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Abstract. We model imperfect governments with public choices which are sequential, myopic, and not free of error. We first use this framework to explore governmental incremental budgeting. We argue that a model of bounded rationality is required to capture the empirical reality of incremental budgeting. We then provide a model which integrates bounds errors and systematic errors. We argue that the empirical evidence is that bounds errors and systematic errors are inextricably intertwined—some level of bounded rationality is required for systematic errors to emerge. We use this to explore political information lobbying. A testable hypothesis is that lobbyists will focus efforts on policy makers of low ability. We show that choosing leaders with high ability, that is Madison's wisdom to discern, is important, especially when policy decisions concern dangerous products (rifles) or dangerous environments (pandemics).

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1. Introduction

We imagine a collective agent, the government, that distributes a resource among a fixed number of policy alternatives. The distribution of the resource among alternatives is a public policy mix. A particular policy mix affects the well–being of individuals. We assume that the government is benevolent in aiming for the best outcome for its citizens. However, we also assume, that the government lacks the information–processing capacity required for a direct comparison of all feasible alternatives. Instead of finding at once a best allocation, the government myopically adjusts the current allocation toward more desired policies. During this adjustment process, the government makes errors inversely proportional to its ability to choose. Our model is not about what governments know (incomplete information), it is about how they use what they know (imperfect processing of information). The impact of public sector errors on people can be specified in the context of that model.

Our approach is based on a theoretical framework developed by de Palma et al. (1994), which allows to investigate the impact of errors made by individuals on their utilities in the case of bounded rationality. Here we adapt this framework in order to investigate the impact of errors in public choice by governments making bounds errors.[1] This approach is absent from the growing economic literature on imperfect public choice, which focus instead on systematic errors. A take on the quickly evolving state of the art in public economics when governments face individuals who make systematic errors is captured in Bernheim and Taubinsky's (2018) chapter on Behavioral Public Economics in the Handbook of Behavioral Economics. There is also a growing and more recent literature on governments that make systematic public choice errors.[2]

Although modelling governments that make systematic errors is important, we will

[1] As will be clear below, our approach is applicable to organizations beyond governments, for example, universities. The term 'bounds errors' has been introduced by Rabin (2013) to denote errors which are about the computational unmanagability of a choice problem. 'Bounds' errors are distinguished from 'astray' errors (also Rabin's term), which arise not from the complexity of a problem but rather from human intuition that leads choices sytematically astray. We will label the latter systematic errors.

[2] In introducing imperfect public choice, the usual approach is through voters, for example a median voter, who makes systematic errors. Bischoff and Siemers (2011) model retrospective voters with biased beliefs, Ortoleva and Snowberg (2015) over–confident voters, Piguillem and Riboni (2015) voters with present bias, Bo et. al. (2018) voters under–appreciating equilibrium effects, and Lockwood and Rockey (2020) voters susceptible to loss aversion.

argue that simple computational unmanageability as in bounded rationality is also important. First, there is good empirical evidence that bounded rationality is required for the emergence of systematic errors and so we provide a formal model of the interaction between bounds and systematic errors. Second, we argue that it is not possible to make sense of classic and common public choice methods (e.g. incremental budgeting) in the absence of bounded rationality. Finally, we argue that we need bounded rationality in order to capture the full potential threat to society from (dis)informational political lobbying.

In Section 2 we model *incremental budgeting.* This is the classic public sector budgeting method for governments and other bureaucracies (for example, university administrations) which aim to allocate annually their expected operating revenue among ministries or bureaus in funding policies (see Wildavsky (1964) and Wildavsky and Caiden (2001)). The backbone of incremental budgeting is small, one at a time, myopic and sequential decisions, ongoing indefinitely into the future. There is no comparison of all possible alternatives across space and time. We argue that the use of this very common budgeting methodology can only be explained in a world of imperfect ability. In other words, a model of bounded rationality is required to be true to the empirical reality of incremental budgeting. We identify specific components of incremental budgeting, which fit Simon's (1955) search for alternatives, satisficing and aspiration adjustment, and we model them. The nature of our model also fits the experiments in Selten et al. (2012) well. If there is no ability to choose in our model, all government choices are equiprobable irrespectively of existing differences in the true value of alternatives. We show that higher ability to choose tightens the choices around better alternatives until at the limit where the ability to choose is perfect, the outcome is exactly analogous to the solution of a standard constrained optimisation problem where a government makes no errors. We also show in our model that a larger dispersion in the social impact of choices, for example, in the presence of possibly dangerous policy choices, increases the importance of making good choices.

In Section 3, we provide a formal extension of our model which integrates bounds errors and systematic errors. We argue that bounds errors and systematic errors are inextricably intertwined—some level of bounded rationality is required for systematic errors to emerge. The existence of bounds errors in a population with individuals of differing abilities to choose explains the empirical observation of a heterogeneous vulnerability to systematic errors.[3]

In Section 4, we apply the model of Section 3 to informational political lobbying. While the regulation of campaign contributions to avoid quid pro quo is pervasive, informational lobbying is considered less of a threat. For example, a ruling by the US Supreme Court in Citizen's United v. Federal Election Commission (130 US 876 (2010)) allows corporations to spend unlimited amounts on political advocacy advertisement during US election campaigns. While economists find the need for the strict management of quid pro quo lobbying natural, it is not so natural for economists to see the need for the regulation of informational lobbying. This is not surprising because, in existing economic models of informational lobbying, the policy makers are unboundely rational. In contrast, we use our framework to model the idea that informational lobbying can be an attempt to move decision–makers away from an accurate assessment of a policy and towards particular policies favoured by the lobbyist. When it is simply information which is being provided by a special interest group to a policy maker, it is not at all clear what role the lobbyist is playing. In our model informational lobbying agencies can be thought of as advertizing agencies who may provide disinformation. We first show that a lobbyist may have the incentive to help elect low ability policy makers in making their lobbying efforts more productive. We then show that in equilibrium, the model predicts that lobbyists will tend to aim their lobbying efforts at policy makers with a lower ability to choose. This is testable. Further we show that, with boundedly rational public choice, there are societal benefits from the optimal regulation of informational lobbying and advertisement. We finally show that this is particularly true when lobbying influences policies about dangerous products, such as assault rifles or global pandemics, especially with governments of

