Deciding between development and preservation of a natural asset: a way out of the impasse?

An implementable model of valuation and public decision-making.

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ABSTRACT

Many environmental policy issues involve conflicts between nature conservation and economic development. The economic rationale behind deciding among alternative options is predicated on some form of benefit-cost analysis (BCA). Key issues to date have been non-market valuation, the effectiveness of the precautionary principle or safe minimum standard, discounting, uncertainty, and how the decision making process implements BCA results. To date, no satisfactory mechanism seems to have been found that reconciles conflicting interests with social welfare, the Hicks-Kaldor criterion falling short. This is because BCA has been conceived of and implemented within a technocratic process, which impinges on all aspects of benefit-cost definition and BCA results, leading to economically arbitrary and socially indeterminate outcomes. An alternative model is proposed, applied to discrete, partly excludable, non-rival but congestible public goods. It is based on mechanism design theory, leading to a democratic, rather than technocratic, social choice mechanism. BCA and optimal mechanism design are combined in a way that renews provision and distribution of information and revelation of social preferences. The role of stated preference techniques, such as contingent valuation, is radically redefined. The model is referred to an Australian case of mining in a National Park.

Keywords: Benefit-cost analysis; conservation; mechanism design; institutional design; non-market valuation; preference revelation; public choice; social preference revelation.

I. INTRODUCTION

Deciding whether to develop the economic potential of a natural resource or to preserve it in an undeveloped state has proven to be one of the most challenging problems for economists and policy makers. The source of the difficulty is well known, and was highlighted as early as 1967 by Krutilla in a widely-cited article (*Conservation reconsidered*). The difficulty can be traced to two underlying issues: the non-existence of preference-revealing markets for public environmental goods and the comparability between market-based and non-market based values.

So far, the response to the first part of the challenge has come in the form of non-market valuation techniques, that strive to estimate, directly or indirectly, the value of a natural asset for a given group of individuals. Therefrom has developed a whole body of literature including indirect revealed preference estimations, based on hedonic pricing or travel cost methods, and stated preference estimates, including contingent valuation or some form of choice modelling (Hanley & Spash, 1993; Blamey et al., 1997). A general theoretical structure has been offered in the form of random utility models (Thurstone, 1927; Manski, 1977; Adamowicz et al., 1998). The response to the second part has come in the form of benefit-cost analysis, where estimates from non-market valuation techniques are brought together with market-based values and combined to yield a decision criterion, such as net present value or benefit-cost ratio.

The object of this contribution is to show that such a response cannot lead to decision outcomes that fulfil even the minimum requirements they are purported to fulfil, namely efficient or Pareto-optimal outcomes. This impossibility, which I show leads to an impasse in the present approach to the problem, does not lie within any of these techniques themselves, but in the way they are combined and implemented in the decision-making process. The issue here is one of

implementation, and the efficiency we are concerned with is not only that of the outcome itself but that of its implementation. In essence, the result of the valuation process does not carry through into the decision-making process in a way that the latter depends in any predictable way on the former. Currently, valuation and decision-making are disconnected. Accordingly, I suggest a way out of this impasse and propose a mechanism that re-establishes the broken link. In the process, the roles of non-market valuation and of benefit-cost analysis are redefined and their present relationship is reversed: rather than feeding non-market value estimates into a benefit-cost framework, we should feed results of a benefit-cost exercise into a non-market valuation social choice mechanism. The proposed solution, however, is up for further investigation; it is not a final result.

I first outline the nature of the problem, then establish why the current approach to the problem leads to a policy impasse; I thirdly propose an alternative approach, a "way out of the impasse"; and finally assess what my model achieves. I conclude on the implications for non-market valuation and benefit-cost analysis in social decision making processes involving the environment.

II. THE NATURE OF THE PROBLEM

Before proceeding further, it seems appropriate to ground the discussion firmly in several examples and clear definitions. The issue at hand is typically exemplified by the following cases:

- to mine or not to mine in a national park or nature reserve?
- to log or not to log an old-growth forest?
- to drain or not to drain a wetland for housing or industrial development?

