

Loss Aversion in Politics*

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Abstract

We study how loss aversion affects the political equilibrium in a simple majority voting model. First, we show a status quo bias, which leads to path dependence. Second, loss aversion implies a moderating effect on the most extreme voters. Third, in a dynamic setting, the effect of loss aversion diminishes with the length of the planning horizon of voters; however, in the presence of a projection bias, majorities are partially unable to understand how fast they will adapt to a new policy. This makes changes less likely and induces time inconsistency: policy changes are timid at the beginning, while in later periods they are made progressively more radical. Fourth, in a stochastic environment, loss aversion yields a significant distaste for risk, but also a smaller attachment to the status quo. The application of these results to a model of redistribution leads to empirically plausible implications.

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1 Introduction

According to Kahnemann and Tversky, (1979) individuals “normally perceive outcomes as gains and losses, rather than as final states of wealth or welfare” (p. 274). Gains and losses are relative to a reference point, that is the current position, or the *status quo*, and “losses loom larger than gains” (p. 279). The importance of loss aversion in individual decision making is largely corroborated by experimental evidence, and it has extensively entered theoretical individual choice models.¹ However, loss aversion has not been widely investigated in the context of social choice models.²

In the present paper we show that introducing loss aversion in politics leads to significant deviations from “standard” voting results, which may also help explain some empirical puzzles when applied to choices regarding redistributive policies. We present a model of unidimensional political choice where the voters differ in their evaluation of the relative costs and benefits of different levels of such policy. In a standard majority rule model with no loss aversion, the policy chosen would be the one preferred by the median voter, and the status quo is irrelevant. With loss aversion instead, the status quo matters. For any initial policy level, a positive mass of voters would vote for the status quo, even if their rationally preferred policy differed from it. The intuition is simple: changing policy implies losses and benefits, but the former loom larger. This generates a sort of *political endowment effect*: once the policy set up by the majority has become the new status quo, an even larger majority of voters does not want to change it.

We then show that loss aversion determines a *moderating effect*: the most extreme types prefer less extreme policies. The median voter wants to change the status quo only if a sufficiently large shock in the environment occurs. Moreover, if the status quo changes, the voting outcome is still affected by the initial status quo: in a multi-period setting, the voters account for the dynamic effect of their loss aversion in future periods, where a *period* is defined precisely as the length of time in which the status quo becomes the new reference point. In this setting, individuals put less weight on their current experience of loss, so that they are more prone to change the current status quo. Since this is more likely to happen among voters of a younger generation, our approach sheds a novel light on the intergenerational conflict about policy reforms. If voters are also subject to a projection bias (Loewenstein et al., 2003), they are partially unable to understand how fast they will adapt to a new policy; only later they realize that they became accustomed

¹See Barberis (2013), Della Vigna (2009) and Rabin (1998) for a discussion of loss aversion, and extensive references to the empirical literature.

²“There are areas of economics where prospect theory has not been applied very extensively, even though it has the potential to offer useful insights. Public finance, health economics, and macroeconomics are three such fields.” (Barberis, 2013, p. 190).

to the new equilibrium faster than they thought, and that adaptation was also less painful than previously expected. We show that, in the presence of a projection bias, changes in any period are less radical than without it. However, thanks to the same mechanism of fast adaptation, voters are willing to make further changes in subsequent periods.

We then introduce uncertainty about policy outcomes, and we illustrate the difference in the social choice of voters who are simply risk averse and those who are also loss averse. Loss averse voters are more likely to reject a risky reform, especially when risk is modest. However, in a risky environment loss averse voters are less subject to the status quo bias, compared to a risk-free environment. Hence, the propensity of a majority to make radical reforms increases with the level uncertainty, especially if risk is not anticipated.

Finally, we apply the model to a specific policy problem: the choice of a tax rate to provide a public good (in the text) or to finance a lump sum redistribution (in Appendix), in a Meltzer and Richard (1981) model. The general results regarding the voting outcomes apply to this model as well, and may help explain some empirical observations. First of all, the status quo bias discussed above implies that even a relatively large departure from the initial income distribution (and thus distribution of preferences for tax rates and public goods) leads to no changes in policy. Secondly, and related to that, even relatively high level of inequality may not lead to “expropriatory” levels of the tax rates, which is a relatively unrealistic feature of the basic Meltzer and Richard model.³ Third, we show results concerning the time horizon of voters: loss aversion weighs more in the decisions of individuals with a shorter horizon, say with a shorter life span (assuming imperfect intergenerational altruism). This implies that societies which are growing older tend to have a stronger status quo bias, namely more resistance to changes in policy, a result which seems realistic enough. Charité et al. (2014) explore how reference points and loss aversion shape individuals’ preferences for redistribution. In a laboratory experiment they find that agents who are assigned the role of social planners redistribute much less from rich to poor when recipients are unaware of their initial endowments. The authors claim that redistributors take into account that the loss experienced by the rich is larger than the benefit enjoyed by the poor.

Other models predict a status quo bias, but for very different reasons. Fernandez and Rodrik (1991) show that when an individual cannot identify herself as winner or loser beforehand, even a reform that benefits a majority gets voted down, because pivotal individuals attach low probability to the event of being among the winners. Uncertainty plays a crucial role in their model. By contrast, with loss aversion

³The relationship between inequality and redistribution has generated much empirical research (see Acemoglu et al. (2013) for a comprehensive survey). Several works report a negative relationship (e.g., Persson and Tabellini, 2003; Borge and Rattso, 2004). Other works point in the opposite direction (e.g., Perotti, 1996; Gil et al., 2004; Scheve and Stasavage, 2012).

the status quo bias does not hinge on uncertainty.⁴ In Alesina and Drazen (1990) an inefficient status quo may survive for a while, because of a war of attrition between conflicting groups which blocks policy reform. In Krehbiel (1998) and in the extensive subsequent literature on pivotal voting, the status quo bias may occur because the majority’s ability to act is tempered by the executive veto and filibuster procedures, which operate in practice as a super-majority threshold. Differently from us, this model predicts that the status quo is an equilibrium only when it is a moderate policy.⁵

In our dynamic model, a voter chooses the policy today taking into account that it will represent the status quo policy tomorrow (i.e., tomorrow’s reference point). Voters are then able to dampen, at least partially, the adverse consequences of loss aversion. This policy behavior is reminiscent of an optimal commitment strategy when individuals suffer self-control problems (e.g., Laibson, 1997; Amador et al., 2006). The idea that voters predict that in the future they will “acclimate” to the policy chosen today ties our model to the literature on endogenous reference points (Kőszegi and Rabin, 2006 and 2007; Loomes and Sugden, 1982; Sugden, 2003). Specifically, Kőszegi and Rabin’s idea of *choice acclimating personal equilibrium* is similar to our idea that the psychological cost of changing the policy today is borne only today, and not tomorrow. Differently from us, that literature focuses on stochastic environments; we rather point at multiperiod choices and intergenerational conflict, which constitutes a realistic political environment. In an intertemporal choice setting with loss averse individuals, Kőszegi and Rabin (2009) show that if an agent cares much more about contemporaneous rather than prospective gain-loss utility, then the ex ante optimal plan may not be time consistent. In our model, time inconsistency eventually derives from a projection bias.

A rich theoretical literature considers the relationship between inequality and redistribution, based upon the Meltzer and Richard (1981) model. Alesina and Rodrik (1994) and Persson and Tabellini (1994) study dynamic redistribution and growth in a median voter setup. Sinn (1996) focuses on the causality which runs from inequality to redistribution (or the other way around). Acemoglu and Robinson (2006) point at the distinction between *de jure* and *de facto* distributions of power, which makes the relationship between democracy and policy outcomes much more complex. Bénabou and Ok (2001) suggest that the reason why we do not observe large-scale expropriation in modern democracies is the *Prospect for Upward Mobility* (POUM) hypothesis. Höchtel et al. (2012) and Galasso (2003) claim that voters may have concerns about fairness, possibly because they avert inequality (see also Alesina

⁴Moreover, Fernandez and Rodrik’s bias distorts a 0-1 decision, “keep the status quo or take the reform”. In our model with continuous policy variable, a certain amount of bias occurs even if the majority opts for a new policy. In other words, although the majority decides to make a reform that changes the status quo, the latter keeps distorting the reform.

⁵See Krehbiel (2008) for extensive references to other similar models.

and Giuliano, 2011, and Alesina et al., 2012). All these works provide a different and non mutually exclusive explanation for why even a relatively poor median voter would not expropriate the rich in a Meltzer and Richard model. We point at the role of loss aversion, which is a psychological distortion. Thus our explanation and theirs are totally different.

Relatively small literature has studied how loss aversion may affect policy outcomes, but in much more specific environments than ours. Grillo (2011) studies a political setting where the government is an agent who sends information to its principals (the voters). Under loss aversion, full information transmission is achieved. Freund and Ozden (2008) and Tovar (2009) consider trade policy: they argue that legislators may be more responsive to protectionist interests if individuals exhibit loss aversion. Rees-Jones (2013) studies how loss aversion affects tax sheltering. Bernasconi and Zanardi (2004) analyze tax evasion by loss averse taxpayers. Milkman et al. (2009) present laboratory evidence that policy bundling reduces the harmful consequences of loss aversion.

Finally, this paper contributes to the recent but growing literature on behavioral political economy. Bendor et al. (2011) present political models with boundedly rational voters. Glaeser (2006) informally points out that the presence of bounded rationality makes the case for limiting the size of government. Krusell et al. (2010) examine government policies for agents who are affected by self-control problems. Lizzeri and Yariv (2012) study majority voting when voters are heterogeneous in their degree of self-control. Bisin et al. (2011) present a model of fiscal irresponsibility and public debt. Passarelli and Tabellini (2013) study how emotional unrest affects policy outcomes.

The outline of the paper is as follows: section 2 lays out the basic model; section 3 introduces loss aversion and derives various results in a static setting; section 4 generalizes the model to a multiperiod setting; section 5 introduces uncertainty about policy outcomes and investigates the relationship between loss aversion and risk aversion; section 6 presents a specific example of how loss aversion shapes individual preferences for public good provision and income taxation; the last section concludes. The Appendix contains proofs for all propositions, as well as an extension of section 6.

2 A Simple Model of Social Choice

Consider a society with a continuum of individuals/voters, heterogeneous in some parameter (t), which we call *type*. Let $F(t)$ be the distribution of t , which is common knowledge. Heterogeneity may arise because of any aspect which affects individual preferences (e.g., income, wealth, ideology, productivity, etc). This society has to choose a unidimensional policy $p \in \mathbb{R}^+$. Any policy entails benefits and costs, which

can be different across individuals. Let $V(t_i, p)$ be the indirect utility function of individual i :

$$V(t_i, p) = B(t_i, p) - C(t_i, p)$$

where $B(t_i, p)$ and $C(t_i, p)$ are indirect benefit and cost functions for individual i , respectively. In order to ensure the existence of a unique majority voting equilibrium, we also assume that, for any p and any t_i :

A1. Benefits are increasing and concave in the policy: $\frac{\partial B(t_i, p)}{\partial p} > 0$, $\frac{\partial^2 B(t_i, p)}{\partial p^2} < 0$;

A2. Costs are increasing and convex in the policy: $\frac{\partial C(t_i, p)}{\partial p} > 0$, $\frac{\partial^2 C(t_i, p)}{\partial p^2} \geq 0$;

A3. Types are indexed such that higher types bear higher marginal costs and/or enjoy lower marginal benefits from the policy: $\frac{\partial B_p(t_i, p)}{\partial t_i} \leq 0$, $\frac{\partial C_p(t_i, p)}{\partial t_i} \geq 0$;

A4. The equilibrium is interior: $\frac{\partial B(t_i, 0)}{\partial p} > \frac{\partial C(t_i, 0)}{\partial p}$.

Thus, for all types, $V(t_i, p)$ is concave in p and, for any t_i , there is a unique policy which maximizes indirect utility $V(t_i, p)$, call it p_i , which solves:⁶

$$B_p(t_i, p) = C_p(t_i, p)$$

By A3, we have that:

$$\frac{\partial p_i}{\partial t_i} \leq 0 \tag{1}$$

This implies that higher types vote for lower policies.⁷ Then, under majority rule, the policy outcome is the median type's bliss point (p_m). Needless to say, this is not necessarily the choice of a social planner. The latter would maximize the sum of individuals' utilities:

$$\int [B(t, p) - C(t, p)] dF(t) \tag{2}$$

Then the first best (p^*) solves the following equation:

$$\bar{B}_p(p) = \bar{C}_p(p) \tag{3}$$

The social planner sets the policy in order to equalize average marginal benefits, $\bar{B}_p(p)$, and average marginal costs, $\bar{C}_p(p)$.

⁶By A1 and A2 the SOC is satisfied.

