (0,1)$ if $\lambda \in \left[\underline{\lambda}(q), \min(\frac{\gamma}{\pi}, 1)\right]$,
- $g(\lambda, q) = 0$ if $\lambda < \underline{\lambda}(q)$.

Using the implicit function theorem, we have for $\lambda \in \left(\underline{\lambda}(q), \min(\frac{\gamma}{\pi}, 1)\right)$:

$$\frac{\partial \tilde{g}}{\partial \lambda}(\lambda, q) = \frac{q^2}{q(1-q)(1-\pi)(1-\lambda)^2 + (1-\pi)\left[\frac{q+(1-q)(1-\pi)(1-\lambda)(1-\tilde{g}(\lambda,q))}{\pi+(1-\pi)\tilde{g}(\lambda,q)}\right]^2} > 0$$

This partial derivative is itself increasing in λ, once one recalls that $\frac{\partial \tilde{g}}{\partial \lambda}(\lambda, q) > 0$. So $\tilde{g}$ is strictly convex in λ on $\left(\underline{\lambda}(q), \min(\frac{\gamma}{\pi}, 1)\right)$. Overall, g is continuous, nondecreasing and convex in λ, continuous and nonincreasing in q.

Fixed point

Let us define $h(x,q) \equiv g\left[f(x,q),q\right]$. We are now looking for a fixed point x of the function h such that $h(x,q) = g\left[f(x,q),q\right] = x$.

From the previous analysis, we derive that h is continuous and nondecreasing in x. h is defined for $x \in [0,1]$ and takes values on $[0,1]$. Therefore, there exists $x \in [0,1]$ such that $h\left[x,q\right] = x$ for any q. This ensures the existence of an equilibrium.

Let $x_1(q) \equiv \tilde{x}\left(\min\left(1, \frac{\gamma}{\pi}\right), q\right)$, and $x_0(q) \equiv \tilde{x}(\underline{\lambda}(q), q)$.

h is defined in the following way:

- $h(x,q) = g(1,q)$ if $x \geq x_1(q)$,
- $h(x,q) = \tilde{h}[x,q] \equiv \tilde{g}[\tilde{f}(x,q),q] \in (0,1)$ if $x \in [x_0(q), x_1(q))$,
- $h(x,q) = g(0,q)$ if $x < x_0(q)$.

Since $\tilde{f}$ is increasing and strictly convex on $[\tilde{x}(0,q), \tilde{x}(1,q))$ and $\tilde{g}$ is increasing and strictly convex on $\left[\underline{\lambda}(q), \min(\frac{\gamma}{\pi}, 1)\right]$, we derive that h is also increasing and strictly convex on $(x_0(q), x_1(q))$.

The value of x such that x is a fixed point of h could possibly lie in each of the three parts of h :

- On $[x_1(q), 1]$, if $h\left[x_1(q),q\right] = g(1,q) \geq x_1(q)$,
- On $[x_0(q), x_1(q)]$, if there exists $x \in [x_0(q), x_1(q)]$ such that $\tilde{g}\left[\tilde{f}(x,q),q\right] = x$,
- On $[0, x_0(q)]$, if $h\left[x_0(q),q\right] = g(0,q) \leq x_0(q)$.

The equilibrium involves perfect recall ($\lambda^* = 1$) in the first case, complete repression ($\lambda^* = 0$) in the last case, and some repression ($0 < \lambda^* < 1$) in the intermediate case.

Existence of a perfect recall equilibrium

The first question we raise is whether there is a perfect recall equilibrium involving $\lambda^* = 1$. This is the case when $g(1,q) \geq x_1(q)$.

Let us consider the different possibilities:

- If $g(1,q) = 1 \Leftrightarrow \pi > \gamma$, this is always the case because $x_1(q) < 1$,

- If $g(1,q) < 1 \Leftrightarrow \pi \leq \gamma$, then $x_1(q) = \tilde{x}(1,q) = \max\left(1 - \frac{m}{1-\pi}, 0\right)$.