Typically, hard cash benefits are to be balanced against non-monetary preservation benefits, many of which have an ethical dimension (Johansson-Stenman, 1998). The balancing exercise is compounded by problems of distribution: who gets what and how much? Usually (though not always), hard cash comes as profits to big industrial companies (the developers), whereas

preservation benefits accrue to a widely dispersed constituency. Unequal bargaining power, lobbying strength, and financial back-up lead to an unlevel playing field situation. Also, there usually do not exist institutional channels whereby dispersed and unorganised preservation interests can express themselves, and particularly their valuation of the alternative options.

Although the problem under consideration is labelled development "versus" preservation, the opposition is not a straightforward one. It is better conceived of as a two-stage process, only the second of which we deal with here. In the first stage, several potential projects go through a (usually bureaucratic) selection process. These potential projects could occupy the whole spectrum along a development-preservation continuum[1]. We assume here that this dynamic selection process "weeds out" all the less preferred options but fails to reach general agreement on one single project. For simplicity, we assume only two competing projects have survived and are backed by two contending parties. More generally, it may be conjectured that the number of surviving options is at most equal to the number of well-identified stakeholder (or interest) groups[2]. Here we have only "developmentalists" (pro-development or D agents) and "preservationists" (pro-preservation or P agents).

The resource itself, the environmental asset, is public property. This is an important qualification. If it were private property, then we would be facing a different problem, equally important, but asking for a different solution mechanism. Nor is it open access in its strictest sense (e.g. the high seas). As public property, some public authority, local or national, has management powers over it, within a well-defined legal system and with enforcing and policing potential.

Summarising and completing the characteristics of the problem, we have:

- A dichotomous and exclusive alternative (an exclusive either/or policy issue)
- Two competing policies well defined in space and time (*hic et nunc*)
- Two opposing sets of interests and stakeholders

- A concentrated and well organised party against a dispersed and poorly organised one
- Constituencies (stakeholders) can be local, national or world-wide
- The environmental asset is public property (community, state or otherwise)
- As soon as the policy question is asked, any time delay is costly to at least one party
- There is a general agreement that a 'best' solution must be found, whatever it be (and of course different stakeholders and policy makers may differ in opinion)

"Solving" the policy problem requires a solution standard, that is, a criterion enabling the definition of what a "solution" is. The economics perspective has been to highlight the socially efficient or Pareto-optimal solution[3]. However, sociologists and political scientists have been quick to point out that other dimensions of social values are also involved, in particular equity and ethical considerations[4] (Johansson-Stenman, 1998). Here, I shall nevertheless base my solution concept on the Pareto-optimal criterion, but in a way that gives it a minimalist interpretation: the solution needs to be at least Pareto-optimal, but should be more than that if possible. In particular, it should be able to reflect stakeholders' relative values of economic efficiency and distributional equity. As a result, I shall define the purpose of my solution as being to implement the socially efficient outcome as revealed by a public valuation process. This process must itself provide the (implicit) weighting of economic efficiency relative to other social criteria.

Deciding between some form of development and some form of conservation, however defined, must in the end rest on some valuation of the competing options, if a socially rational choice is to be made. If rationality is not a concern, there is no problem left to solve. Leaving for now the question of what rationality is at stake, it must be clear that the decision-making problem and the valuation problem are, or should be, closely linked. Because the current approach to this problem has not seriously acknowledged this link, present practice appears to be heading towards a policy impasse. I shall contend that this also reflects a theoretical impasse, to which a bypass is needed.

III. THE IMPASSE

One can summarise the current shortcomings to the policy resolution problem as follows:

- not all preferences can express themselves, particularly the more dispersed pro-preservation preferences
- decision-making is not linked to valuation in any predictable way
- economics and politics are disconnected (too many restrictive assumptions: analytical convenience is obtained at the cost of efficient implementation)
- economics and science are disconnected (current policy solutions do not maximise the value from available scientific knowledge: botany, ecology, hydrology, etc.)

Why is this so? What has gone wrong? My answer to this, with respect to nature preservation issues, lies with the role given to non-market valuation (NMV) and benefit-cost analyses (BCA) in the decision-making (DM) process. Currently, results from NMV and BCA are conceived of as a direct informational input into the DM process, as pictured in **figure 1**.