⁷We use this convention of higher types preferring lower policies because it will immediately link to our application to a voting model on tax rate, and income will be the identifier of types (cf. section 6).

3 Social Choice with Loss Aversion

With loss aversion, losses loom larger than gains, and both are evaluated relative to the status quo. Let $\lambda > 0$ be the parameter which captures loss aversion, and let p^S be the status quo policy. *Increasing* the policy (i.e., $p > p^S$) entails more benefits and larger costs (like paying more taxes for more public good). However, higher costs yield a psychological experience of loss, which amounts to $\lambda [C(t_i, p) - C(t_i, p^S)]$. Vice versa, *reducing* the policy (i.e., $p < p^S$) entails a gain as lower costs (e.g., less taxes), but also a loss in terms of lower benefits (less public good). The psychological component of the loss of benefits is $\lambda [B(t_i, p^S) - B(t_i, p)]$. Thus, experienced indirect utility with loss aversion, call it $V(t_i, p | p^S)$, is given by the material utility of the policy, $V(t_i, p)$, minus the psychological loss due to possible departures from the status quo:⁸

$$V(t_i, p | p^S) = \begin{cases} V(t_i, p) - \lambda [C(t_i, p) - C(t_i, p^S)] & \text{if } p \geq p^S \\ V(t_i, p) - \lambda [B(t_i, p^S) - B(t_i, p)] & \text{if } p < p^S \end{cases}$$

The optimality condition (w.r.t. p) is then:

$$\begin{aligned} B_p(t_i, p) - (1 + \lambda)C_p(t_i, p) &\geq 0 & \text{if } p \geq p^S \\ (1 + \lambda)B_p(t_i, p) - C_p(t_i, p) &\leq 0 & \text{if } p < p^S \end{aligned}$$

It is easy to see that voter i sets her desired policy, p_i , according to the following rule:

$$p_i \text{ solves } \begin{cases} 0 = B_p(t_i, p) - (1 + \lambda)C_p(t_i, p) & \text{if } t_i < \check{t} & (4a) \\ p = p^S & \text{if } \check{t} \leq t_i \leq \hat{t} & (4b) \\ 0 = (1 + \lambda)B_p(t_i, p) - C_p(t_i, p) & \text{if } t_i > \hat{t} & (4c) \end{cases}$$

where \check{t} is implicitly determined by $B_p(t, p^S) - (1 + \lambda)C_p(t, p^S) = 0$, and \hat{t} is implicitly determined by $(1 + \lambda)B_p(t, p^S) - C_p(t, p^S) = 0$. Observe that $\check{t} < \hat{t}$, and both \hat{t} and \check{t} depend on the status quo policy. This is an important point, and further on we will come back to it.

3.1 Status quo bias

By (4), an individual's most preferred policy depends not only on her type, but also on the current level of the policy, the status quo. Specifically, the population is split

⁸This formulation is consistent with the more general notion of reference dependent utility given by Köszegi and Rabin (2006), where their "gain-loss utility" is given, in this case, by $-\lambda [C(t_i, p) - C(t_i, p^S)]$ if $p \geq p^S$, and $\lambda [B(t_i, p) - B(t_i, p^S)]$ if $p < p^S$. We do not assume any change in the concavity of $V(t_i, p | p^S)$. Thus we focus on loss aversion, and we do not consider diminishing sensitivity.

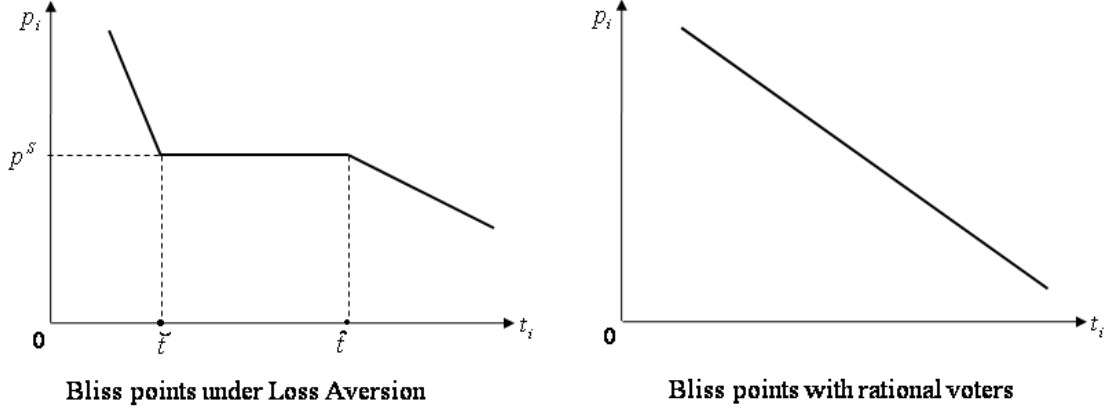


Figure 1: The relationship between types and bliss points

in three groups (cf. Figure 1): 1. a group of *intermediate* types (i.e., all i such that $\check{t} \leq t_i \leq \hat{t}$) who want to keep the status quo; 2. a group of *high* types (i.e., $t_i > \hat{t}$) who want a lower level of the policy; 3. a group of *low* types (i.e., $t_i < \check{t}$) who want a higher amount of the policy. The following proposition summarizes this point.

Proposition 1 (Status quo bias)

- i)* All “intermediate” types such that $\check{t} \leq t_i \leq \hat{t}$ want to keep the status quo policy;
- ii)* All “high” types with $t_i > \hat{t}$ want to decrease the current amount of p ;
- iii)* All “low” types, with $t_i < \check{t}$ want to increase the current amount of p .

Note that \check{t} is decreasing in λ and \hat{t} is increasing in it. Thus the size of the range of types voting for the status quo is increasing in the amount of loss aversion λ .

Proposition 2 (Equilibrium)

- i)* If $t_m \in [\check{t}, \hat{t}]$, then the policy is the status quo;
- ii)* If $t_m < \check{t}$, then the policy outcome is $p_m > p^S$;
- iii)* If $t_m > \hat{t}$, then the policy outcome is $p_m < p^S$.

Hence we have shown a status quo bias.⁹ The existing status quo also influences how the median voter would like to change it if $t_m \notin [\check{t}, \hat{t}]$. More specifically, for

⁹The status quo policy then represents a general source of opposition to reforms, even when rationally the majority of voters would regard the consequences of reforms as an improvement (Samuelson and Zeckhauser, 1988; Baron and Journey, 1993).

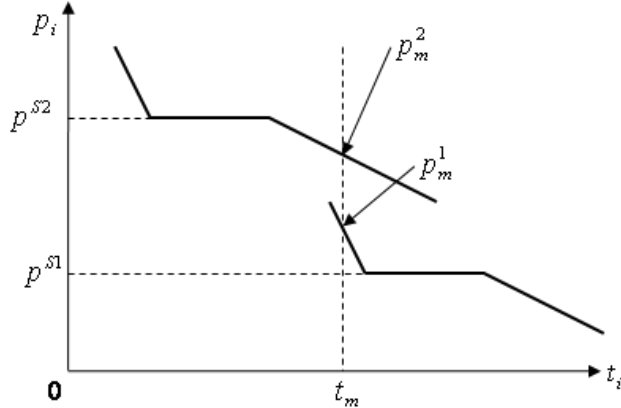


Figure 2: Equilibria with different status quo policies

a given t_m , consider different levels of the status quo: when the latter is very low, the median wants to increase the policy. In making this decision, however, she overweighs the increases in the costs, and this leads her to choose a relatively low policy. Vice versa, when the status quo is high, the median wants to reduce p . In this case, she overweighs the sacrifice of giving up the policy. This will bring her to choose an however high policy. As a result, the *same* median will chose a higher policy when p^S is high, and lower policy when p^S is low. This point is shown in Figure 2. If the status quo is rather low (p^{S1}) the median chooses p_m^1 . If the status quo is quite high (p^{S2}) that same median chooses $p_m^2 > p_m^1$. In a way, the status quo continues to exert an influence on the policy outcome even when the median is willing to abandon it. The following proposition establishes this result formally.

Proposition 3 (Entrenchment)

When a society decides to depart from the status quo, it ends up choosing a policy that (positively) depends on the status quo.

As we pointed out earlier, under loss aversion, societies which implemented large policies in the past (e.g., high level of redistribution, generous welfare state, strict regulation) will continue to opt for rather high levels of it, even when they choose to reduce those levels. Vice versa, societies with a history of low levels of the policy, will keep choosing rather low levels when they opt for an increase. Consequently, loss aversion sheds a novel light on the reason why differences among societies are so persistent when it comes to policy choices and the role of the government.

3.2 Moderation

With this framework it is possible to prove a *moderating effect*. When individuals are loss averse, the distance among their ideal policies is lower: those who demand

for more p overweigh the increases in cost; this dampens their demand for a policy expansion. On the contrary, those who would like to reduce p overweigh the loss of benefits; thus they desire to reduce the policy by a lesser amount. Moreover, as individuals become more loss averse, the number of those who prefer the status quo increases,¹⁰ thus further dampening polarization.

Proposition 4 (Moderation)

Loss aversion leads all low types (i.e., $t_i < \check{t}$) to demand for less p , and all high types (i.e., $t_i > \hat{t}$) to demand for more p .

Lower polarization implies that if the median's tastes are far from the average, the political distortion is smaller in the presence of loss aversion.

3.3 Efficiency

Let's assume that the social welfare function is the sum of individual utility without loss aversion or reference point (cf. Section (2) above).¹¹ When the median voter displays *average* preferences, i.e., the median and the average voter coincide, the latter chooses the social optimum (cf. equation (3) above). Under loss aversion instead, this may not or may not be true. The median's optimal policy will be a function of the status quo. If the latter is high (low), that median chooses a policy higher (lower) than the efficient level.

Proposition 5 (Efficiency)

Consider a median whose rational policy preferences equal the average.

- i) If the status quo is higher than the social optimum ($p^S > p^*$), then the policy is socially too high.*
- ii) If the status quo is lower than the social optimum ($p^S < p^*$), then the policy is socially too low;*
- iii) The socially optimal policy occurs only if it already is the status quo ($p^S = p^*$), and the median does not want to change it.*

This proposition contains a kind of *impossibility* result: in spite the median has average preferences, she never chooses the socially optimal policy when she changes the status quo. With loss aversion there is a political distortion, in spite the median's preferences reflect the average preferences in the society.

¹⁰Recall that \check{t} is decreasing in λ and \hat{t} is increasing in it.

¹¹The alternative would be the sum of utilities in which loss aversion biases are present. In this case, it is easy to show that the loss averse median with average preferences always chooses the socially efficient policy. This is the avenue followed by Charité et al. (2014). They show that a (welfarist) individual in the role of social planner takes care of loss aversion and reference points when deciding redistributive policies.

3.4 Policy changes

The standard model without loss aversion predicts that even small shocks that affect the median of the distribution would lead to a change in policy. That is no longer true in the presence of loss aversion. Intuitively, suppose at time $k = 1$ the median has set a new status quo, p^{S1} . This new status quo defines the interval $[\hat{t}^1, \hat{t}^1]$, and the median is approximately at the center of this interval. When the median sets a new status quo, there will be a number of types both above and below t_m that prefer the status quo. At time $k = 2$, a shock θ that affects the median of the type distribution occurs. If θ is small, the median still lies in the interval. Thus, the status quo set at time 1 survives the shock. In order to change the status quo, the shock at time 2 has to be sufficiently large. In a way, the majority waits until times are ripe for a change, even when the status quo is suboptimal for a majority of voters.

4 A Dynamic Model with Loss Aversion

In a multi period economy, in any period the policy set by the majority will represent the status quo policy of the following period. In fact, we define a *period* the length of time in which a certain outcome becomes the status quo. This situation generates an incentive to choose the policy in order to dampen the adverse effects of loss aversion. This hypothesis corresponds to assuming that individuals correctly assess their future preferences, and take into account how their choices today will affect those preferences in the future. However, Loewenstein et al. (2003) cast doubt on this kind of ability. They claim and verify experimentally (see also Loewenstein and Adler (1995)) that individuals are subject to a *projection bias*, which leads them to systematically overestimate the extent to which their future preferences resemble their current ones. In this section we explore these issues in our model of social choice.