  There are then two sub-cases:

  a. $1 - \frac{m}{1-\pi} \leq 0 \Leftrightarrow \pi \geq 1 - m$: this is always the case

  b. $1 - \frac{m}{1-\pi} > 0 \Leftrightarrow \pi < 1 - m$:
  one easily shows that $0 < g(1,q) < 1$, so $g(1,q) = \tilde{g}(1,q) = \frac{\pi(1-\gamma)}{\gamma(1-\pi)}$ for all q. We derive that $g(1,q) - \tilde{x}(1,q) = \frac{\pi(1-\gamma)}{\gamma(1-\pi)} - 1 + \frac{m}{1-\pi}$. This expression is increasing in π, negative at $\pi = 0$ and positive at $\pi = \gamma$. It cancels out for $\pi = \gamma(1-m)$. Therefore, $g(1,q) \geq x_1(q) \Leftrightarrow \pi \geq \gamma(1-m)$.

Since $\gamma(1-m) < 1-m$, and $\gamma(1-m) < \gamma$, we thus have established the first part of the Proposition: there is an equilibrium with $\lambda^* = 1$, and $x^* = g(1,q) = \min\left(\frac{\pi}{1-\pi}\frac{1-\gamma}{\gamma}, 1\right)$ if and only if $\pi \geq \gamma(1-m)$.

The case $\pi \geq \gamma(1-m)$: multiplicity of equilibria

This equilibrium need not be unique. The first thing to notice is that, if another equilibrium exists, then there must generically be three equilibria in total. Let us prove this.

The existence of a perfect recall equilibrium implies that $h[x_1(q), q] \geq x_1(q)$: h is above the 45 degree line at $x = x_1(q)$.

Suppose first that there exists an equilibrium in which $\lambda^* = 0$. This happens when $h[x_0(q), q] \leq x_0(q)$, which means that h is below the 45 degree line at $x = x_0(q)$. h is continuous so there must be a third point where h crosses the 45 degree line. Furthermore, since h crosses the 45-degree line from below, the slope of h at the intersection must be strictly above 1. Because h is strictly convex on $(x_0(q), x_1(q))$, the slope of $\tilde{h}$ is strictly larger than 1 after this intersection point, so h cannot cross the 45-degree line again in this interval.

Suppose instead that there is no equilibrium in which $\lambda^* = 0$. This implies that $h[x_0(q), q] > x_0(q)$, which means that h is above the 45 degree line at $x = x_0(q)$. If h ever crosses the 45-degree line on $(x_0(q), x_1(q))$, strict convexity implies that it must be exactly twice: at the first intersection point, h has a slope smaller than 1, while it has a slope larger than 1 at the second intersection point. Notice that is possible to have a situation where h is tangent at the 45 degree line, in which case there are

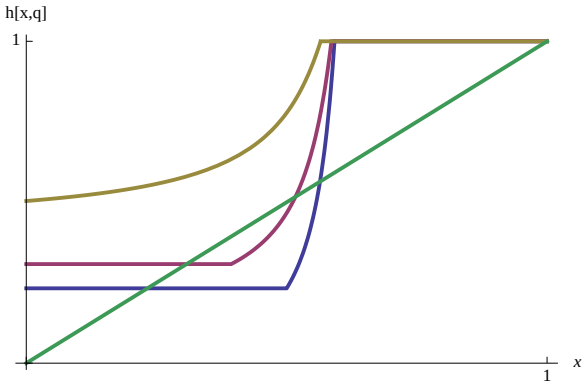

Figure 3: The case $\pi \geq \gamma$

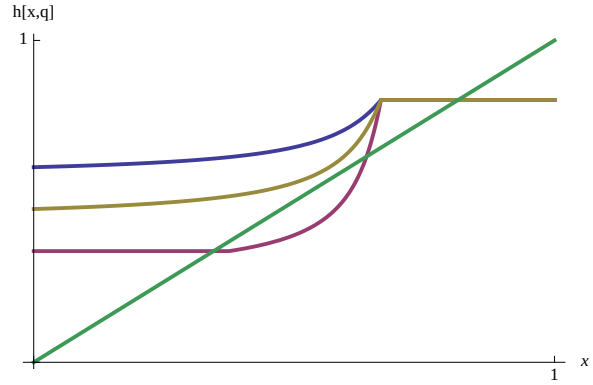

Figure 4: The case $\gamma(1-m) \leq \pi < \gamma$

only two equilibria in total. This happens only for a single value of q, so this case is non-generic.