[3] To offer one example here, consider, Herrnstein's (1991) experiments. Many experimental subjects facing a somewhat complex dynamic problem fell back choosing on the basis of current costs and benefits. However, this was not true of all experimental subjects. Some individuals used the same information to fully solve the same dynamic problems. It is as if their tendency to make systematic errors was mitigated according to their ability to choose.

lower ability. Taken together these imply that public efforts and expenditures on creating a highly–trained and highly–valued civil service is rational in managing lobbying effects and in generating good outcomes. A further prerequisite for the effective management of lobbying is the choice of leaders with high ability, in other words, leaders with Madison's 'wisdom to discern'.[4]

2. Boundedly Rational Incremental Budgeting

We consider a government that allocates a resource among a number m of *bureaus* such as health, education, public works, the military or policing and so on. The search for an *optimal* public policy mix requires global comparisons of detailed feasible distributions of the resource among bureaus and, furthermore, a mapping back from each feasible allocation to a single, all encompassing objective function. We assume that the government does not have the ability to make such global comparisons in order to determine an optimal public policy (see Harstad and Selten (2013 p. 505)).

The seminal contributor to governmental budgeting was the political scientist Aaron Wildavsky, see Wildavsky (1964) and Wildavsky and Caiden (2001).[5] The classic approach is incremental budgeting. In Wildavsky and Caiden's chapter describing incremental budgeting, some of the subsections are entitled: Budgeting is Historical; Budgeting is Simplified; Budgeting is Sequential; Budgeting is Repetitive; and Budgeting is Satisficing.

> "General agreement on past budgetary decisions combined with years of accumulated experience and specialization allow those who make the budget to be concerned with relatively small increments to an existing base. " (page 47)
>
> "Calculations may be simplified by lowering one's sights. Although they do not use Herbert Simon's vocabulary budget officials do not maximize but, instead, they "satisfice" (satisfy and suffice). " (page 47)

[4] Besley (2006) starts his book, *Principled Agents,* with a quote from Madison, framer of the American Constitution (1788): "The aim of every political Constitution, is or ought to be, first to obtain for rulers men who possess most wisdom to discern, and most virtue to pursue, the common good of society; and in the next place, to take the most effectual precautions for keeping them virtuous whilst they continue to hold their public trust." Besley focuses on virtue, we focus on wisdom.

[5] Wildavsky's ideas were developed and expanded in Jones and Baumgartner (2002). For recent references on public budgetting see MacDonald (2011).

Incremental budgeting is also prevalent beyond governments. For example, in universities,

> "...incremental budgeting is the most common: decisions are centrally driven; changes are at the margins of historical base budgets." Curry et. al. (2013 p. 13)

Under incremental budgeting a government allocates incremental adjustments to existing budgets. Well in advance of the next fiscal year, a central budgeting committee estimates coming fiscal–year revenue and costs and sometimes decides to supplement the incremental adjustment pool by applying an across–the–board cut. The pool is often relatively small. The committee asks for proposals from the bureaus connected to new or existing policies, evaluates them and then makes choices over the set of proposals until the pool is exhausted. In other words, the backbone of incremental budgeting consists of small, one at a time, sequential, myopic decisions, ongoing indefinitely into the future. All feasible policy alternatives are not compared in the current period or across all time as required in an unboundedly rational story. The obvious question is why?

We maintain that the use and nature of this very common budgeting methodology can only be understood in a world of imperfect ability to choose. It is a heuristic. Toward this end we use the myopic and incremental adjustment process in de Palma et. al. (1994, Sections I and II) to portray in a simple manner what seems essential to applied public choice, namely, that public choice is about a sequence of myopic decisions aiming to change allocation parts rather than about determining at once a final, best allocation. This theoretical approach is true to the empirical reality of incremental budgeting as is clear from the work of Wildavsky and more broadly in the work of Herbert Simon (1955). On Simon's aspiration adjustment, the hope in the central budgeting committee is that small incremental adjustment in each year, repeated across years, will lead to an acceptable outcome while managing workload and mitigating risks. On Simon's search for alternatives, the committee, not immediately knowing the best use for funds, invites bureaus to submit proposals for incremental adjustments. Finally, we will show that in the presence of errors the steady state of our model is not optimizing—it is Simon's satisficing.[6]