In this new dynamic setting, all individuals live n periods, indexed by k ($k = 1, \dots, n$), with no discounting for future utility. The majority choose the policy in each period. At period k , the policy of period $k - 1$ (p^{k-1}) becomes the new the status quo. Thus, p^{k-1} is a policy variable in period $k - 1$, while in period k it is a predetermined state variable. In period 1, the (exogenous) status quo policy is $p^0 = p^{-112}$. In each period bliss points are sequentially rational and maximize residual lifetime utility from that period onwards. Voters underestimate their ability to adapt to the new status quo. We follow Loewenstein et al. (2003) in assuming that predicted utility is a weighted average between true utility and the utility based on a one-period lagged reference point. More precisely, in period k , voter i 's *predicted*

¹²For simplicity we assume that $p^{-2} = p^{-1}$

utility is an average of i 's true preferences (with the current reference point, p^{k-1}) and her past preferences (with reference point p^{k-2}):

$$\tilde{V}(t_i, p^k | p^{k-2}, p^{k-1}) = (1 - \alpha) V(t_i, p^k | p^{k-1}) + \alpha V(t_i, p^k | p^{k-2}) \quad (5)$$

α parametrizes the projection bias ($0 \leq \alpha \leq 1$): if $\alpha = 1$, then i perceives that her preferences in period k will not change as a result of a change in the status quo, p^{k-1} . When $\alpha = 0$, she has no projection bias. With this formulation, a voter thinks ex ante she will need two periods to get completely accustomed to the new policy, while ex post she actually accustomizes after one single period. Loss aversion is λ , and projection bias is α . Proposition 6 below states (and Appendix proves) that the median makes her policy choice *as if* her loss aversion were $\frac{\lambda(1+\alpha)}{n}$. Suppose there is no projection bias ($\alpha = 0$). In fact, loss aversion derives from a psychological cost that is borne at the time the change occurs. The psychological cost of a policy change today is borne today only, while the material benefits of that change are enjoyed also in the future. In a way, living for n periods gives the voter the chance to “spread” the psychological cost over n periods. Then voters choose according to $\frac{\lambda}{n}$, rather than λ . This implies that adverse consequences of loss aversion are lower if residual life is longer.

Proposition 6 also says that the higher the projection bias (i.e., the larger $\frac{\lambda(1+\alpha)}{n}$) the smaller the propensity to change. The reason is that ex ante the voter thinks she will bear the cost of change for two periods, while ex post the cost is gone after one single period. She is genuinely unaware of that. This leads her to perceive ex ante a larger psychological cost of changing the status quo. Thus, ex ante she is less willing to change.

The projection bias, however, also yields dynamic inconsistency: suppose the median changes the policy in period 1. In the second period, she realizes that she has fully adapted to the new policy, faster than she thought. Thus in period 2 her actual utility turns out to be different from the predicted one. Had she known that, she would have made a different plan, with a bigger change. Her first period plan was optimal ex ante, but it turns out to be suboptimal ex post. In the presence of a projection bias, the voters' policy preferences can be time inconsistent. This may lead the majority to revise its plan, opting for a new policy change. This process of plan revisions possibly comes to an end after a certain number of periods. In a sense, because of the projection bias, reforms are *diluted* over time.

Proposition 6 *In the presence of a projection bias parametrized by α , a majority of loss averse voters living for n periods*

- i) Sets the policy at period 1 as if the loss aversion parameter were $\frac{\lambda(1+\alpha)}{n}$, and plans to keep that policy unchanged in all subsequent periods;*

- ii) *The same majority at period 2 eventually changes the former plan, setting a new policy and re-planning to keep this new policy unchanged in all later periods; the perceived loss aversion parameter is $\frac{\lambda(1+\alpha)}{n-1}$;*
- iii) *This process of plan revisions may continue, and eventually it stops after a finite number of periods.*

Finally, notice that for n going to infinity, i.e., for an infinitely lived agent, loss aversion becomes irrelevant. Projection bias and loss aversion may explain why often policy reforms are timid at the beginning, while in later periods they are made progressively more radical. The reason is that only later people realize that adaptation is not so costly. This model shows that majorities with a longer residual life are less biased by the status quo. The next question is, what happens in societies where individuals have different residual lives, say, younger and older generations? We answer this question in Section 6, where we consider a public finance voting model.

5 Risk Aversion and Loss Aversion

In this section we explore how loss averse voters make their choices when there is uncertainty about the outcome resulting from a policy. We address three questions: first, suppose a risky policy plan and a risk-free plan are available, when do voters prefer the risky plan? For instance, a risky reform with no guarantee of success is opposed to a safe status quo. When does the majority endorse the reform? Second, given a certain level of risk, how much p does the majority demand? For example, individuals vote on taxes, but they do not know if the government's efficiency in using proceeds will be high or low. Does the majority ask for high or low taxes? Third, in which respect the behavior of loss averse voters is different from risk averse voters?

We use the model by Köszegi and Rabin (2007), which allows for a comprehensive treatment of reference dependence *individual* choice under risk. But we amend it in two directions in order to make it suitable for studying the *collective* policy choice made by the majority. First, unlike Köszegi and Rabin, voters not only choose between policy plans with different amount of risk, but they also choose the level of p in each plan. Second, voters are different in types, so that they have different evaluations of the risk embodied in each policy.

Consider a situation with uncertainty about the benefits of a policy.¹³ For any level of policy, benefits depend on a random variable θ that determines the state

¹³This is a simplifying assumption. Not much hinges on it: one could also consider uncertainty regarding costs, or both costs and benefits; the model would be only slightly different.

of the world (e.g., the efficiency of the government or the effects of a reform). If the state is *good* (i.e., $\theta = \theta^g$) then the benefits are high. If the state is *bad* (i.e., $\theta = \theta^b$) benefits are low. The distribution of θ is common knowledge. The state will be good with probability q , and it will be bad with probability $(1 - q)$. For simplicity, voters' benefit functions are the same for all types: $B(t_i, p, \theta) = B(p, \theta)$.¹⁴ We further simplify things assuming that θ has an additive impact on benefits: $B(p, \theta^g) = B(p + \theta^g)$, and $B(p, \theta^b) = B(p - \theta^b)$, with $\theta^g > 0, \theta^b > 0$.

5.1 Risk averse voters with no loss aversion

Individual i 's expected utility is

$$E[V(t_i, p, \theta)] = qB(p + \theta^g) + (1 - q)B(p - \theta^b) - C(t_i, p) \quad (6)$$

The concavity of $B(\cdot)$ leads to risk aversion: if the amount of risk is sufficiently large, then all voters would prefer to pay a premium to insure themselves against policy uncertainty.¹⁵ However, this does not necessarily mean that voters demand for less p when there is some risk in the policy. Consider the FOC to maximize $E[V(t_i, p, \theta)]$:

$$E[B_p(p, \theta)] = C_p(t_i, p)$$

where $E[B_p(p, \theta)] \equiv qB_p(p + \theta^g) + (1 - q)B_p(p - \theta^b)$, and suppose $E(\theta) = 0$. It is easy to see that if B_p is convex, despite risk aversion, voters want a larger policy in the presence of risk. The reason is that a marginal increase of p yields a marginal benefit in the good state that is substantially higher than the marginal benefit in the bad state. This leads to a higher demand for p compared to the case without risk. In short, risk aversion may lead voters to turn down a reform if the prospect is not sufficiently better than the status quo. But if they take the reform, risk aversion does not imply that they choose a level of p that is close to p^S ; once they choose the reform, they might want to choose a level of the policy that is radically different from p^S . In other words, if voters opt for reform, risk aversion does not imply any form of bias toward the status quo or any moderating effect.

Things are different when risk is modest: Rabin's calibration theorem says that anything more than negligible risk aversion over moderate stakes yields *absurdly severe* risk aversion over large risk (Rabin, 2000).¹⁶ This implies that expected utility maximizers must be neutral to modest risk. Then, if the risk is over modest stakes (i.e., θ^g and θ^b are sufficiently small), $V(\cdot)$ is approximately linear in p . In

¹⁴We make this assumption because, for simplicity, we want to abstract away from any source of heterogeneity other than t_i . In a more realistic world uncertainty can be different across voters.

¹⁵Let $\bar{p} \equiv p + q\theta^g + (1 - q)\theta^b$ be the expected realization of the policy. By risk aversion, $E[V(t_i, p, \theta)] < V(t_i, \bar{p})$, for any p .

¹⁶Cf. Rabin and Thaler (2001) for a comprehensive treatment of related issues.

this case, if $E(\theta) = 0$, voters choose the same level of the policy with or without uncertainty. The proposition below summarized these results.

Proposition 7 *If the expected outcome of two plans is the same, then risk averse voters*

- i) always choose the less risky plan in case of large-scale risk;*
- ii) are indifferent between the two plans in case of small-scale risk;*
- iii) demand for more (less) policy when the plan is more risky and marginal benefits are convex (concave);*
- iv) The equilibrium policy is the median's bliss point.*

The intuition is that when risk is small, voters that maximize expected utility endorse a reform whenever the expected outcome is better than the status quo. When risk is large, they require the expected benefits of the risky plan to be sufficiently larger than the benefits of the risk-free plan. For instance, voters regard the status quo as a form of insurance against the risk associated with reforms: if insurance is too expensive (i.e., if the expected outcome of the reform is substantially larger than the status quo) voters prefer reform. In some cases, more uncertainty might lead voters to prefer a larger amount of the policy. For example, a majority might prefer a more drastic reform when the effects are more uncertain; or, on the contrary voters might be willing to pay more taxes when there is bigger uncertainty about the efficiency of the government.

5.2 Loss averse and risk averse voters

In order to introduce loss aversion, we must define the reference point in this model with uncertainty. Following Köszegi and Rabin (2007), we will assume that the reference point can be either deterministic or stochastic: i.e., it can be either a specific policy outcome (e.g., the status quo) or a probability distribution over alternative outcomes. The reference point (either deterministic or stochastic) is exogenous, so it cannot be affected by voters' choices.¹⁷

5.2.1 Deterministic reference point

Let us assume that the reference point is the policy of the previous period (p^S), and it is known and evaluated with no uncertainty.¹⁸ $B(p^S)$ is the current *observed* level

¹⁷We do not study endogenous reference points, although it would represent a nice extension of our approach. According to Köszegi and Rabin (2007) the reference point is endogenous when individuals make committed decisions long before outcomes occur.

¹⁸The status quo p^S is an appropriate reference point when it represents an alternative to a risky reform (i.e., a form of insurance against that risk), or simply when voters do not expect risk.

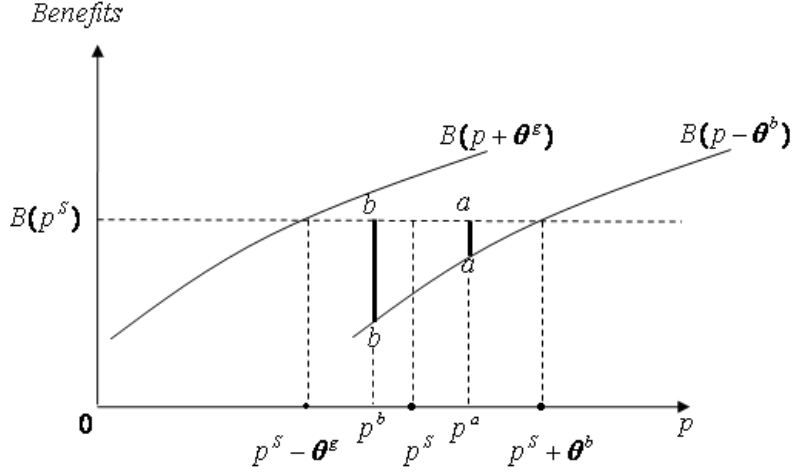


Figure 3: Benefit functions in different states of the world

of benefits. Since there is uncertainty about the policy outcome next period, the situation may either improve or worsen if voters choose p^S . We show that voters are still biased towards p^S , but the bias is smaller compared to the case without risk. This means that in a riskier environment, voters are more prone to demand changes.

Figure 3 shows the benefit function in the good state, $B(p + \theta^g)$, and the benefit function in the bad state, $B(p - \theta^b)$. Two policy levels are relevant in this model: $p^S - \theta^g$, and $p^S + \theta^b$. The former is the level of risky policy that ensures the status quo benefits in the good state; the latter is the level which ensures the status quo benefits in the bad state. The idea is that in the good (bad) state one needs a smaller (bigger) amount of p to ensure the current level of benefits.

If p is chosen within the interval $(p^S, p^S + \theta^b)$ voters avert two types of psychological loss: the first one is the *usual* loss due to the fact that costs are higher than the status quo: the second one is the expected loss of benefits that would occur in the bad state. Take for instance the policy p^a in Figure 3. The first loss is $\lambda [C(t_i, p^a) - C(t_i, p^S)]$; a way to contain it is sticking with the status quo. The second loss occurs with probability $(1 - q)$ and amounts to $\lambda [B(p^S) - B(p^a - \theta^b)]$;¹⁹ a way to contain this second loss is demanding an higher p . We will show below that this leads some voters to desire more policy than the status quo.

If p is chosen within the interval $(p^S - \theta^g, p^S]$, voters expect a loss of benefits, but *only* in the bad state. No other feelings of loss because costs are lower than the status quo. Take policy p^b in Figure 3. The expected loss is only $\lambda(1 - q) [B(p^S) - B(p^b - \theta^b)]$.²⁰ If the state is good, benefits are larger than the status

¹⁹cf. segment *aa* in Figure (3)

²⁰cf. segment *bb* in Figure (3).