The case $\pi \geq \gamma(1-m)$: conditions for uniqueness

We are now going to establish conditions for the perfect recall equilibrium to be unique.

If $h[x,q] = x$ has a unique solution $\lambda^* = 1$ for some q, then, for all $q' < q$, there is also a unique equilibrium involving perfect recall. Existence is due to the fact that the condition to obtain a perfect recall equilibrium is independent of q, so if such an equilibrium exists for some q, then it also exists for all q. Conditional on the existence of a perfect recall equilibrium, it is easy to see that a necessary and sufficient condition for this equilibrium to be unique is $h[x,q] > x$ for all $x < x_1(q)$. Since $h[x,q'] \geq h[x,q]$ and $x_1(q') \leq x_1(q)$ when $q' < q$, we derive that $h[x,q] > x$ for all $x < x_1(q)$ implies that $h[x,q'] > x$ for all $x < x_1(q')$. Therefore, the equilibrium is also unique for all $q' < q$.

Graphically, Figures 3 and 4 display the function h for different values of q. When q decreases, the function h moves to the northwest of the positive orthant. So if $h[x,q]$ is always strictly above the 45 degree line for $x < x_1(q)$, then $h[x,q']$ is also a fortiori above the 45 degree line for $x < x_1(q')$.

If $q \to 0$, the equilibrium must be unique because we always have $\lambda^* = 1$. Let us now examine whether the equilibrium is unique when $q \to 1$. If this is the case, then it is a fortiori the case for all q, as we have just seen. Otherwise, there exists a $\overline{q} < 1$ such that the perfect recall equilibrium is unique if $q < \overline{q}$.

We have $\lim_{q\to 1} f(x,q) = 1$ if $x > \frac{1-\pi-m}{1-\pi}$, and $\lim_{q\to 1} f(x,q) = 0$ if $x < \frac{1-\pi-m}{1-\pi}$. Since we are in the case where $\pi \geq \gamma(1-m)$, there exists an equilibrium in which $\lambda^* = 1$. So a necessary condition for this equilibrium to be unique is $\lim_{q\to 1} g(0,q) > 1 - \frac{m}{1-\pi}$.

- If $\pi > 1-m$, then $1 - \frac{m}{1-\pi} < 0$ and the equilibrium is always unique,
- If $\pi \leq 1-m$, the condition to have $g(0,q) > 1 - \frac{m}{1-\pi}$ for some $q < 1$ is $-\gamma + \frac{\pi}{1-m} - \frac{\pi q}{q+(1-q)m} > 0$. When q goes to 1, this condition reads $-\gamma(1-m) + \pi m > 0 \Leftrightarrow \pi > \frac{\gamma(1-m)}{m}$. A necessary for this condition to be consistent with $\pi \leq 1-m$ is $\gamma < m$.

We can now conclude that the equilibrium is perfect recall equilibrium is unique when q goes to 1 if and only if $\pi > \min\left(1-m, \frac{\gamma(1-m)}{m}\right)$. In the case where the perfect equilibrium is not unique when q goes to 1, there exists a value $\overline{q} < 1$ such that the perfect recall equilibrium is unique if and only if $q < \overline{q}$.

The case $\pi < \gamma(1-m)$

Let us now consider the case where $\pi < \gamma(1-m)$. This implies that there is no equilibrium with $\lambda^* = 1$. The function h is below the 45 degree line at $x = x_1(q)$. There are two cases (see Figure 5 for a graphical illustration):

- $h[x_0(q), q] \leq x_0(q)$, so an equilibrium exists where $\lambda^* = 0$. Since the two points $(x_0(q), h[x_0(q), q])$ and $(x_1(q), h[x_1(q), q])$ are then both strictly below the 45 degree line, h must be strictly below the 45 degree line on $[x_0(q), x_1(q)]$ by convexity, so there is no other fixed point.
- $h[x_0(q), q] > x_0(q)$, so no equilibrium exists where $\lambda^* = 0$. In this case, because of strict convexity, $\tilde{h}$ can cross the 45 degree line only once, so there is a unique fixed point $x^* \in (x_0(q), x_1(q))$.