2.1. A Model of Incremental Budgeting. Government decisions are taken in a series of gradual steps over the years. We begin with the current *fiscal year,* $t-1$, and consider the incremental budgeting decisions which will determine the final budget for year t to be applied at the beginning of that year. We assume that the total amount of resources available at the beginning of any year is fixed and equals B; and that the final allocation of resources among the m bureaus in year $t-1$ is given by the vector

$$\mathbf{B}_{t-1} \equiv (B_{1,t-1}, ..., B_{i,t-1}, ..., B_{m,t-1})$$

where B_i represents the *budget* of bureau i with[7]

$$\sum_{i=1}^{m} B_{i,t-1} = B.$$

To simplify, we assume that the external environment, including revenue and costs, does not change over the years so that the pool is created solely by the across–the–board cut, the size of which we also assume to be fixed over the years. Well in advance of the next fiscal year t, the central committee in the current year $t-1$ decides to generate an *incremental adjustment pool* of resources equal to $w > 0$. Collecting this amount requires an *across–the–board cut rate* of $0 < c < 1$, defined by $w = cB$, and which reduces the budget of each bureau proportionally. Given the size of the incremental cut, incremental adjustment starts with a preliminary stage allocation $\mathbf{B}_t^{(0)} = (B_{1,t}^{(0)}, ..., B_{i,t}^{(0)}, ..., B_{m,t}^{(0)})$ of base budgets that correspond to the final allocation of resources in the previous year net of their across–the–board cuts,

$$B_{i,t}^{(0)} = (1-c)B_{i,t-1} \quad \text{for} \quad i = 1, ..., m. \tag{1}$$

[6] Modelling of strategic interaction across committee members, and more generally, agency problems with these committees do exist. We take a step back, focus on a simple, benevolent representative agent model of government and take first steps to understand the underlying decision–theoretic problem.

[7] To tie this more closely to individual policies we can interpret the B_i components as line item budgets within a bureau's overall budget. Then the appropriate cost functions for particular policies.

In principle, there are still an infinite number of feasible ways in which the incremental adjustment pool w could be allocated among the m bureaus. For consistency with incremental budgeting, we assume that w is allocated across the m bureaus in the current year using a sequence of small and myopic decision steps.[8] The government calls for the bureaus to submit one, one–unit proposal in each step, evaluates the m proposals and allocates the unit to what it perceives to be the single best proposal by a bureau. This leads to the government considering only m public policy mixes at any step.

If the first resource unit is allocated to bureau i, the re–allocated government's budget at the first step will be given by

$$\mathbf{B}_{i,t}^{(1)} = ((1-c)B_{1,t-1}, ..., (1-c)B_{i,t-1} + 1, ..., (1-c)B_{m,t-1}) \text{ for } i = 1, ..., m. \quad (2)$$

Let $Y_{i,t}^{(1)} = f[B_{i,t}^{(1)}]$ be the government's myopic perception of the societal benefit of policy mix $B_{i,t}^{(1)}$ in the first step. It will normally be a misperception, that is, not free of error. It is myopic in that future consequences of current allocation decisions are not considered (see de Palma et. al. (1994) Section I Myopic Adjustments, for example, footnote 4) as well as other possible bounds errors associated with the computational unmanageability of the problem.

The m corresponding perceived *impact increments* of allocating one-unit of resources to bureau i are

$$\Delta\mathcal{Y}_{i,t}^{(1)} = f[\mathbf{B}_{i,t}^{(1)}] - f[\mathbf{B}_{t}^{(0)}] \text{ for } i = 1, ..., m.$$

We assume that the government allocates the unit at the first step to bureau j such that

$$\Delta\mathcal{Y}_{j,t}^{(1)} = \max\{\Delta\mathcal{Y}_{i,t}^{(1)} \text{ for } i = 1, ..., m\}. \quad (3)$$

In all subsequent steps $l = 2, ...w$ within the year the government considers the

[8] This is consistent with Selten et. al. (2012) who provide experimental evidence about individuals working sequentially on self–selected sub–goals, one at a time, without even eventually making the trade–offs across sub–goals which are necessary in order to solve the overall problem.

submitted proposals in order to decide where to allocate the unit at the next step. The impact increment of an award to bureau i at the second step is perceived to be $\Delta\mathcal{Y}_{i,t}^{(2)} = f[\mathbf{B}_{i,t}^{(2)}] - f[\mathbf{B}_{j,t}^{(1)}]$, where $\mathbf{B}_{j,t}^{(1)}$ is given by (2) provided it was bureau j that received the unit of resource in the previous step. In general, the calculation of impact increments is exactly analogous to that of step 2,

$$\Delta\mathcal{Y}_{i,t}^{(\ell)} = f[\mathbf{B}_{i,t}^{(\ell)}] - f[\mathbf{B}_{j,t}^{(\ell-1)}],$$

provided that bureau j was awarded the resource unit in the preceding step $\ell - 1$. It is as if the government in each year aims to employ a gradient strategy in order to climb along the steepest slope of the perceived impact surface toward a peak of that surface—a strategy that represents the government's incremental budgeting heuristic.

Once the w single–unit decision steps are complete in a year's incremental budgeting process then the year's consumption occurs and we arrive at the beginning of next year and the next budgeting process. Next year's starting point is $\mathbf{B}_{t+1}^{(0)} \equiv \mathbf{B}_t^{(w)}$. In this way there is a long sequence of small decision steps going off into the indefinite future.

2.2. Perception Errors. To assume government perceptions are accurate in our model, would be to presume that governments are perfectly capable to determine the incremental effects of the m alternative policy mixes. In realistically complex situations where cognitive limits exist, it is well-established that people, and so governments, do make bounds errors while taking decisions based on choice procedures such as (3).[9] We now model those errors through the simple process**,**

$$\Delta\mathcal{Y}_{i,t}^{(\ell)} = \Delta\Upsilon_{i,t}^{(\ell)} + \varepsilon_{i,t}, \tag{4}$$

where $\Delta\mathcal{Y}_{i,t}^{(\ell)}$ and $\Delta\Upsilon_{i,t}^{(\ell)}$ respectively stand for the *perceived* and the *true* impact increments of public policy i at step l of period t.