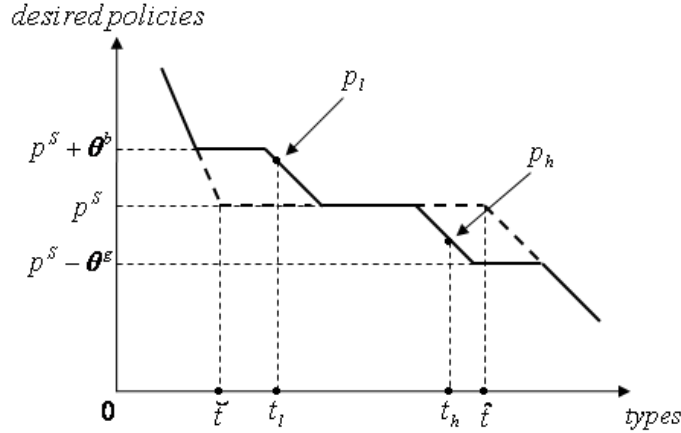


Figure 4: Under uncertainty fewer voters want the status quo

quo, despite the policy is lower. The chance that benefits may be larger than the status quo leads some voters to prefer a lower policy than p^S .

Policy preferences of loss averse voters under uncertainty are shown by the solid line in Figure 4. The dotted line shows voters' desired policy without uncertainty. Take type t_h : if there is no uncertainty she desires p^S ; if there is uncertainty she wants a policy p_h that is lower than the status quo. The reason is that $p_h < p^S$ is *less painful* if there is uncertainty because the loss of benefits occurs only in the bad state. This smaller *expected* loss of benefits leads this voter to demand for less policy. The appendix proves that, under uncertainty, those who want less policy instead of p^S are the types sufficiently close to \hat{t} .

Take now type t_l in Figure 4: with no uncertainty, she wants the status quo; under uncertainty, she wants a policy $p_l > p^S$. The reason is that, in the presence of uncertainty, in p^S she bears the psychological cost due to the loss of benefits, that would occur in the bad state. She can lower this sense of loss by demanding an higher p . She trades off this incentive to ask for more p against the loss due to higher costs.

In a stochastic environment, voters' preferences are less dispersed, and a smaller mass wants p^S . The status quo bias is therefore less stringent, and the equilibrium is the median's most preferred policy (cf. Appendix for analytical details):²¹

Proposition 8 *Suppose the reference point is the status quo policy. If $E(B_p(p^S, \theta)) = B_p(p^S)$, the status quo bias is smaller when there is uncertainty. Specifically,*

²¹The expected utility function under loss aversion displays three kinks. For this reason, there is also a mass of voters who prefer $p^S + \theta^b$ and another mass who prefer $p^S - \theta^g$ (cf. figure 4). This is due to our choice of modelling risk as a random shock with two possible realizations.

- i) the mass of intermediate types who want to keep the status quo policy is smaller;*
- ii) some high types want a lower policy;*
- iii) some low types want a higher policy;*
- iv) The equilibrium policy is the median's bliss point.*

Thus, loss averse voters are more prone to change when there is risk.²² But this does not imply that they love risk. On the contrary, loss aversion predicts strong distaste to any order of risk, in particular first-order risk aversion in p^S (Rabin, 2000).²³ This means that loss averse voters are unlikely to accept a policy plan with modest stochastic improvements or worsenings of the status quo, even if the expected outcome is substantially better than the status quo: a much stronger aversion to change with respect to voters that are simply risk averse.

This model also shows that the distaste to risk predicted by loss aversion is relative to the reference policy (i.e., the status quo, in this case). Thus, voters turn down a risky reform if the outcomes are modest improvements or worsenings of the status quo, while they would have voted for the same reform if the status quo were different.

In sum, this model provides two main results: first, loss averse voters dislike risk more than risk averse voters (e.g., loss averse voters are more likely to reject a risky reform); second, in a risky environment, loss averse voters become less attached to the status quo, compared to a risk-free environment. Thus, they are prone to more radical reforms when there is risk. This might help to rationalize why, as the environment becomes uncertain, voters sometimes endorse extremely radical shifts in policies. For instance, the reforms proposed by Mrs. Thatcher or Mr. Reagan were perceived both as extremely uncertain and radical. Nonetheless, people endorsed them.

5.2.2 Stochastic reference point

How do voters choose the policy when the environment is uncertain *and* they expect risk? Voters are acclimatized to the stochastic environment, eventually because there is no alternative risk-free policy plan. If the policy is the status quo, they

²² $E(B_p(p^S, \theta)) = B_p(p^S)$ represents a sufficient condition. The appendix shows that the proposition above holds whenever $E(B_p(p^S, \theta))$ is not too different from $B_p(p^S)$.

²³The appendix shows that voters' expected utility functions are not differentiable in p^S . This implies first-order risk aversion.

As pointed out earlier, voters consider the status quo as a form of insurance against the risk of a reform. It is easy to see that the premium that voters prefer to pay to insure themselves against the policy uncertainty is higher under loss aversion than under risk aversion.

expect to enjoy either $B(p^S + \theta^g)$ or $B(p^S - \theta^b)$. The reference policy is stochastic: $p^S + \theta^g$ with probability q , and $p^S - \theta^b$ with probability $(1 - q)$.

The anticipation of a bad outcome implies that, when the bad outcome occurs, voters feel a lower sense of loss. The appendix proves that this leads some low types to demand p^S instead of a higher policy.

The anticipation of a good outcome implies that, when the bad outcome occurs, the latter looms larger. This leads some high types to stick with p^S instead of asking for a lower level of p . Then:

Proposition 9 *When loss averse voters expect risk, the status quo bias is stronger compared to unexpected risk.*

This model predicts that voters have a small incentive to deviate from the status quo when they anticipate risk. Proposition 8 says that risk leads some voters to ask for more policy as a way to mitigate the sense of loss that occurs in the bad state. Risk also implies that some high types ask for less policy because there is the chance of a good state. Proposition 9 says that when risk is anticipated both these incentives are weaker. Thus, voters are less willing to deviate from the status quo.

6 Loss aversion in a Public Finance Model

This section applies the framework described above to a basic Meltzer and Richard model with public good provision.²⁴ The policy consists in the provision of a non-excludable public good financed by a proportional income tax. Agents enjoy utility from consumption of a private good (c_i) and the public good (g) that we measure here in per capita terms. Instead of a public good, we could have had a lump sum redistribution and results would have been identical (see the Appendix).

Let the utility function be quasi-linear in c_i , and concave and increasing in g :

$$u(c_i, g) = c_i + H(g)$$

($H' > 0$, $H'' < 0$). Individuals are heterogeneous in income: let y_i be the income of individual i , and denote by \bar{y} the average income. Denote with m the individual with the median income. The government budget is balanced and the prices of c and g are normalized to 1. Indirect utility of voter i is then:

$$V(y_i, g) = y_i + H(g) - \frac{y_i}{\bar{y}} g$$

²⁴The model of this section is a stylized version of Meltzer and Richard (1981) as presented by Persson and Tabellini (2000, pp. 48-50).

Her most preferred level of g is:

$$g_i = (H')^{-1} \frac{y_i}{\bar{y}} \quad (7)$$

Policy preference functions are single peaked and the bliss points negatively depend on individual incomes: richer individuals want a smaller government because the private cost of one unit of public good, $\frac{y_i}{\bar{y}}$, is higher for them. The equilibrium is the median voter's most preferred policy, g_m . The normative implication is that the majority rule, or Downsian electoral competition, implements the social optimum only if the median voter's income equals the average income. If instead the income distribution is skewed toward the right (i.e. $y_m < \bar{y}$), the voting outcome is overspending and overtaxation. Suboptimal provision of public good and taxation occurs in the opposite case.

6.1 Loss aversion

Let g^S be the status quo amount of public good. Lower public good provision or additional taxes are both a loss, while more public good or tax reductions are a gain. Under loss aversion indirect utility is then:

$$V(g, y_i | g^S) = \begin{cases} V(y_i) - \lambda \frac{y_i}{\bar{y}} (g - g^S) & \text{if } g \geq g^S \\ V(y_i, g) - \lambda [H(g^S) - H(g)] & \text{if } g < g^S \end{cases}$$

The bliss point, i.e., the most preferred amount of g is:²⁵

$$g_i = \begin{cases} (H')^{-1} \cdot \frac{y_i(1+\lambda)}{\bar{y}} & \text{if } y_i < \check{y} \\ g^S & \text{if } \check{y} \leq y_i \leq \hat{y} \\ (H')^{-1} \cdot \frac{y_i}{\bar{y}(1+\lambda)} & \text{if } y_i > \hat{y} \end{cases} \quad (8)$$

Suppose that median income declines by a small amount compared to the mean, i.e., inequality increases, at least according to this measure. In the standard model that would always imply a change in policy: higher taxes and more public good. In the model with loss aversion, instead, an increase in income inequality may lead to no changes in taxation as long as the change in inequality does not push the parameter values outside the range in which the status quo prevails. In addition, with loss aversion, the marginal cost of more public good is higher and the marginal benefit of less public good is lower. Therefore, compared to the standard Meltzer and Richard model, the rich increase their demand for public good and the poor

²⁵Where $\check{y} \equiv \frac{1}{(1+\lambda)} H'(g^S) \bar{y}$, and $\hat{y} \equiv (1+\lambda) H'(g^S) \bar{y}$. Observe that if $y_i < \check{y}$ then $(H')^{-1} \frac{y_i(1+\lambda)}{\bar{y}} > g^S$ and if $y_i > \hat{y}$ then $(H')^{-1} \frac{y_i(1+\lambda)}{\bar{y}} < g^S$ (cf. Proposition 1).

Finally observe that both \check{y} and \hat{y} negatively depend on the status quo, g^S .

reduce theirs.²⁶ The level of disagreement about the size of government is lower in a loss averse society. As pointed out earlier, this is another reason which may explain why, even with relatively high levels of inequality, we do not always observe extreme redistributive policies in democracies. This result may help to rationalize why the recent increase in inequality in many OECD countries has not translated always in immediate moves toward more redistribution.

6.1.1 *Old and Young societies*

As pointed out by the general model, when the benefits of a policy change can be enjoyed for several periods, the majority chooses the policy strategically, taking into account the multi-period effects of loss aversion. This implies that, other things being equal, younger majorities are more prone to change the status quo.

Suppose the population is split in two generations, the young and the old. In order to focus on the specific effects of loss aversion, let us assume that the two generations are the same in all respects except residual life: the old live only the next n periods; the young live the next nl periods ($l > 1$). Loss aversion and projection bias parameters are the same for both young and old. By Proposition 6, the old make their political choices *as if* their loss aversion were $\frac{\lambda(1+\alpha)}{n}$, and the young as if loss aversion were $\frac{\lambda(1+\alpha)}{nl}$. This implies that there are less young voters entrenched in the status quo, compared to old voters. It may happen that the majority of young voters wants a change in policy, but the majority of old voters does not. The reason does not rely on differences in material interests. It is instead a psychological reason: the old do not want to bear the psychologically costly commitment to a change today, because their future horizon in which to enjoy the benefits of that commitment is shorter. The policy outcome depends on the population shares: old societies, where the share of young people is low, are more likely to remain with the status quo.

We illustrate this point with a parametric example. Assume the two generations are the same in all respects (i.e., income distribution, utility functions, loss aversion). Income is uniformly distributed in $[\frac{1}{2}, \frac{3}{2}]$. Thus $y_m = \bar{y} = 1$ in both groups. Let the utility from the public good be $H(g) = \ln(g)$. The socially efficient level of public good is $g^* = (H')^{-1} \cdot 1 = 1$. Assume that the status quo is $g^S = \frac{3}{2}$, a level which is socially too high. It is easy to see that, by Proposition 6, for any $\lambda(1 + \alpha) \geq \frac{n}{2}$, the median of the old generation prefers to keep the (inefficient) status quo (cf. the upper graph in Figure 5), whereas the median of the young generation prefers the status quo only if $\lambda(1 + \alpha) \geq \frac{nl}{2}$ (cf. the lower graph in Figure 5). Thus, for any

²⁶An alternative and not mutually exclusive argument for why the poor may not want to aggressively expropriate the rich is the *Prospect for Upward Mobility* (POUM) hypothesis by Bénabou and Ok (2001).