Proof of Proposition 2

Let us first prove that $\pi + (1-\pi)x^*$ is nondecreasing in π. The derivative of this function reads $1 - x^* + \frac{\partial x^*}{\partial \pi}$.

We distinguish different cases:

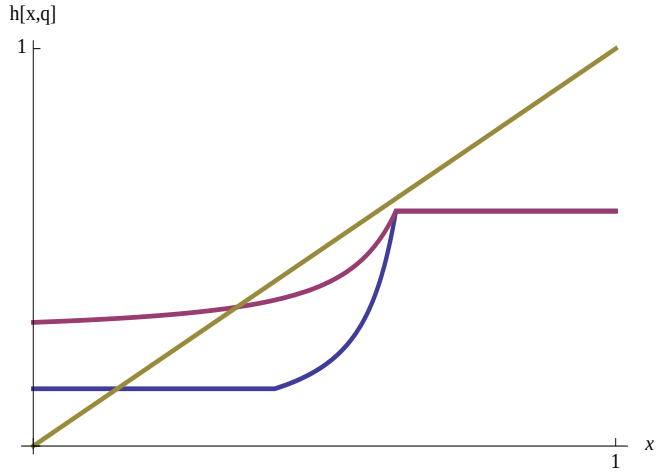

Figure 5: The case $\pi < \gamma(1-m)$

a) $x^* = 1$ or $x^* = 0$,

b) $\lambda^* = 1$ and $x^* < 1$,

c) $\lambda^* = 0$ and $0 < x^* < 1$,

d) $0 < \lambda^* < 1$ and $0 < x^* < 1$.

In case (a), $1 - x^* + \frac{\partial x^*}{\partial \pi} = 1 - x^* \geq 0$; in case (b), $x^* = \frac{\pi}{1-\pi}\frac{1-\gamma}{\gamma}$, so $1 - x^* + \frac{\partial x^*}{\partial \pi} > 0$; in case (c), we have

$$-\gamma + \frac{\pi}{\pi + (1-\pi)x^*} - \frac{\pi q}{q + (1-q)(1-\pi)(1-x^*)} = 0 \tag{4}$$

The implicit function theorem allows to infer from (4) that

$$\frac{\partial x^*}{\partial \pi} = \frac{x^*[q + (1-q)(1-\pi)(1-x^*)]^2 - q[q + (1-q)(1-x^*)][\pi + (1-\pi)x^*]^2}{\pi(1-\pi)[q + (1-q)(1-\pi)(1-x^*)]^2 + q(1-q)\pi(1-\pi)[\pi + (1-\pi)x^*]^2},$$

which implies that $1 - x^* + (1-\pi)\frac{\partial x^*}{\partial \pi}$ has the sign of

$$q + (1-q)(1-\pi)(1-x^*) - q[\pi + (1-\pi)x^*]$$

$$= (1-\pi)(1-x^*) > 0.$$

Finally, in case (d), we derive from $\lambda^* \in (0,1)$ that $1 - \lambda^* = q\frac{(1-x^*)(1-\pi)-m}{(1-q)(1-\pi)(1-x^*)m}$. $x^* \in (0,1)$ then implies that

$$-\gamma + \frac{\pi}{\pi + (1-\pi)x^*} - \frac{\pi q[(1-\pi)(1-x^*) - m]}{(1-q)(1-\pi)^2(1-x^*)^2} = 0 \tag{5}$$

The implicit function theorem allows to infer from (5) that

$$\frac{\partial x^*}{\partial \pi} = \frac{x^*(1-q)(1-\pi)^3(1-x^*)^3 - q(1-x^*)[(1-\pi)(1-x^*) - m(1+\pi)][\pi + (1-\pi)x^*]^2}{\pi(1-\pi)^4(1-x^*)^3(1-q) + \pi(1-\pi)q[(1-\pi)(1-x^*) - 2m][\pi + (1-\pi)x^*]^2},$$

which implies that $1 - x^* + (1-\pi)\frac{\partial x^*}{\partial \pi}$ has the sign of

$$(1-q)(1-\pi)^2(1-x^*)^2 - q[\pi + (1-\pi)x^*][(1-\pi)(1-x^*) - m]$$

$$= (1-q)(1-\pi)^2(1-x^*)^2[\pi + (1-\pi)x^*]\frac{\gamma}{\pi} > 0,$$

using (5).