[9]It would be possible to model incomplete information, but for simplicity and methodolical clarity here, we assume complete information. Then errors are not about what governments know, but about how governments use what they know.

We will consider biased errors in the next Section, but for now we assume that those errors are random and that they are i.i.d. Gumbel distributed across time and sectors with zero mean. We can therefore write them as

$$\varepsilon_{i,t} \sim \frac{\varepsilon}{\mu} \text{ for } \mu > 0 \text{ and } \varepsilon_{i,t} \to 0 \text{ as } \mu \to \infty, \tag{5}$$

where ε has zero mean and μ^{-1} is the dispersion parameter of the random errors $\varepsilon_{i,t}$. Since those errors become smaller as μ increases, we say that μ portrays the government's *ability to choose*, where larger μ corresponds to higher ability. The ability to choose is about the government's wisdom to discern.

By replacing perceived impact increments with true impact increments in (3), we obtain our intended description of the sequence of myopic choice procedures used by the government in its effort to determine a best public policy. Namely, we imagine that the government allocates the unit of the resource to bureau i in step l if

$$\Delta\Upsilon_{i,t}^{(l)} + \varepsilon_{i,t} = \max\left\{\Delta\Upsilon_{j,t}^{(l)} + \varepsilon_{j,t} \text{ for } j = 1, ..m\right\}. \tag{6}$$

The errors imply that government choices based on (6), can only be determined up to a corresponding probability distribution which, following McFadden (1994), is given by the multinomial logit model, where $\mathbb{P}_{i,t}^{(l)}$ is the probability that the government allocates the unit of resource to bureau i at the beginning of step l of period t, or

$$\mathbb{P}_{i,t}^{(l)} = \frac{\exp\left(\mu\Delta\Upsilon_{i,t}^{(l)}\right)}{\sum_{j=1}^{m}\exp\left(\mu\Delta\Upsilon_{j,t}^{(l)}\right)}. \tag{7}$$

2.3. Stationary State. We expect that the adjustment process (6) may lead to some time–invariant equilibrium or *stationary state* over the budgeting years. In every step l bureau i receives one unit of the resource with probability $\mathbb{P}_{i,t}^{(l)}$. On the other hand, due to the proportionality of the cut, the corresponding amount of the single unit cut in the resource during that step paid by bureau i is given by $B_{i,t-1}/B$, where $B_{i,t-1}$ is the final budget of bureau i in $t-1$. It follows that the expected change $\Delta B_{i,t}$ in the budget for bureau i at step l in year t is given by

$$E\left(\Delta B_{i,t}^{(l)}\right) = \mathbb{P}_{i,t}^{(l)} - B_{i,t-1}/B. \tag{8}$$

Summing over the w steps, we obtain

$$\sum_{l=1...w} E\left(\Delta B_{i,t}^{(l)}\right) = \sum_{l=1...w} \mathbb{P}_{i,t}^{(l)} - w\frac{B_{i,t-1}}{B} = \sum_{l=1...w} \mathbb{P}_{j,t}^{(l)} - cB_{i,t-1}.$$

At a stationary state the allocation probabilities $\mathbb{P}_{i,t}^{(l)}$ are constant over time, and denoted by $\overline{\mathbb{P}}_i$. Then the equation implies that the resource received by a bureau is expected to be equal to the budget cut or, $w\overline{\mathbb{P}}_i = cB_i$, and we verify that $\sum_{i=1...m} w\overline{\mathbb{P}}_i = w = cB$, consistent with stationarity. We then have the time-invariant system

$$\overline{\mathbb{P}}_i = \overline{B}_i/B \text{ for } i = 1, ..., m \tag{9}$$

Dividing (9) by the same expression for $i = 1$, and using (7) in the result, we obtain

$$\Delta\overline{\Upsilon}_i - \Delta\overline{\Upsilon}_1 = \frac{1}{\mu} \ln \frac{\overline{B}_i}{\overline{B}_1} \text{ for } i > 1. \tag{10}$$

in the stationary state for all μ.

Let us now define a simple expression for the true impact increments at the stationary state. We consider the decision of allocating a unit of resource to the budget of bureau i in a step of a budget year and its consequences for all future years along the stationary path. Denote the initial change in the budget available for utilization during year t for bureau i when it achieves an award $\Delta B_{i,(0)} = 1$. That budget will be fully consumed during that year, but the budget year at $t + 1$ will start with that budget decision still playing a role in year $t+1$ consumption according to $\Delta B_{i,(1)} = \left((\Delta B)_{i,(0)} - c\right) = (1 - c)$. Therefore,

$$\Delta B_{i,(q)} = (1 - c)^q \tag{11}$$

is the portion of the original one-unit budgeting award still playing a role in budgeting decisions for bureau i after q years.

We require that the true impact increment must take into full account all future impact consequences of the initial budgeting decision:[10]

$$\Delta\Upsilon_i = \sum_{q=0}^{\infty} \Delta\Upsilon_{i,(q)}.$$

where $\Delta\Upsilon_{i,(q)}$ is the impact of that one unit, q years after the initial allocation decision. We also assume that the function $\Upsilon = \upsilon[B_1, ..., B_k]$, which determines the true current aggregate impact Υ generated by the m budgets, is differentiable, strictly increasing, and strictly quasi-concave. Using (11), if we expand $\upsilon[\cdot]$ in Taylor series around B_i and retain only linear terms, we can express true impact increments as

$$\begin{aligned} \Delta\Upsilon_i &\simeq \sum_{q=0}^{\infty} \Delta B_{i,(q)} \frac{\partial\upsilon}{\partial B_i} \\ &\simeq \frac{\partial\upsilon}{\partial B_i} \sum_{q=0}^{\infty} (1-c)^q \\ &\simeq \frac{\partial\upsilon}{\partial B_i} / c \end{aligned} \tag{12}$$

provided that $0 < c < 1$. From now on we treat this as an equality and we introduce it in (10) to obtain

$$\frac{\partial\upsilon}{\partial\overline{B}_i} - \frac{\partial\upsilon}{\partial\overline{B}_1} = \frac{c}{\mu} \ln \frac{\overline{B}_i}{\overline{B}_1} \text{ for } i > 1. \tag{13}$$