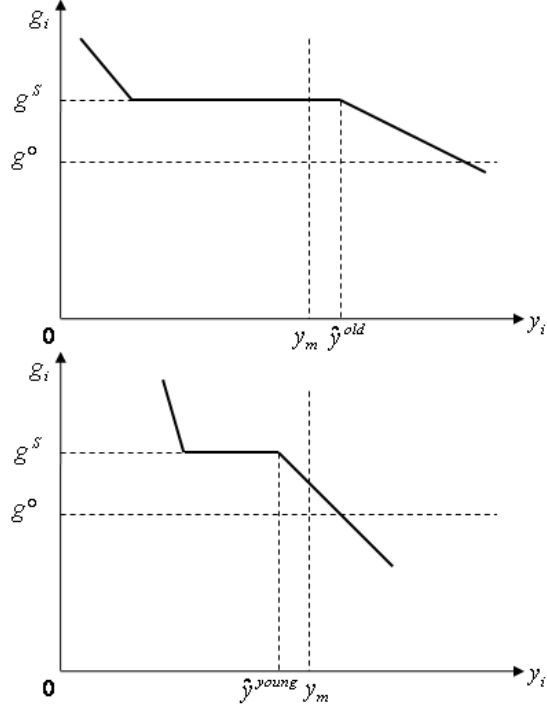


Figure 5: The majority of young voters wants to change. The majority of old voters does not.

$\frac{n}{2} \leq \lambda(1 + \alpha) \leq \frac{nl}{2}$, the majority of young voters wants to change g (for less public good) and the majority of old voters does not want to change.

How will society eventually choose? Let a be the share of old voters in the society, and $(1 - a)$ the share of young voters ($0 \leq a \leq 1$). The old voters who do not want to reduce g are the ones whose income is lower than $\hat{y}^{old} = \frac{2}{3} \left(1 + \frac{\lambda(1+\alpha)}{n}\right)$.²⁷ The young voters who do not want to reduce g are the ones whose income is lower than $\hat{y}^{young} = \frac{2}{3} \left(1 + \frac{\lambda(1+\alpha)}{nl}\right)$.²⁸ Since in both groups income distribution is uniform in $[\frac{1}{2}, \frac{3}{2}]$, there are $a \left[\frac{2}{3} \left(1 + \frac{\lambda(1+\alpha)}{n}\right) - \frac{1}{2}\right]$ old voters, and $(1 - a) \left[\frac{2}{3} \left(1 + \frac{\lambda(1+\alpha)}{nl}\right) - \frac{1}{2}\right]$ young voters who prefer the status quo to any $g < g^S$. If these two masses of voters are not smaller than a half of the population, the status quo survives: $a \left[\frac{2}{3} \left(1 + \frac{\lambda(1+\alpha)}{n}\right) - \frac{1}{2}\right] + (1 - a) \left[\frac{2}{3} \left(1 + \frac{\lambda(1+\alpha)}{nl}\right) - \frac{1}{2}\right] \geq \frac{1}{2}$. Solving this inequality yields the condition for the status quo:

$$a \geq \frac{nl - 2\lambda(1 + \alpha)}{2\lambda(1 + \alpha)(l - 1)} \quad (9)$$

²⁷Cf. the upper graph of Figure 5

²⁸Cf. the lower graph of Figure 5.

This inequality tells us that older societies (higher a) are more likely to remain stuck with the status quo, whereas societies where young generations live longer than older generations (higher l) are more likely to abandon it. If both young and old live longer (high n), the status quo is less likely. Of course stronger loss aversion (higher λ) and larger projection bias (higher α) make reforms less likely.²⁹

Finally, we can document a sort of paradox: suppose that $\lambda(1 + \alpha) = \frac{9}{10}$, $n = 1$, and $l = 2$. Loss aversion/projection bias are rather high, young voters live two periods and the old ones live only one period. In this case, $\frac{n}{2} \leq \lambda(1 + \alpha) \leq \frac{nl}{2} \rightarrow \frac{1}{2} \leq \lambda(1 + \alpha) \leq 1$: the majority of young voters would like to change the status quo, and the majority of old voters would like to retain it. By (9), if $a \geq \frac{1}{9}$ the society remains with the status quo. Despite the old voters are only one ninth of the population, the entire society sticks to the status quo. Because of loss aversion and shorter residual life, policy preferences in the old generation are much less dispersed around the status quo. The share of people who want the status quo is much higher in the older group.

The general idea is that loss aversion favors political cohesion within older generations. This enhances their chance to play a pivotal role in forming the majority. This result suggests that older societies (for instance those with low fertility rates) tend to become more averse to change and may remain *stuck* more often in a status quo even when the latter becomes inefficient.

7 Conclusions

In this paper we have explored how loss aversion affects the political equilibrium in a simple voting model. A society needs to choose the level of a certain policy which has benefits and costs. Individuals differ in their evaluation of these benefits and costs and everybody suffers from loss aversion. Without loss aversion, the equilibrium policy would be the one most preferred by the median voter but the initial status quo would have been irrelevant. With loss aversion, instead, the results are very different. First, we show a status quo bias, that is for any initial status quo a positive mass of voters would prefer the latter to their ideal policy. The size of this share of voters is increasing with the size of the parameter which measures loss aversion. An immediate implication of this result is that small shocks to preferences (or to the environment) do not lead to changes of policies; the shocks have to be sufficiently large to overcome the status quo bias, i.e., to make a majority of voters willing to subject themselves to the necessary losses (and increases benefits) of the policy change. Thus, societies become very averse to change even when reforms would be collectively quite welfare improving.

²⁹In fact, (9) is more likely to be satisfied when a is large and/or the RHS is low. As for the latter, observe that it decreases in l (since $\lambda(1 + \alpha) > \frac{n}{2}$) and in $\lambda(1 + \alpha)$, and it increases in n .

Second, we show a path dependence: the voting equilibrium depends on the initial status quo. Societies with a certain attitude in past policies (say, large government size, strong regulation, etc..) continue to display the same policy attitude even when they make changes.

Third, loss aversion implies a moderating effect: the most extreme types – who would want to move the status quo in their direction – have more moderate ideal policies than without loss aversion.

Fourth, in a dynamic setting, the effect of loss aversion diminishes with the length of the planning horizon of voters. Younger societies are more prone to change; however, loss aversion also favors the political cohesion of older generations, increasing their chance to affect the social choice. This sheds a novel light on the intergenerational conflict about policy reforms. Finally, we investigate the interaction of loss aversion and risk aversion in a stochastic environment in which the results of policies are not known with certainty. We explored both the case of a deterministic and stochastic status quo policy.

We then apply this model to the celebrated Meltzer and Richard (1981) model with a public good (in the text) or with lump sum redistributions (in the Appendix). The application of our general results to this model leads to some empirically plausible implications; one is that even relatively large increases in income inequality, which in the model without loss aversion would lead to more taxes and more public goods (or transfers), may not lead to a change in the status quo. A related point is that even with very large increases in inequality the level of redistribution with loss aversion would be lower than without it.

Finally, we show that older societies are more *conservative* in the sense they are more subject to the effect of loss aversion which lead to a stronger status quo bias.

References

- [1] Acemoglu, Daron, Suresh Naidu, Pascual Restrepo and James A. Robinson (2013): “Democracy, Redistribution and Inequality”, in Anthony A. Atkinson and François Bourguignon (eds), *Handbook of Income Distribution*, North Holland.
- [2] Acemoglu, Daron and James A. Robinson (2006): *Economic Origins of Dictatorship and Democracy*, New York, Cambridge University Press.
- [3] Acemoglu, Daron, Davide Ticchi and Andrea Vindigni (2011): “Emergence and Persistence of Inefficient States”, *Journal of the European Economic Association*, 9(2), pp. 177-208.
- [4] Alesina, Alberto, Guido Cozzi and Noemi Mantovan (2012): “The Evolution of Ideology, Fairness and Redistribution”, *Economic Journal*, 122(565), pp. 1244-1261.
- [5] Alesina, Alberto and Allan Drazen (1991): “Why are Stabilizations Delayed?”, *The American Economic Review*, 81(5), pp. 1170-1188.
- [6] Alesina, Alberto, and Paola Giuliano (2011): “Preferences for Redistribution”, in Alberto Bisin, Jess Benhabib and Matthew Jackson (eds), *Handbook of Social Economics*, pp. 93-132, North Holland.
- [7] Alesina, Alberto and Edward L. Glaeser (2004): *Fighting Poverty in the US and Europe: A World of Difference*, New York: Oxford University Press.
- [8] Alesina, Alberto and Francesco Passarelli (2014): “Regulation versus Taxation”, *Journal of Public Economics*, 110, pp. 147-156.
- [9] Alesina, Alberto and Dani Rodrik (1994): “Distributive Politics and Economic Growth”, *Quarterly Journal of Economics*, 109, pp. 465-490.
- [10] Amador, Manuel, Iván Werning and George-Marios Angeletos (2006): “Commitment vs. Flexibility”, *Econometrica*, 74(2), pp. 366-396.
- [11] Barberis, Nicholas C. (2013): “Thirty Years of Prospect Theory in Economics: A Review and Assessment”, *Journal of Economic Perspectives*, 27(1), pp. 173-196.
- [12] Baron, Jonathan and James Journey (1993): “Norms against voting for coerced reform”, *Journal of Personality and Social Psychology*, 64, pp. 347-355.

- [13] Bénabou, Roland and Efe A. Ok (2001): “Social Mobility and the Demand for Redistribution: The Poum Hypothesis”, *The Quarterly Journal of Economics*, 116(2), pp. 447-487.
- [14] Bendor, Jonathan, Daniel Diermeier, David A. Siegel and Michael M. Ting (2011): *A Behavioral Theory of Elections*, Princeton, Princeton University Press.
- [15] Bernasconi, Michele and Alberto Zanardi (2004): “Tax Evasion, Tax Rates, and Reference Dependence”, *FinanzArchiv*, 60, pp. 422-445.
- [16] Bisin, Alberto, Alessandro Lizzeri, and Leeat Yariv (2011): “Government Policy with Time Inconsistent Voters”, *mimeographed*.
- [17] Black, Duncan (1948): “On the Rationale of Group Decision-making”, *Journal of Political Economy*, 56, pp. 23-34.
- [18] Borge, Lars-Erik and Jorn Rattso (2004), “Income Distribution and Tax Structure: Empirical Test of the Meltzer–Richard Hypothesis”, *European Economic Review*, 48, pp. 805-826.
- [19] Charité, Jimmy, Raymond Fisman, and Ilyana Kuziemko (2014): “Reference points and demand for redistribution: Experimental evidence”, *mimeographed*.
- [20] DellaVigna, Stefano (2009): “Psychology and Economics: Evidence from the Field”, *Journal of Economic Literature*, 47(2), pp. 315-372.
- [21] Downs, Anthony (1957): *An Economic Theory of Democracy*, Harper Collins.
- [22] Fernandez, Raquel and Dani Rodrik (1991): “Resistance to Reform: Status Quo Bias in the Presence of Individual- Specific Uncertainty”, *The American Economic Review*, 81(5), pp. 1146-1155.
- [23] Freund, Caroline and Çağlar Özden (2008): “Trade Policy and Loss Aversion”, *The American Economic Review*, 98(4), pp. 1675-1691.
- [24] Galasso, Vincenzo (2003): “Redistribution and Fairness: A Note”, *European Journal of Political Economy*, 19(4), pp. 885-892.
- [25] Gil, Ricard, Casey B. Mulligan and Xavier Sala-i-Martin (2004): “Do Democracies have different Public Policies than Nondemocracies?”, *Journal of Economic Perspectives*, 18, pp. 51-74.
- [26] Glaeser, E. L. (2006): “Paternalism and Psychology”, *The University of Chicago Law Review*, 73(1), pp. 133-156.

- [27] Grillo Edoardo (2011): “Electoral Speeches and Reference Dependence: Can Politicians’ Announcements be Credible?”, Princeton University, *mimeographed*.
- [28] Höchtel, Wolfgang, Rupert Sausgruber and Jean-Robert Tyran (2012): “Inequality Aversion and Voting on Redistribution”, *European Economic Review*, 56(7), pp. 1406–1421.
- [29] Kahneman, Daniel and Amos Tversky (1979), “Prospect Theory: An Analysis of Decision under Risk”, *Econometrica*, 47(2), pp. 263-292.
- [30] Köszegi, Botond and Matthew Rabin (2006): “A Model of Reference-Dependent Preferences”, *Quarterly Journal of Economics*, 122(4), pp. 1133-1165.
- [31] Köszegi, Botond and Matthew Rabin (2007): “Reference-Dependent Risk Attitudes”, *American Economic Review*, 97(4), pp. 1047-1073.
- [32] Köszegi, Botond and Matthew Rabin (2009): “Reference-Dependent Consumption Plans”, *American Economic Review*, 99(3), pp. 909-936.
- [33] Krehbiel, Keith (1998): *Pivotal Politics: A Theory of US Lawmaking*, Chicago: University of Chicago Press.
- [34] Krehbiel, Keith (2008): “Pivots”, in Barry R. Weingast and Donald A. Wittman (eds.) *The Oxford Handbook of Political Economy*, New York: Oxford University Press.
- [35] Krusell, Per, Burhanettin Kurusçu and Anthony A. Smith (2010): “Temptation and Taxation”, *Econometrica*, 78, pp. 2063-2084.
- [36] Laibson, David (1997): “Golden Eggs and Hyperbolic Discounting”, *Quarterly Journal of Economics*, 112(2), pp. 443-477.
- [37] Lizzeri, Alessandro and Leeat Yariv (2012): “Collective Self-Control”, *mimeographed*.
- [38] Loewenstein, George and Daniel Adler (1995), “A Bias in the Prediction of Tastes”, *Economic Journal*, vol. 105(431), pp. 929-937.
- [39] Loewenstein, George, Ted O’Donoghue and Matthew Rabin (2003): “Projection Bias In Predicting Future Utility”, *The Quarterly Journal of Economics*, vol. 118(4), pp. 1209-1248.