We have therefore proven that, in all cases, $\pi + (1-\pi)x^*$ is nondecreasing in π.

Let us now turn to the comparative statics of x^* in the least efficient equilibrium. Let us denote $x^a \leq x^b \leq x^c$ the three possible equilibrium values of x^*; if the equilibrium is unique, we have $x_a = x_b = x_c$. We examine the impact of a change in m, γ or q on x^a.

By definition, we have $h[x^a, q] = x^a$. In addition, in the least efficient equilibrium, we always have $\frac{\partial h}{\partial x}(x^a, q) < 1$ (this derivative is 0 if x^a is in a flat part of h, it is positive but strictly below 1 if x^a is on the part where h is strictly convex. Notice that we disregard for now the case where this derivative equals 1, which corresponds the case where $x_a = x_b < x_c$, i.e. the limit case of two equilibria, which we treat later). Differentiating the first equality with respect to $i \in \{m, \gamma, q\}$ gives

$$\frac{\partial h}{\partial x}(x^a, q)\frac{\partial x^a}{\partial i} + \frac{\partial h}{\partial i}(x^a, q) = \frac{\partial x^a}{\partial i},$$

which implies

$$\frac{\partial x^a}{\partial i} = \frac{\frac{\partial h}{\partial i}(x^a, q)}{1 - \frac{\partial h}{\partial x}(x^a, q)}.$$

The righthand side has the sign of the numerator $\frac{\partial h}{\partial i}(x^a, q)$. Since h is nondecreasing in m and nonincreasing in q and γ, we derive the result.[36]

[36]Notice that, whenever there are three equilibria, i.e. $x^a < x^b < x^c$, the comparative statics

Finally, let us examine the comparative statics of $\overline{q}$ with respect to γ and m. At $q = \overline{q}$, we have $x^a = x_b < x_c$, and x^a is in the part where $h = \tilde{h}$. We have $\tilde{h}[x^a, \overline{q}] = x^a$ and $\frac{\partial \tilde{h}}{\partial x}(x^a, \overline{q}) = 1$. $\overline{q}$ is indeed characterized by a tangency condition: at the fixed point $x^a = x^b$, the curve $\tilde{h}$ must be tangent to the 45 degree line.

Differentiating the first equality with respect to $i \in \{m, \gamma\}$ gives

$$\frac{\partial \tilde{h}}{\partial x}(x^a(\overline{q}), \overline{q}) \left[\frac{\partial x^a}{\partial q}(\overline{q}) \frac{\partial \overline{q}}{\partial i} + \frac{\partial x^a}{\partial i} \right] + \frac{\partial \tilde{h}}{\partial q}(x^a(\overline{q}), \overline{q}) \frac{\partial \overline{q}}{\partial i} + \frac{\partial \tilde{h}}{\partial i}(x^a(\overline{q}), \overline{q}) = \frac{\partial x^a}{\partial q}(\overline{q}) \frac{\partial \overline{q}}{\partial i} + \frac{\partial x^a}{\partial i}$$

Using $\frac{\partial \tilde{h}}{\partial x}(x^a(\overline{q}), \overline{q}) = 1$, we derive

$$\frac{\partial \overline{q}}{\partial i} = -\frac{\frac{\partial \tilde{h}}{\partial i}(x^a, \overline{q})}{\frac{\partial \tilde{h}}{\partial q}(x^a, \overline{q})}$$

The denominator is negative, so $\frac{\partial \overline{q}}{\partial i}$ has the sign of $\frac{\partial \tilde{h}}{\partial i}(x^a(\overline{q}), \overline{q})$.

$\tilde{h}$ is nondecreasing in m and nonincreasing in γ. This implies that the equilibrium is more likely to be unique, i.e. $\overline{q}$ increases, when m increases and γ decreases. □

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with respect to x^b is reversed. Relatedly, $\frac{\partial x^a}{\partial i}$ is not defined when $x_a = x_b < x_c$, as we then have $\frac{\partial h}{\partial x}(x^a, q) = 1$.

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