Finally, taking the sum of (9) over the m bureaus, we get

$$\sum_{j=1}^{m} \overline{B}_j = B \tag{14}$$

Thus the solution to the system of m equations represented by (13) and (14) determines the stationary state mix of public policies as described by the corresponding mix of budgets $(\overline{B}_1, ..., \overline{B}_m)$.

[10] Again for simplicity we assume no discounting.

2.4. Ability and Public Choice. The structure of probabilities (7) implies that, if there is no ability to choose ($\mu = 0$), all government choices are equiprobable irrespective of existing differences in the true value of alternatives: $\overline{B}_i = \overline{B}_1$ for $i = 2, ..., m$. Higher ability to choose tightens the distribution of marginal allocation probabilities around better alternatives. At the limit, where the ability to choose is perfect ($\mu \to \infty$), the Kuhn-Tucker conditions and (13) imply that at least one of the following conditions must hold: 1) $\overline{B}_i = 0$; 2) $\overline{B}_1 = 0$; 3) both $\overline{B}_i = 0$ and $\overline{B}_1 = 0$; and 4)

$$\frac{\partial \upsilon}{\partial \overline{B}_i} = \frac{\partial \upsilon}{\partial \overline{B}_1} \text{ for all } i \tag{15}$$

which, together with (14), represent the necessary conditions for

$$\max_{\overline{B}_1,...,\overline{B}_m} \upsilon[\overline{B}_1,..., \overline{B}_m] \text{ subject to } \sum_{i=1}^{m} \overline{B}_i \leq B. \tag{16}$$

Assuming that there is a single global maximum and no other local maxima, it follows that *the equilibrium public policy mix becomes exactly analogous to the solution of a standard constrained optimization problem if the government makes no errors* whatsoever along its myopic public choice path.

2.5. Ability and Impact. In this Section we examine the effects of ability to choose on the steady–state level of the aggregate impact. Using (9), we can express the equilibrium level of aggregate impact $\overline{\Upsilon}$ achieved by the government as

$$\overline{\Upsilon} \;=\; \upsilon[B\overline{\mathbb{P}}_1, ..., B\overline{\mathbb{P}}_m]. \tag{17}$$

Then we have

$$\begin{aligned} \frac{d\overline{\Upsilon}}{d\mu} &= B\sum_{i=1}^{m} \frac{\partial \upsilon}{\partial \overline{B}_i} \frac{\partial \overline{\mathbb{P}}_i}{\partial \mu} \\ &\underset{\text{by (12)}}{\simeq} cB\sum_{i=1}^{m} \Delta\overline{\Upsilon}_i \frac{\partial \overline{\mathbb{P}}_i}{\partial \mu} \end{aligned}$$

We next differentiate (7):

$$\frac{\partial \overline{\mathbb{P}}_i}{\partial \mu} = \left(\Delta \overline{\Upsilon}_i - \sum_{j=1}^{m} \Delta \overline{\Upsilon}_j \overline{\mathbb{P}}_j \right) \overline{\mathbb{P}}_i.$$

Replacing the latter into the former and using (12), we obtain,

$$\frac{d\overline{\Upsilon}}{d\mu} = B \left(\sum_{i=1}^{k} \left(\frac{\partial \upsilon}{\partial \overline{B}_i} \right)^2 \overline{\mathbb{P}}_i - \left(\sum_{i=1}^{k} \frac{\partial \upsilon}{\partial \overline{B}_i} \overline{\mathbb{P}}_i \right)^2 \right) > 0.$$

Since the RHS is proportional to the variance of a discrete random variable with realizations $\partial \upsilon / \partial \overline{B}_i$ which occur with probability $\overline{\mathbb{P}}_i$, we conclude that *the equilibrium level of aggregate impact increases with the government's ability to choose.* Thus the equilibrium level of aggregate impact remains below the corresponding feasible maximum if the ability to choose is imperfect. In that sense the government's choice behaviour in our model is strongly related to Simon's (1955) concept of *satisficing*. Notice how the increase in aggregate impact caused by an improvement of the ability to choose depends on the distribution of true impact increments: larger differences among the elements of this distribution imply larger gains caused by higher ability. Expressed differently, a larger dispersion in the impact of public choices, for example in the presence of dangerous possible outcomes, increases the importance of making good public choices. These results help justify the presence of a highly trained and highly valued civil service—especially in unsettled times as today.

3. Systematic Errors

In this Section we will extend our model to systematic errors. We will argue that the impact of systematic errors decreases as the ability to choose increases. Rabin (2013 p. 538) argues that

> "... not all limits to rationality are based on computational unmanageability. Many of the ways humans are less than fully rational are not because the right answers are so complex. They are instead because the wrong answers are

so enticing. Human intuition leads us astray in all sorts of ways that are simply not well described in terms of the difficulty or complexity of problems that bounded–rationality models seem best suited for. The pervasiveness of bounds errors where people are daunted by the task of optimization, or are simply not geared to it, should not be doubted. But astray errors, as one might call them, likewise seem pervasive, and especially amenable to neoclassical modeling."