- [40] Loomes, Graham and Robert Sugden (1982): “Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty”, *Economic Journal*, 92(4), pp. 805-824.
- [41] Meltzer, Allan H. and Scott F. Richard (1981): “A Rational Theory of the Size of Government”, *Journal of Political Economy*, 89(5), pp. 914-927.
- [42] Milkman, Katherine L., Mary Carol Mazza, Lisa L. Shu, Chia-Jung Tsay and Max H. Bazerman (2009): “Policy Bundling to Overcome Loss Aversion: A Method for Improving Legislative Outcomes”, *Harvard Business School*, Working Paper N. 09-147.
- [43] Passarelli, Francesco and Guido Tabellini (2013): “Emotions and Political Unrest”, CEPR Discussion Paper No. DP9446.
- [44] Perotti, Roberto (1996): “Growth, Income Distribution and Democracy: what the data say”, *Journal of Economic Growth*, 1, pp. 149-187.
- [45] Persson, Torsten and Guido Tabellini (1994): “Is Inequality Harmful to Growth?”, *American Economic Review*, 84, pp. 600-621.
- [46] Persson, Torsten and Guido Tabellini (2002): *Political Economics: Explaining Economic Policy*, Cambridge: MIT Press.
- [47] Persson, Torsten and Guido Tabellini (2003): *The Economic Effects of Constitutions*, Cambridge: MIT Press.
- [48] Rabin, Matthew (1998): “Psychology and Economics”, *Journal of Economic Literature*, 36(1), pp. 11-46.
- [49] Rabin, Matthew (2000): “Risk Aversion and Expected-Utility Theory: A Calibration Theorem”, *Econometrica*, 68(5), pp. 1281-1292.
- [50] Rabin, Matthew and Richard H. Thaler (2001): “Anomalies: Risk Aversion”, *Journal of Economic Perspectives*, 15(1), pp. 219-232.
- [51] Rees-Jones, Alex (2013): “Loss Aversion Motivates Tax Sheltering: Evidence From U.S. Tax Returns”, *mimeographed*.
- [52] Samuelson, William, and Richard J. Zeckhauser (1988): “Status Quo Bias in Decision Making”, *Journal of Risk and Uncertainty*, 1(1), pp. 7-59.
- [53] Scheve, Kenneth and David Stasavage (2012): “Democracy, War, and Wealth: Lessons from Two Centuries of Inheritance Taxation,” *American Political Science Review*, 106(1), pp. 82-102.

- [54] Sinn, Hans-Werner (1996): “Social Insurance, Incentives and Risk Taking”, *International Tax and Public Finance*, 3, pp. 259-280.
- [55] Sugden, Robert (2003): “Reference-Dependent Subjective Expected Utility”, *Journal of Economic Theory*, 111, pp. 172-191.
- [56] Tovar, Patricia (2009): “The Effects of Loss Aversion on Trade Policy: Theory and Evidence”, *Journal of International Economics*, 78, pp. 154-167.
- [57] Tversky, Amos, and Daniel Kahneman (1991): “Loss Aversion in Riskless Choice: A Reference-Dependent Model”, *Quarterly Journal of Economics*, 106(4), pp. 1039-1061.

8 Appendix 1: Proofs

Proof. Proposition 1

- i) Recall that \check{t} is implicitly determined by $B_p(t, p^S) - (1 + \lambda)C_p(t, p^S) = 0$, and \hat{t} is implicitly determined by $(1 + \lambda)B_p(t, p^S) - C_p(t, p^S) = 0$. Thus, for any “intermediate” type $t_i \in [\check{t}, \hat{t}]$, the optimality condition is

$$\begin{aligned} B_p(t_i, p) - (1 + \lambda)C_p(t_i, p) &\leq 0 && \text{if } p \geq p^S \\ (1 + \lambda)B_p(t_i, p) - C_p(t_i, p) &\geq 0 && \text{if } p < p^S \end{aligned}$$

thus the bliss point is $p_i = p^S$.

- ii) For any “high” type, $t_i > \hat{t}$,

$$\begin{aligned} B_p(t_i, p^S) - (1 + \lambda)C_p(t_i, p^S) &< 0 \\ (1 + \lambda)B_p(t_i, p^S) - C_p(t_i, p^S) &< 0 \end{aligned}$$

Thus the bliss point is lower than the status quo, $p_i < p^S$

- iii) For any “low” type, $t_i < \check{t}$,

$$\begin{aligned} B_p(t_i, p^S) - (1 + \lambda)C_p(t_i, p^S) &> 0 \\ (1 + \lambda)B_p(t_i, p^S) - C_p(t_i, p^S) &> 0 \end{aligned}$$

Thus the bliss point is larger than the status quo, $p_i > p^S$.

QED ■

Proof. Proposition 2 Implicit differentiating (4) w.r.t. t_i , and using A1-A3 yield

$$\frac{\partial p_i}{\partial t_i} = \begin{cases} -\frac{B_{pt}(t_i, p_i) - (1+\lambda)C_{pt}(t_i, p_i)}{B_{pp}(t_i, p_i) - (1+\lambda)C_{pp}(t_i, p_i)} < 0 & \text{if } t_i < \check{t} \\ 0 & \text{if } \check{t} \leq t_i \leq \hat{t} \\ -\frac{(1+\lambda)B_{pt}(t_i, p_i) - C_{pt}(t_i, p_i)}{(1+\lambda)B_{pp}(t_i, p_i) - C_{pp}(t_i, p_i)} < 0 & \text{if } t_i > \hat{t} \end{cases}$$

Therefore bliss points are unique and (weakly) monotone in types. The policy outcome is the median's bliss point. **QED** ■

Proof. Proposition 3 Both \check{t} and \hat{t} negatively depend on p^S : by the definition of \check{t} and \hat{t} in the text, it follows that:

$$\frac{\partial \check{t}}{\partial p^S} = -\frac{B_{pp}(\check{t}, p^S) - (1+\lambda)C_{pp}(\check{t}, p^S)}{B_{pt}(\check{t}, p^S) - (1+\lambda)C_{pt}(\check{t}, p^S)} < 0 \quad \text{and} \quad \frac{\partial \hat{t}}{\partial p^S} = -\frac{(1+\lambda)B_{pp}(\hat{t}, p^S) - C_{pp}(\hat{t}, p^S)}{(1+\lambda)B_{pt}(\hat{t}, p^S) - C_{pt}(\hat{t}, p^S)} < 0$$

By (4), if p^S is sufficiently low, then $t_m < \check{t}$. In this case the policy outcome p_m solves $B_p(t_m, p) - (1+\lambda)C_p(t_m, p) = 0$. If p^S is sufficiently high, then $t_m > \hat{t}$. In this case p_m solves $(1+\lambda)B_p(t_m, p) - C_p(t_m, p) = 0$. By A1-A2, $B_p(t_m, p)$ is decreasing in p and $C_p(t_m, p)$ is increasing. Thus the policy outcome is lower in the former case. **QED** ■

Proof. Proposition 4 By (4), it follows that without loss aversion (i.e., $\lambda = 0$) the bliss points of all types equal the bliss points in the rational model. Implicit differentiating (4) yields,

$$\begin{aligned} \frac{\partial p^i}{\partial \lambda} &< 0 & \text{if } t_i < \check{t} \\ \frac{\partial p^i}{\partial \lambda} &> 0 & \text{if } t_i > \hat{t} \end{aligned}$$

With loss aversion, the bliss points of low types are smaller, and decreasing in the loss aversion coefficient. The bliss points of high types are larger, and increasing in the loss aversion coefficient. Moreover,

$$\frac{\partial \check{t}}{\partial \lambda} < 0 \quad \frac{\partial \hat{t}}{\partial \lambda} > 0$$

Therefore, the higher λ , the more people prefer the status quo. **QED** ■

Proof. Proposition 5 Assume that the median type has “average preferences”: $B_p(t_m, p) - C_p(t_m, p) = \bar{B}_p(p) - \bar{C}_p(p)$. By (3) with no loss aversion, t_m would choose the socially optimal policy.

Now assume loss aversion: $\lambda > 0$. By Proposition 3,

- i) if $p^S > p^*$, then either the median chooses p^S , or she chooses $p_m > p^*$;
- ii) if $p^S < p^*$, then either the median chooses p^S , or she chooses $p_m < p^*$;

iii) the policy is socially optimal only if it is already the status quo, $p^S = p^*$, and the median does not want to change it.

QED ■

Proof. Proposition 6 For expositional convenience we split the proof in two parts. We start by assuming that there is no projection bias; then, in the second part, we consider it.

First part. Assume there is no projection bias ($\alpha = 0$), so that at any period k perceived utility equals actual utility: $\tilde{V}(t_i, p^k | p^{k-2}, p^{k-1}) = V(t_i, p^k | p^{k-1})$. Let us prove that after period 1, the majority has no incentive to change the policy set at period 1. We proceed backwards: in period n , each individual i chooses her policy in order to maximize her residual lifetime utility, $V(t_i, p^n | p^{n-1})$:

$$p_i^n \in \arg \max_{p^n} \begin{cases} V(t_i, p^n) - \lambda [C(t_i, p^n) - C(t_i, p^{n-1})] & \text{if } p^n \geq p^{n-1} \\ V(t_i, p^n) - \lambda [B(t_i, p^{n-1}) - B(t_i, p^n)] & \text{if } p^n < p^{n-1} \end{cases}$$

This maximization yields the individual bliss points in period n :

$$p_i^n \text{ solves } \begin{cases} 0 = B_p(t_i, p^n) - (1 + \lambda)C_p(t_i, p^n) & \text{if } p^n > p^{n-1} & (10a) \\ p^n = p^{n-1} & \text{if } p_i^n = p^{n-1} & (10b) \\ 0 = (1 + \lambda)B_p(t_i, p^n) - C_p(t_i, p^n) & \text{if } p_i^n < p^{n-1} & (10c) \end{cases}$$

For each i , p_i^n is unique and it is weakly decreasing in t_i . Thus the equilibrium policy is the median's bliss point, p_m^n (which solves (10) above for $i = m$). This equilibrium solution is a function of the state variable, p^{n-1} . Let $p_m^n = G(p^{n-1})$ denote this function.

At time $n - 1$, any individual chooses p_i^{n-1} taking into account the consequences of her choice on the future equilibrium outcome:

$$p_i^{n-1} \in \arg \max_{p^{n-1}} \{V(t_i, p^{n-1} | p^{n-2}) + V(t_i, G(p^{n-1}) | p^{n-1})\} \quad (11)$$

For expositional convenience, let us consider the median voter. Below, we show that the median voter's bliss point is the equilibrium policy. We now prove that the median has no incentive to choose $p^{n-1} \neq G(p^{n-1})$; i.e., in period $n - 1$ she does not want to choose a policy that is different from the policy that she will choose in period n in equilibrium.