The profession agrees as evidenced by the large and growing literature on individuals, voters and governments who are assumed to make systematic errors, as was noted in the introduction. We agree with Rabin about the utility of making a distinction, as well as about the importance of systematic errors. We now argue, however, that these two types of error are interdependent in that some level of bounded rationality is required for the emergence of systematic errors.

We model systematic errors using the concept of *bias* $\beta_i > 0$ which draws equilibrium choices and expenditures toward a particular choice i. We assume that random errors (5) are modified as

$$\Delta\mathcal{Y}_{i,t} - \Delta\Upsilon_{i,t} = \varepsilon_{i,t} \sim \frac{1}{\mu}(\varepsilon + \beta_i). \tag{18}$$

That is, the bias directly affects random errors by introducing a positive expectation favouring the biased choice—it pulls the perceived impact further away from the true impact. The bias decreases as ability increases and it is completely eliminated when the ability becomes perfect. This is analogous to those with the highest ability to choose overcoming the tendency to be led astray.

Why is the right specification of systematic errors one where the bias decreases as the ability to choose increases and is completely eliminated when ability becomes perfect? By now there are many empirically relevant examples of systematic errors. For each one it is difficult, if not impossible, to imagine a systematic error which could not be overcome by a person with sufficient cognitive ability. This is for the simple reason that if we have the cognitive ability to identify a systematic error we should be able to imagine a strategy, which could be utilised by individuals with perfect ability to overcome the systematic error. Consider the following empirical evidence.

In Herrnstein's (1991) experiments, many subjects facing an even somewhat complex dynamic problem fell back to choosing on the basis of current costs and benefits: a present–bias systematic error.[11] This was not true, however, of all experimental subjects. Some individuals facing the same dynamic problem used the same information to solve the dynamic problem optimally. In Selten and Stoecker's (1986) repeated prisoner dilemma experiments the players, instead of rationally defecting throughout, cooperate until some point close to the final period. Crawford (2013) argued that this may be due to some individuals with 'inappropriately' short time horizons. He explained the heterogeneity in the behaviour across individuals as being driven by differing cognitive abilities. Another example can be found in Rabin's (2002) work on the law of small numbers. There are people who seem to really believe in and behave according to this 'law' while others, who 'believe' in statistics, will presumably not make this systematic error. Finally, in the case of narrow bracketing, we would expect relatively narrower brackets to be associated with people with relatively lower cognitive ability. These examples suggest that bounds and systematic errors are inextricably intertwined, in particular, that some level of cognitive inability is necessary for a manifestation of systematic errors. In some sense, an inability to overcome a systematic error, becomes a bounds error.

The probabilities (7) are now re–written as

$$\mathbb{P}_{i,t} = \frac{\exp(\mu\Delta\Upsilon_{i,t} + \beta_i)}{\sum\limits_{j=1}^{k} \exp\left(\mu\Delta\Upsilon_{j,t} + \beta_j\right)}. \tag{19}$$

If we introduce these probabilities into the equilibrium definition (9), solve the result for $\Delta\overline{\Upsilon}_i - \Delta\overline{\Upsilon}_1$ and use (10) and (12), we obtain

$$\frac{\partial \upsilon}{\partial \overline{B}_i} - \frac{\partial \upsilon}{\partial \overline{B}_1} = \frac{c}{\mu}\left(\ln\frac{\overline{B}_i}{\overline{B}_1} - (\beta_i - \beta_1)\right) \text{ for } i > 1 \tag{20}$$

[11] See footnote 4 in de Palma et al. (1994).

which, together with (14), provides the equilibrium solution in the case of systematic errors. When $\mu \to \infty$, following the argument in Section 2.4, (20) implies that the equilibrium solution becomes equivalent to corresponding equilibria of the constrained optimization model (16) and the biases play no role. At the other extreme, when $\mu = 0$, probabilities (19) yield systematically biased, instead of equiprobable choices.

4. POLITICAL INFORMATION LOBBYING

We now employ our model of systematic errors as a model of political information lobbying. Efforts to systematically influence a government in favour of a particular policy are pervasive in the realm of public choice and clearly important for understanding public policy. Lobbying, political contributions, public advertisement by interest groups and the very prospect of an election are examples of external pressure facing a government. Bombardini and Trebbi (2020), in their recent survey on lobbying, note that lobbying expenditures in the United States has varied between \$3 and \$5 billion annually over recent years and that there are over 10,000 lobbyists operating in the US at any one time. Transparency International estimates the number of European lobbyists as more 25,000. It is not surprising then that the public has strong concerns about the potential negative consequences of lobbying for their society. A central question from Bombardini and Trebbi (2020, p. 392) states:

> "Is lobbying a valid political mechanism to, as the national Institute for Lobbying and Ethics asserts, "petition the government for a redress of grievances" or is it a tool that distorts public policy away from the social optimum, a crucial mechanism for the transformation of concentrated economic power into political heft and corruption?"

Grossman and Helpman (1994) and (1996) expressed the problem of political contributions as 'policy favours' being sold in a political market. In other words political decisions, not in the societal interest but rather in the interest of lobby group, is a *quid pro quo*—a rational, but potentially corrupt, economic exchange between the organization benefiting from the lobbying and the policy–maker, mediated by a lobbyist. Work studying the appropriate societal responses to the potential for public corruption is of obvious importance to the well being of a society and has been of long concern. This is a central theme in Besley's (2006) book, which aims to achieve an understanding of the political selection of virtuous leaders and how to face them with the right incentives, and so makes important contributions. Precautions against 'buying' policy outcomes through campaign contributions are pervasive throughout the democratic world.

However, there is also work on informational lobbying, where a special interest group has concerns or information which could be informative for the policy–maker. While the focus for economists has been quid pro quo, informational lobbying has been the focus in Sociology and Political Science. Further, lobbying as information, rather than as a quid pro quo, is used by lobbyists to legitimize their expenditures and efforts.

> "Lobbying is a legitimate and necessary part of our domestic political process. Government decisions affect both people and organizations, and information must be provided in order to produce informed decisions. Public officials cannot make fair and informed decisions without considering information from a broad range of interested parties." (see National Institute for Lobbying and Ethics website).

While economists would find natural the need for the strict management of quid pro quo lobbying, it is not so natural for economists to see the need for the regulation of informational lobbying. This is clear in the existing theoretical models of informational lobbying, namely, in cheap–talk models and money–burning models (see Bombardini and Trebbi (2020)). These theoretical literatures lead to the conclusion that the information from lobbyists is at least partially informative and managed rationally by policy makers, and therefore not a serious problem for society. In these models after all, all players including the policy makers, are unboundely rational and so would freely dispose of pure disinformation. This literature on informational lobbying is reminiscent of the traditional approaches to product advertisement in economics. Advertisement was modeled as either providing direct information about the product (see Telser (1964) and Grossman and

Shapiro (1984)) or as creating an "image" for the product which can either serve as a signal of product quality, see Milgrom and Roberts (1986), or enter the utility function as a complement to the product advertised, see Becker and Murphy (1993)). Such models imply that both informative and image advertisement are good since they provide either useful information or utility. It is correct that lobbying can provide valuable information to the policy process. This is consistent with the provision of 'information' to policy–makers and public advertisement by special interest groups having been seen as much less of a threat than campaign contributions in some countries. For example, a relatively recent ruling by the US Supreme Court in Citizen's United v. Federal Election Commission (130 US 876 (2010)) allows corporations to spend unlimited amounts on political advocacy advertisement during election campaigns.

The empirical support for existing theories is less than perfect. As Bombardini and Trebbi (2020) conclude,

> "The short answer is that the evidence points to some form of information being supplied, but not all the evidence lines up with the type of information that is beneficial to the public at large."

A possibility consistent with this conclusion on the empirical evidence is that some informational lobbying is not about the provision of information at all, but rather about the provision of disinformation. There is some difficulty in the information lobbying literature to specify a particular role for lobbyists. In our theory, lobbying firms are *advertising* firms**.**

4.1. A Model of Disinformation Lobbying. First consider the model of Section 2 where errors are not systematically biased. Consider policy in the simple case of two bureaus where μ is finite. We assume that a lobbyist for policy 2 has been hired to advocate for increased policy expenditure. In other words, the lobbyist profits from an increase in $\overline{B}_2$. Also assume that bureau 2's policy optimally requires relatively little expenditure: $\partial v/\partial \overline{B}_1 = \partial v/\partial \overline{B}_2$ at $\overline{B}_1 > \overline{B}_2$. The lack of bias renders any effort to bias existing policy makers ineffective. However, we have also shown in Section 2 that as the ability of the policy–maker falls, the policy–maker finds it more difficult to discriminate between the impact of different policies. This leads to a tendency towards equalizing bureau budgets. Here, this is a desired policy outcome for the lobbyist. In other words, the lobbyist has an incentive to work to elect a policy–maker of lower ability. This is not about electing a corrupt policy–maker, it is about electing an honest, but low–ability policy–maker.

Now consider systematic errors and an existing government. In Section 3 we modeled systematic errors using the concept of bias $\beta_i > 0$, which drew the steady–state policy away from better choices. There we assumed that bias was exogenous. Here we assume that bias is a function of lobbying expenditure, that is, effort in providing political disinformation. It is natural and correct to think about lobbyists competing against each other with lobbying expenditures to achieve diametrically opposed ends as wasteful rent–seeking, but here any lobbying can be worse than wasteful. It can be about provision of disinformation and moving policy choices away from better alternatives.[12]

Now consider (20). It is immediate that if the ability of government is perfect, then

$$\frac{\partial v}{\partial \overline{B}_1} = \frac{\partial v}{\partial \overline{B}_2}$$

the government would not rely on biased information, only on the intrinsic character of the choice, and lobbying with disinformation would be ineffective. At the other extreme where $\mu = 0$ and the government has no ability to choose then

$$\ln \frac{\overline{B}_2}{\overline{B}_1} = (\beta_2 - \beta_1)$$

so that expenditure on policy 2, $\overline{B}_2$, is increasing in bias β_2. Then disinformation which increases the bias towards policy 2 is valuable to the lobbyist for bureau 2. In the general case, using the implicit function theorem and using $\overline{B}_1 = B - \overline{B}_2$, we find,

$$\frac{d\overline{B}_2}{d\beta_2} = \frac{1}{-\mu(v_{22} + v_{11} - 2v_{21})/c + B/\overline{B}_1\overline{B}_2}$$

where v_{ij} is the second derivative of arguments in $v[B_{1,}B_2]$. Notice that this is consistent

[12] We leave strategic interaction between lobbyists for future work.

with the extreme cases above as $d\overline{B}_2/d\beta_2 = 0$ with $\mu \to \infty$ and $d\overline{B}_2/d\beta_2 = \overline{B}_1\overline{B}_2/B > 0$ with $\mu = 0$. With finite μ, lobbying increases $\overline{B}_2$ if the denominator is positive. Sufficient for this are diminishing marginal impacts, $v_{ii} < 0$ and policies which are q–complements, $v_{ij} \geq 0$.[13] Below we assume $v_{22} + v_{11} - 2v_{21} < 0$ so that $d\overline{B}_2/d\beta_2 > 0$.