Suppose, by contradiction that she does. Say that she maximizes lifetime utility, s.t. $p^{n-1} < G(p^{n-1})$. Assume also that $p^{n-1} > p^{n-2}$. In this case, after some algebraic manipulation, we can re-write the objective function in (11) as:

$$\begin{aligned} & B(t_m, p^{n-1}) - C(t_m, p^{n-1}) + B(t_m, G(p^{n-1})) - C(t_m, G(p^{n-1})) \\ & - \lambda [C(t_m, G(p^{n-1})) - C(t_m, p^{n-2})] \end{aligned}$$

Recall that $p^{n-1} > p^{n-2}$. Thus maximizing this function w.r.t. p^{n-1} yields an interior solution which solves:

$$\frac{\partial B(t_m, p^{n-1})}{\partial p^{n-1}} - \frac{\partial C(t_m, p^{n-1})}{\partial p^{n-1}} + \frac{\partial B(t_m, p_m^n)}{\partial p_m^n} \frac{\partial p_m^n}{\partial p^{n-1}} - (1 + \lambda) \frac{\partial C(t_m, p_m^n)}{\partial p_m^n} \frac{\partial p_m^n}{\partial p^{n-1}} = 0$$

Since $p^{n-1} < p_m^n = G(p^{n-1})$, by implicit differentiating (10), $G'(p^{n-1}) = \frac{\partial p_m^n}{\partial p^{n-1}} = 0$. Thus, if $p^{n-2} < p^{n-1} < p_m^n$, the last two terms of the above equations are zero, then the equation which pins down the median's most preferred policy in period $n - 1$ is

$$\frac{\partial B(t_m, p^{n-1})}{\partial p^{n-1}} - \frac{\partial C(t_m, p^{n-1})}{\partial p^{n-1}} = 0$$

Observe that in this case the policy is chosen rationally, i.e., the policy is the same as the one in the case with no loss aversion. But this is a contradiction, because if the median chooses the policy rationally in period $n - 1$, then she will have no chance to increase her utility in period n other than keeping that policy unchanged. Thus, the policy that she chooses at $n - 1$ must be the same policy that she will choose at period n . But this contradicts the assumption that $p^{n-1} < p_m^n$.

Applying the same rationale, it can be proved that a contradiction arises also in the other three cases: 1. $p^{n-2} > p^{n-1} < p_m^n$; 2. $p^{n-2} < p^{n-1} > p_m^n$; 3. $p^{n-2} > p^{n-1} > p_m^n$. This proves that $p^{n-1} = p_m^n$: in period $n - 1$ the median sets the policy at a level that she is not willing to change in period n .

In period $n - 2$, by applying the same argument as above, it follows that $p^{n-2} = p_m^{n-1}$: the median at period $n - 2$ sets a policy that she will not be willing to change at period $n - 1$. But the latter is the same policy that she will choose at period n ; then $p^{n-2} = p_m^{n-1} = p_m^n$. Applying this same argument recursively, we end up with $p^1 = p_m^2 = \dots = p_m^n$: the first period policy is set at a level that the median will not be willing to change in any subsequent period.

We can see now how the median sets p^1 . Recall that the median's choice at period 2 – and in all subsequent periods – depends on p_1 ; thus $p_m^n = \dots = p_m^2 = G(p^1)$. Moreover, since $p_m^2 = \dots = p_m^n$, experienced utility in any period from 2 till n is constant and equal to $V(t_m, G(p^1) | p^1)$. Lifetime utility at period 1 is then $V(t_m, p^1 | p^0) + (n - 1)V(t_m, G(p^1) | G(p^1))$, and p^1 is set to maximize it. After some algebraic manipulation, we can rewrite lifetime utility as:

$$\begin{cases} n B(t_m, p^1) - n C(t_m, p^1) - \lambda [C(t_m, p^1) - C(t_m, p^0)] & \text{if } p^1 \geq p^0 \\ n B(t_m, p^1) - n C(t_m, p^1) - \lambda [B(t_m, p^1) - B(t_m, p^0)] & \text{if } p^1 < p^0 \end{cases}$$

Maximizing this function w.r.t. p^1 , and using the result above yield the following optimal choice path:

$$p_m^1 \text{ solves } \begin{cases} 0 = B_p(t_m, p^1) - \left(1 + \frac{\lambda}{n}\right) C_p(t_m, p^1) & \text{if } p_m^1 > p^0 & (12a) \\ p^1 = p^0 & \text{if } p_m^1 = p^0 & (12b) \\ 0 = \left(1 + \frac{\lambda}{n}\right) B_p(t_m, p^1) - C_p(t_m, p^1) & \text{if } p^1 < p^0 & (12c) \end{cases}$$

$$\text{and } p_m^2 = \dots = p_m^n = p_m^1 \quad (12d)$$

This proves that the median sets the policy at the first period *as if* her loss aversion were $\frac{\lambda}{n}$, and she is not willing to change it in all subsequent periods.

It only remains to prove that the median's bliss point, p_m^1 in (12) is the equilibrium policy in all periods. To see this, consider an individual i with $t_i < t_m$. She would like a policy that is (weakly) higher than the median's policy in any period. At the last period period (n), given p^{n-1} , she can only vote sincerely (cf. the proof of Proposition 2). In period $n - 1$, she has no incentive to vote strategically for a policy that is lower than the median's equilibrium, p_m^{n-1} , because if she did the only effect would be passing a p^{n-1} that would bias the median towards a lower policy in period n . Thus, she votes sincerely also in period $n - 1$.

Applying this argument recursively, it follows that she always vote sincerely, at least starting from period 2 onwards. Things are similar in period 1: in this period she has no incentive to vote for a policy that is higher than the median's equilibrium, p_m^1 , because if she did the only strategic effect would be passing a p^1 that would bias the median towards a lower policy in period 2, and in all subsequent periods. Therefore, the best thing she can do in period 1 is voting for a policy that is lower than (or equal to) p_m^1 . Thus, $p_i^1 \leq p_m^1$ for any $t_i > t_m$. Equivalently, $p_i^1 \geq p_m^1$ for any $t_i < t_m$. The equilibrium in the first period is p_m^1 (cf. 12a-12c), and it is also the equilibrium in all subsequent periods (cf. 12d).

Second part. Assume there is projection bias, $\alpha \in (0, 1]$. Let us proceed backward. In period n , any individual i chooses her policy in order to maximize her perceived residual lifetime utility $\tilde{V}(t_i, p^n \mid p^{n-2}, p^{n-1})$, as defined by (5):

$$p_i^n \in \arg \max_{p^n} \begin{cases} V(t_i, p^n) - \lambda(1 - \alpha) [C(t_i, p^n) - C(t_i, p^{n-1})] & \text{if } p^n \geq p^{n-1} \\ - \lambda\alpha [B(t_i, p^{n-2}) - B(t_i, p^n)] & \text{and } p^n \geq p^{n-2} \\ V(t_i, p^n) - \lambda(1 - \alpha) [B(t_i, p^{n-1}) - B(t_i, p^n)] & \text{if } p^n < p^{n-1} \\ - \lambda\alpha [B(t_i, p^{n-2}) - B(t_i, p^n)] & \text{and } p^n < p^{n-2} \end{cases}$$

This maximization yields the individual bliss points. As in the first part of this proof, the equilibrium policy is the one preferred by the median, but it is a function of the state variables p^{n-1} and p^{n-2} : $p_m^n = T(p^{n-1}, p^{n-2})$.

At time $n - 1$, each individual chooses her most preferred policy, p_i^{n-1} :

$$p_i^{n-1} \in \arg \max_{p^{n-1}} \left\{ \tilde{V}(t_i, p^{n-1} \mid p^{n-3}, p^{n-2}) + \tilde{V}(t_i, p^n \mid p^{n-2}, p^{n-1}) \right\}$$

Again, one can easily verify that the equilibrium policies of periods $2, \dots, n$ coincide with the median's plan to keep these policies unchanged: $p_m^n = \dots = p_m^2 = p^1$.

We can now see how the median sets p^1 : lifetime perceived utility at period 1 is $V(t_m, p^1 \mid p^0) + (1 - \alpha)V(t_m, p_m^2 \mid p^1) + \alpha V(t_m, p_m^2 \mid p^0) + (n - 2)V(t_m, p_m^2 \mid p^1)$. Recall that the equilibrium policy at time 2 is $p_m^2 = T(p^1, p^0)$. Then we can re-write perceived utility as $V(t_m, p^1 \mid p^0) + (1 - \alpha)V(t_m, T(p^1, p^0) \mid p^1) + \alpha V(t_m, T(p^1, p^0) \mid p^0) + (n - 2)V(t_m, T(p^1, p^0) \mid p^1)$. After some algebraic manipulation, we obtain:

$$\begin{cases} \begin{aligned} &nB(t_m, p^1) - nC(t_m, p^1) - \lambda [C(t_m, p^1) - C(t_m, p^0)] \\ &-\lambda(1 - \alpha) [C(t_m, T(p^1, p^0)) - C(t_m, p^1)] \\ &-\lambda\alpha [C(t_m, T(p^1, p^0)) - C(t_m, p^0)] \end{aligned} & \begin{aligned} &\text{if } p^1 \geq p^0 \\ &\text{and } T(p^1, p^0) \geq p^0 \end{aligned} \\ \\ \begin{aligned} &nB(t_m, p^1) - nC(t_m, p^1) - \lambda [B(t_m, p^1) - B(t_m, p^0)] \\ &-\lambda(1 - \alpha) [B(t_m, p^1) - B(t_m, T(p^1, p^0))] \\ &-\lambda\alpha [B(t_m, p^0) - B(t_m, T(p^1, p^0))] \end{aligned} & \begin{aligned} &\text{if } p^1 < p^0 \\ &\text{and } T(p^1, p^0) < p^0 \end{aligned} \end{cases}$$

Maximizing this function w.r.t. p^1 , and using the result above yields the following optimal choice path (observe that $p_m^2 = p^1$ implies that $\frac{\partial T}{\partial p^1}(p^1, p^0) = 1$):

$$p_m^1 \text{ solves } \begin{cases} 0 = B_p(t_m, p^1) - \left(1 + \frac{\lambda(1 + \alpha)}{n}\right) C_p(t_m, p^1) & \text{if } p_m^1 > p^0 & (13a) \\ p^1 = p^0 & \text{if } p_m^1 = p^0 & (13b) \\ 0 = \left(1 + \frac{\lambda(1 + \alpha)}{n}\right) B_p(t_m, p^1) - C_p(t_m, p^1) & \text{if } p^1 < p^0 & (13c) \end{cases}$$

$$\text{and } p_m^2 = \dots = p_m^n = p_m^1 \quad (13d)$$

This proves that the median sets the policy at the first period *as if* her perceived loss aversion were $\frac{\lambda(1+\alpha)}{n}$, and she is not willing to change it in any subsequent period. Observe that an increase in the projection bias parameter, α , will increase perceived loss aversion.

By the same argument as in the first part, it follows that the median's plan above is also the plan that the majority chooses at the first period.

Finally, we prove that this plan is time inconsistent: in period 2, after having chosen $p_m^2 = p_m^1$, the median realizes that her true utility is $V(t_m, p_m^2 | p_m^1)$ instead of $\tilde{V}(t_m, p_m^2 | p_m^1, p^0)$. Suppose that $p_m^1 > p^0$; by (13a), true utility in period 2 (and in later periods) is not maximized by $p^2 = p_m^1$. This level is too low, so the median would have rather chosen a level such that $B_p(t_m, p^1) - (1 + \frac{\lambda}{n})C_p(t_m, p^1) = 0$. Thus, in period 2 there is scope to increase utility by choosing a different policy. This is the case if there exists a level of $p^2 > p_m^1$ which solves $B_p(t_m, p^2) - (1 + \frac{\lambda(1+\alpha)}{n-1})C_p(t_m, p^2) = 0$. In period 2 the median chooses the policy as if her loss aversion parameter is $\frac{\lambda(1+\alpha)}{n-1}$. She is still subject to the projection bias as regards the next period, and her residual life is $n - 1$ periods. Moreover in period 2 she will plan to keep the new policy unchanged for all later periods. This latter plan may be time inconsistent as well: for the same reason, the median might be willing to change it in period 3.

This process of plan revisions stops at period h if h is such that $B_p(t_m, p^{h-1}) - (1 + \frac{\lambda}{n-(h-1)})C_p(t_m, p^2) > 0$ and $B_p(t_m, p^h) - (1 + \frac{\lambda(1+\alpha)}{n-h})C_p(t_m, p^2) < 0$. In words, the policy chosen in period $h - 1$ is ex post suboptimal, but in period h , because of loss aversion and too short residual life, there is no incentive to change it. **QED** ■

Proof. Proposition 7 Let $\bar{p} = q(p + \theta^g) + (1 - q)(p - \theta^b)$ be the expected outcome of the risky plan, and assume $E(\theta) = 0$.

- i) In case of large scale risk, the concavity of $B(\cdot)$ implies that for any i and any p it holds $E[V(t_i, p, \theta)] < V(t_i, \bar{p})$: all voters prefer the risk-free plan with the same expected outcome. Moreover, by the concavity of $B(\cdot)$, between two risky plans all voters prefer the less risky one; i.e., the plan which is second-order stochastically dominant.
- ii) Small-scale risk implies that $V(t_i, p, \theta)$ is substantially linear in p (cf. Rabin's Calibration theorem), so voters are risk-neutral. Thus irrespective of risk, all voters are indifferent between two policy plans with the same mean, while they always prefer the plan with the highest expected outcome.
- iii) The optimality condition which pins down voter i 's most preferred policy is: $E[B_p(p, \theta)] = C_p(t_i, p)$. If $B_p(p, \theta)$ is convex in p then for any p , $E[B_p(p, \theta)] > B_p(\bar{p})$. This implies that the optimality condition is satisfied for a higher value of p : all voters prefer more p when the policy is risky.
- iv) For any probability distribution of θ (i.e., for any q), by implicit differentiating the optimality condition above, it follows that voter i 's most preferred policy is decreasing in t_i . Thus the decisive voter is the median.