To explore the effect of the policy–makers ability on lobbying incentives, take a derivative of $d\overline{B}_2/d\beta_2$ with respect to μ,

$$\frac{d}{d\mu}\left(\frac{d\overline{B}_2}{d\beta_2}\right) = \frac{(v_{22} + v_{11} - 2v_{21})/c}{\left(-\mu(v_{22} + v_{11} - 2v_{21})/c + B/\overline{B}_1\overline{B}_2\right)^2} + \frac{d(d\overline{B}_2/d\beta_2)}{d\overline{B}_2}\frac{d\overline{B}_2}{d\mu} \tag{21}$$

The direct effect (first term) is negative or it makes the impact of lobbying smaller as ability μ increases. Lobbying is most effective on the low ability policy maker according to the direct effect. But there is also an indirect effect. Taking a derivative of (20) with respect to μ,

$$\frac{d\overline{B}_2}{d\mu} = \frac{\ln(\overline{B}_2/\overline{B}_1) - (\beta_2 - \beta_1)}{\mu(-\mu(v_{22} + v_{11} - 2v_{21})/c + B/\overline{B}_1\overline{B}_2)} \quad \begin{array}{cccccc} > & 0 & \text{if} & N & > & 0 \\ = & 0 & \text{if} & N & = & 0 \\ < & 0 & \text{if} & N & < & 0 \end{array}$$

where N is the numerator. The numerator will have same sign as $\partial v/\partial\overline{B}_2 - \partial v/\partial\overline{B}_1$ from (20). Therefore it will be negative when the allocation involves too much $\overline{B}_2$ from an efficiency/optimizing perspective, and positive when it involves too little. In other words, increasing the ability of the policy–maker moves the outcome towards the optimal allocation as in Section 2. This can lead to a countervailing indirect effect to the direct effect in (21). To consider this, assume that $d(d\overline{B}_2/d\beta_2)/d\overline{B}_2$ is positive. Then the indirect effect of ability on $\overline{B}_2$ works against the direct effect when $d\overline{B}_2/d\mu$ is positive, in other words, when $\overline{B}_2$ is smaller than the efficient level. The intuition is that a higher ability policy–maker will increase $\overline{B}_2$ more towards the efficient level than a low–ability policy–maker. This is counter to the direct effect, which leads the lobbyist for policy 2 to prefer facing a low–ability policy maker. But of course the indirect effect can be

[13]If the denominator were negative the lobbyist for 2 would have the incentive to work to increase β_1 as $d\overline{B}_2/d\beta_2 = -d\overline{B}_2/d\beta_1$ and so in either case there would be disinformation lobbying.

reinforcing. In this case, when $\overline{B}_2$ is larger than efficient then the lobbyist's desire to be working with a low ability policy maker will be reinforced by the indirect effect, as the lobbyist is trying to convince the policy maker to push $\overline{B}_2$ further beyond the efficient level.

To summarize this Section, we have used our framework to model the idea that informational lobbying can be an attempt to move decision–makers away from an accurate assessment of a policy and towards particular policies favoured by the lobbyist.[14] When it is simply information which is being provided by a special interest group to a policy–maker, it is not at all clear what role the lobbyist is playing. In our model informational lobbying agencies can be thought of as advertizing agencies who may provide disinformation. We first show that a lobbyist may have the incentive to help elect low ability policy makers. We then show in steady–state, the model predicts that lobbyists will tend to aim their lobbying efforts at policy makers of lower ability as the effort will normally be more productive.

5. Concluding Remarks

> "The power and the success of perfectly rational behavior as a model of choice is to be found in the observation that many real events can be explained by assuming that economic actors behave as if they have a perfect ability to choose. Yet there are phenomena for which explanations alternative to those provided within the context of perfectly rational behavior might appear closer to experience in important respects" (de Palma et. al. (1994, p. 433)).

There are, by now, many examples in the economics literature of phenomena where the 'as if' approach fails. Here we explore some instances of the 'as if' failure in a public choice context. We first consider the usual for governments incremental budgeting approach. We argue that the very nature of this common budgeting methodology, myopic, incremental and sequential, using one at a time decisions on solicited proposals, ongoing, off to an

[14] This can be a good thing, for example, if the policy–maker has an imperfect ability and the favoured policy of the lobbyist happens to be too low from society's perspective. But in our model, that would be fortuitous, rather than the intention of the lobbyist.

indefinite future, only makes sense under an imperfect ability to choose. Our model fits Simon's (1955) search for alternatives, satisficing, and aspiration adjustment. We then extend the basic problem to build a framework which integrates bounds errors and systematic errors. We argue that bounds errors and systematic errors are inextricably intertwined—some level of bounded rationality is required for systematic errors to emerge. The biased errors then allow us to consider (dis)information lobbying which moves policy makers away from an accurate assessment of policy and toward the lobbyist's preferred policy choices. In our model, we show that lobbyists tend to prefer low ability policy makers, so may work to elect them, and would tend to focus their disinformation on the low–ability policy maker. This is a testable hypothesis. More generally there is a rationale for optimally restricting political information lobbying. This is especially true in a policy environment with a larger dispersion in the potential social impact of policy choices, for example, in the presence of possibly dangerous choices, such as policies regarding assault rifles or Covid 19 and with administrations of lower ability. In these cases, the importance of making good choices is critical and consequently increases the societal value of talented, high–ability public servants and leaders with the 'wisdom to discern'.

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