QED ■

Proof. Proposition 8

- i) Let $[\check{t}^u, \hat{t}^u]$ be the set of types that want the status quo when there is uncertainty. As above, $[\check{t}, \hat{t}]$ is the set of types that want the status quo when there is no uncertainty. We have to show that $\check{t} < \check{t}^u$ and $\hat{t}^u < \hat{t}$.

Voter i 's experienced indirect utility when there is uncertainty and the reference point is the status quo is the following

$$\begin{aligned}
 E[V(t_i, p, \theta | p^S)] &= \\
 &= \begin{cases} E[V(t_i, p, \theta)] - \lambda [C(t_i, p) - C(t_i, p^S)] & \text{if } p \geq p^S + \theta^b \\ E[V(t_i, p, \theta)] - \lambda [C(t_i, p) - C(t_i, p^S)] \\ \quad - \lambda(1 - q) [B(p^S) - B(p - \theta^b)] & \text{if } p^S < p < p^S + \theta^b \\ E[V(t_i, p, \theta)] - \lambda(1 - q) [B(p^S) - B(p - \theta^b)] & \text{if } p^S - \theta^g < p \leq p^S \\ E[V(t_i, p, \theta)] - \lambda [B(p^S) - E[B(p, \theta)]] & \text{if } p \leq p^S - \theta^g \end{cases} \quad (14)
 \end{aligned}$$

In this function, $E[V(t_i, p, \theta)]$ is the expected utility without loss aversion (cf. equation 6). The additional terms weighed by λ capture loss aversion.

As pointed out earlier, \check{t} solves $B_p(p^S) - C_p(t, p^S) - \lambda C_p(t, p^S) = 0$, and \hat{t} solves $B_p(p^S) - C_p(t, p^S) + \lambda B_p(p^S) = 0$. Similarly, \check{t}^u solves $E(B_p(p^S, \theta)) - C_p(t, p^S) - \lambda C_p(t, p^S) + \lambda(1 - q)B_p(p^S - \theta^b) = 0$, and \hat{t}^u solves $E(B_p(p^S, \theta)) - C_p(t, p^S) + \lambda(1 - q)B_p(p^S - \theta^b) = 0$. Recall that $C_p(t, p^S)$ is increasing in t . Since $E(B_p(p^S, \theta)) = B_p(p^S)$, then $\check{t} < \check{t}^u$ and $\hat{t}^u < \hat{t}$.

Observe that $E(B_p(p^S, \theta)) = B_p(p^S)$ is only a sufficient condition: in fact, we have that $\check{t} < \check{t}^u$ and $\hat{t}^u < \hat{t}$ as long as $E(B_p(p^S, \theta))$ is not too different from $B_p(p^S)$.

- ii-iii) Take a type $t_i \in (\hat{t}^u, \hat{t})$. Without uncertainty, since $t_i < \hat{t}$ then $(1 + \lambda)B_p(t_i, p^S) - C_p(t_i, p^S) > 0$, and $B_p(p^S) - (1 + \lambda)C_p(t_i, p^S) < 0$: she prefers the status quo. Under uncertainty, since $t_i > \hat{t}^u$ then $E(B_p(p^S, \theta)) - C_p(t_i, p^S) + \lambda(1 - q)B(p^S - \theta^b) < 0$, and $E(B_p(p^S, \theta)) - (1 + \lambda)C_p(t_i, p^S) + \lambda(1 - q)B(p^S - \theta^b) < 0$. Thus when there is uncertainty this high type t_i wants lower the policy w.r.t. the status quo. Similarly, it is possible to prove that, under uncertainty, all types in (\check{t}, \check{t}^u) want a policy that is higher than the status quo.

- iv) The proof consists in showing that the p^i which maximizes (15) is weakly decreasing in t . This proof parallels the proof of Proposition 7.iv) above. Thus we omit it.

QED ■

Proof. Proposition 9 All agents expect risk. If they choose the reference policy, p^S , the outcome is either $p^S + \theta^g$ with probability q , or $p^S - \theta^b$ with probability $(1 - q)$.

Voter i 's experienced indirect utility in this case is

$$E [V(t_i, p, \theta | p^S)] = \begin{cases} E [V(t_i, p, \theta)] - \lambda [C(t_i, p) - C(t_i, p^S)] & \text{if } p \geq p^S + \theta^b + \theta^g \\ E [V(t_i, p, \theta)] - \lambda [C(t_i, p) - C(t_i, p^S)] + \\ \quad - \lambda q(1 - q)M & \text{if } p^S < p < p^S + \theta^b + \theta^g \\ E [V(t_i, p, \theta)] - \lambda [q^2 L + q(1 - q)M + \\ \quad + (1 - q)^2 Q] & \text{if } p^S - \theta^g - \theta^b < p \leq p^S \\ E [V(t_i, p, \theta)] - \lambda [q^2 L + q(1 - q)M + \\ \quad + (1 - q)qN + (1 - q)^2 Q] & \text{if } p \leq p^S - \theta^g - \theta^b \end{cases} \quad (15)$$

with $L = L(p, \cdot) \equiv B(p^S + \theta^g) - B(p + \theta^g)$; $M = M(p, \cdot) \equiv B(p^S + \theta^g) - B(p - \theta^b)$;
 $N = N(p, \cdot) \equiv B(p^S - \theta^b) - B(p + \theta^g)$; $Q = Q(p, \cdot) \equiv B(p^S - \theta^b) - B(p - \theta^b)$.

The rationale of $E [V(t_i, p, \theta | p^S)]$ above is the following:

L is the loss of benefits experienced when the agent expects the good state and the good state actually occurs. This loss occurs with probability q^2 , and only when she chooses $p \leq p^S$;

M is the loss of benefits experienced when the agent expects the good state, but the bad state actually occurs, so that benefits are lower than $B(p^S + \theta^g)$. This loss occurs with probability $q(1 - q)$, and only when she chooses $p < p^S + \theta^b + \theta^g$;

N is the loss of benefits experienced when the agent expects the bad state, but the good state occurs; however benefits are lower than $B(p^S - \theta^b)$. This loss occurs with probability $q(1 - q)$, and only if she chooses $p \leq p^S - \theta^g - \theta^b$;

Q is the loss of benefits experienced when the agent expects the bad state, and the bad state occurs; however benefits are lower than $B(p^S - \theta^b)$. This loss occurs with probability $(1 - q)^2$, and only when she chooses $p \leq p^S$.

- when the agent chooses $p > p^S$, the cost is higher than the status quo; the usual experienced loss for higher cost is $C(t_i, p) - C(t_i, p^S)$.

Let $[\tilde{t}^{us}, \hat{t}^{us}]$ be the set of types that want the status quo when there is uncertainty and the reference policy is stochastic. This interval is different when the reference policy is stochastic. Specifically, in order to prove this proposition we have to show that $\tilde{t}^{us} < \tilde{t}^u$ and $\hat{t}^{us} > \hat{t}^u$ where \tilde{t}^u and \hat{t}^u are defined in the proof of Proposition

8. This implies that more people want to keep the status quo when the reference policy is stochastic.

Consider \hat{t}^{us} : it solves $E(B_p(p^S, \theta)) - C_p(t, p^S) - \lambda C_p(t, p^S) - \lambda q(1-q)M_p(p^S, \cdot) = 0$. Since $M_p(p^S, \cdot) = -B_p(p^S - \theta^b)$, and since $q(1-q) < (1-q)$, then it is easily proved that $\hat{t}^{us} < \hat{t}^u$. Now consider \hat{t}^{us} : it is implicitly defined by $E(B_p(p^S, \theta)) - C_p(t, p^S) - \lambda q^2 L_q(p^S, \cdot) - \lambda q(1-q)M_p(p^S, \cdot) - \lambda(1-q)^2 Q_q(p^S, \cdot) = 0$, with $L_q(p^S, \cdot) = -B_p(p^S + \theta^g)$, and $Q_q(p^S, \cdot) = -B_p(p^S - \theta^b)$. By simple algebraic manipulation, $L_q(p^S, \cdot) - \lambda q(1-q)M_p(p^S, \cdot) - \lambda(1-q)^2 Q_q(p^S, \cdot) > \lambda(1-q)B_p(p^S - \theta^b)$.

Recall by the proof of Proposition 8 that \hat{t}^u solves $E[B_p(p^S, \theta)] - C_p(t, p^S) + \lambda(1-q)B_p(p^S - \theta^b) = 0$. Thus, for any t , the LHS of the latter equation is always smaller than the LHS of the equation above which defines \hat{t}^{us} . Therefore, $\hat{t}^{us} > \hat{t}^u$. **QED** ■

9 Appendix 2: Loss Aversion with Lump Sum Transfers

As in Meltzer and Richard (1981), the policy consists in a lump-sum transfer financed by a proportional income tax. Individuals are heterogeneous in labor productivity (x_i). The distribution of x_i is common knowledge, and its average is normalized to one: $\bar{x} = 1$. Individuals are risk neutral and draw utility from consumption and disutility from labor. Their utility is:

$$v_i = c_i - U(l_i)$$

where c is consumption, l is labor, and $U(\cdot)$ is an increasing and convex function with $U(0) = 0$. Labor is the only factor of production. The government can levy a linear income tax τ and provide a non-negative lump sum transfer r . The budget constraint of individual i is:

$$c_i = x_i l_i (1 - \tau) + r$$

The balanced public budget constraint is (the population size is one):

$$\tau \bar{l} = r$$

Individual labor choice is:

$$l_i^* \in \arg \max_{l_i} x_i l_i (1 - \tau) + r - U(l_i)$$

The individual optimality condition,

$$x_i (1 - \tau) - U'(l_i) = 0$$

yields individual labor supply:

$$l_i^* = U'^{-1}(x_i(1 - \tau))$$

Since $U'^{-1}(\cdot)$ is an increasing function, individual (and total) labor supply increases in productivity and decreases in taxes.

Using the government budget constraint, the individual policy preference function (recall that $\bar{x} = 1$) is:

$$V_i(\tau) = l_i^* x_i (1 - \tau) + \tau L^*(\tau) - U(l_i^*)$$

where $L^*(\tau)$ is the equilibrium total labor supply function. Recall that $l_i^* x_i = y_i$ and $L^*(\tau) = \bar{y}(\tau)$. Then,

$$V_i(\tau) = y_i(1 - \tau) + \tau \bar{y}(\tau) - U\left(\frac{y_i}{x_i}\right)$$

Applying the envelop theorem, and maximizing, yields the optimality condition (Meltzer and Richard, 1981, eq. (13), p. 920), which pins down the individuals' bliss points:

$$\bar{y} + \tau \frac{\partial \bar{y}}{\partial \tau} - y_i \leq 0$$

Bliss points are interior only for individuals whose labor productivity is lower than the average, $x_i < 1 \rightarrow y_i < \bar{y}$. All the other types want zero tax.

Let us now apply loss aversion. We assume that an individual does not compensate mentally taxes with transfers: i.e., she perceives the monetary amount of taxes that she pays separately with respect to the amount of transfers that she receives. Let τ^S be the status quo tax rate. By loss aversion, the indirect utility is computed relative to the status quo, and losses are overweighed. Thus for individuals who enjoy positive net transfers, it becomes (under $\tau \bar{y}(\tau) - \tau^S \bar{y}(\tau^S) > 0$):

$$V_i(\tau, y_i | \tau^S) = \begin{cases} [y_i(1 - \tau) - y_i(1 - \tau^S)] (1 + \lambda) + \tau \bar{y}(\tau) - \tau^S \bar{y}(\tau^S) & \text{if } \tau \geq \tau^S \\ - [U(y_i) - U(y_i)] & \\ y_i(1 - \tau) - y_i(1 - \tau^S) + [\tau \bar{y}(\tau) - \tau^S \bar{y}(\tau^S)] (1 + \lambda) & \text{if } \tau < \tau^S \\ - [U(y_i) - U(y_i)] & \end{cases}$$

The first line says that, by loss aversion, the voter overweighs the reduction of personal income (a loss) when she decides for a tax increase. The second line says that she overweighs the loss of transfers if the tax rate decreases. The optimality condition is then

$$\begin{cases} \bar{y} + \tau \frac{\partial \bar{y}}{\partial \tau} - y_i(1 + \lambda) \geq 0 & \text{if } \tau \geq \tau^S \\ [\bar{y} + \tau \frac{\partial \bar{y}}{\partial \tau}] (1 + \lambda) - y_i \geq 0 & \text{if } \tau < \tau^S \end{cases}$$

Starting from this point, all results of the model with public good provisions (in the text) also hold in this model of lump sum redistribution.