Figure 1 here

NMV and BCA experts hope that decision-makers will include these results in their policy decisions. How they will be included, and how they will actually influence the outcome, if at all, is mostly left to wishful thinking. The reality is that strong corrupting external forces will bias the final outcome in a way that may end up being inconsistent with results from the NMV and BCA valuation exercise. Such "institutional bias" or "capture" is well documented in the literature: see for example Pignataro (1993) and Rizzo (1993). This frequently results in economically inefficient and socially arbitrary outcomes. As a consequence, the value of the NMV and the BCA exercises is itself reduced. One way to state our purpose here is to recover the full value of NMV and BCA.

Practitioners of NMV and BCA should not be alarmed, *au contraire*. The value of the tools themselves is not the issue; rather their implementation in a DM process is. Their value is affected through the quality of their implementation.

The key statement here is that, in the current institutional setup, the combination of NMV and BCA results are not "satisfactorily and successfully implementable". I borrow these concepts of satisfactory and successful from mechanism design theory, as best described in a paper by Green and Laffont (1977). A DM mechanism is said to be satisfactory if it selects Pareto-optimal outcomes. It is further said to be successful if it selects the outcome that reflects the highest valuation by individuals in society, such that everyone will be satisfied with the outcome, provided that everyone was satisfied with accepting the DM mechanism as a solution procedure. Let us now examine why current practice cannot succeed.

The current approach to the "development vs. preservation" problem can be summarised as follows:

1) Use NMV techniques (particularly stated preference valuations) to estimate non-market values;
2) Include the results, alongside market-based values, in a BCA framework of competing options;
3) Use BCA results to "inform" DM.

The problems with this current approach are at least threefold:

1) Low credibility of NMV (particularly SPV) estimates
2) Arbitrary use of NMV estimates in the BCA framework
3) Arbitrary use of BCA (if any) in the DM process.

In the early 1990s, a national debate raged regarding the wisdom to go ahead with uranium mining in Kakadu national park in Australia's Northern Territory. A national contingent valuation study was carried out with what most people agree, in spite of many criticisms, were high professional standards (Carson et al., 1994; RAC 1991 a,b). The study concluded that the value of "not mining"

(that is, preservation) outweighed the value of mining by a factor of at least 4 (Carson et al., 1994). Apparently, there should not have been any hesitation as to what the course of action should have been. And yet, the mining companies hotly disputed the result and, as it turned out, the decision-makers (the Australian federal government) decided not to rely on these results to justify their final decision. The government did in fact opt for preservation, but on the grounds that it harmed local aboriginal Australians. More recently, without further valuation, the (new) government simply overturned the decision and gave the go-ahead for uranium mining, a decision that is currently still hotly opposed by many segments of society. This story can be kept in mind in examining the three shortcomings listed above.

Low credibility of NMV estimates. In the eyes of the decision-makers it is firstly linked to their hypothetical setup. This holds primarily for SPV (stated preference valuations) such as contingent valuation and choice modelling techniques[5]. The main criticism levelled at the hypothetical setup is the lack of real economic commitment for the preferred option. Several studies have recently studied the real WTP - hypothetical WTP (willingness to pay) relationship, asking the question: does hypothetical WTP truthfully represent real WTP? The overall answer is at best indeterminate, if only because many of the studies confound private good and public good aspects, but seems to lean on the negative side[6]. If this is the case, what exactly is being measured through hypothetical bids?

An alternative to the hypothetical setup is the experimental setup, with "XCVM" (Swallow, 1994) being a particular example. In some of the previous real vs. hypothetical WTP studies, "real" referred to actual monetary commitments, but in an experimental, and therefore artificial, setup (Boyce et al., 1992; Neill et al., 1994; Swallow, 1994)[7]. If the "hypothetical bias" can be considered to be solved, the "contextual bias" cannot. By design and by purpose, experimental setups (as well as their hypothetical counterparts) are meant to allow for the control of all factors affecting the outcome. The benefit is in this control and its capacity for explanatory power. The cost is in the

limited number of factors allowed to affect the outcome. Some factors are allowed to vary while all others are maintained (or thought to be maintained) fixed. Not all factors can be allowed to vary if control is to be effective. One can categorise these factors as follows:

1) *information provision and distribution*
    - contradictory evidence and scientific uncertainties
    - learning and preference formation
2) *heterogeneity of constituencies*
    - multiple constituencies (local, national, world-wide)
    - differences in risk aversion, correlated with other factors (e.g. wealth)
    - differences in discount rates, correlated with other factors
    - differences in rationality and preference structures, especially for non-use values
    - marginal utility of income vs. that from natural asset (Medin et al., 1998)
    - varying tensions between WTP and ATP (ability to pay)
3) *institutional setup (mechanism design)*
    - freedom of participation vs. general taxation
    - freedom to choose payment mode
    - different or incremental entitlements over the resource
    - link between payment and provision rule

Because of this, there is a "contextual bias" in that the results of both hypothetical and experimental setups cannot be extrapolated to a "real" policy setup: the final outcome will be affected by "all other contextual factors". As Charles Smith (1990) convincingly demonstrates with auctions, and Kosz (1998) in a valuation of a national park, real decisions based on valuations are "full-context dependent".

Thirdly, the credibility of NVM exercises is affected by the two other shortcomings linked to arbitrariness, in that it may affect people's responses during the hypothetical or experimental

bidding session. As it becomes increasingly common knowledge that implementation is unpredictable or arbitrary, people's responses may well be increasingly affected.

Use of NMV results in a BCA framework. It is arbitrary in at least two ways: in the weighting of uncertainties and in the choice of a discount rate. When BCA analysts combine values based on market-based prices and values derived from an NMV exercise, they are faced with different degrees of uncertainty in the quality of the numbers obtained, which affects their credibility. If X > Y but X is a much less credible number (has much larger error potential) than Y, then there is an indeterminacy. Usually, it is not possible to know how large an error is made in a valuation estimate, precisely because of the lack of a standard to compare it with. In practice, this means a bias towards market-based values, which may be rational, but the extent of which remains arbitrary.

As for the choice of a discount rate, it is a long known and debated issue over which a huge literature exists, starting perhaps with Marglin's (1963) seminal paper on the social discount rate. To put it bluntly, the question as to which discount rate must be chosen in a public decision making process is to this day a rationally unresolved issue. There is as yet no one best answer.

Use of BCA results (if any) in the DM process. It is also arbitrary, partly because of the two previous shortcomings, and partly due to the "corrupting external forces" mentioned earlier: hidden political agendas, nepotism, lobbying, bribing.

The current approach to valuation and decision making in environmental policy leads to an impasse in that the three problems just described are interlocked and reinforce each other.

The final result is the production of stacks and stacks of valuations, the value of which appears to be at most academic. They cannot be said to have had any real impact on decision making, with perhaps one notable exception: natural resource damage assessments (NRDA) in the USA. As will

appear clearly, however, the judicial context of these valuations is not incidental to their relative effectiveness.

I relate these three shortcomings to the implementation of the valuation - decision making link. It is bureaucratic, or technocratic, and has too often proven inefficient and arbitrary. What we need is a more efficient implementation design. I suggest that a democratic, rather than bureaucratic, mechanism can be more efficient, Dryzeck's (1995) misgivings notwithstanding[8]. The challenge lies in linking results from hypothetical setups (surveys), non-hypothetical but experimental setups (lab experiments), and non-hypothetical non-experimental setups (real policy), as first advocated by Bohm (1984) in a remarkable pioneering study. By taking up this challenge, one is led to overturn the accepted relationships between valuation, benefit-cost analysis and public decision-making.

IV. A WAY OUT OF THE IMPASSE?

The goal is to address the three shortcomings of the standard approach and to find a satisfactory and successful (and therefore efficient) mechanism for the specific environmental policy problem of concern: to "develop" or to "preserve" a natural asset?

To do so, there seems to be at least two fundamental social pre-requisites:

- a principle of sufficient democracy (SD)
- a principle of sufficient technology (ST)

The SD principle refers to a minimum condition where a community of people prefers solving a policy issue using a democratic process rather than any other form of process. This means that all stakeholders are empowered to make their preferences known and accounted for. This must be considered as a political given at any one point in time, and part of a historical and cultural heritage.

Nevertheless, the "willingness to favour democratic decision-making processes" can evolve over time. As Wheeler (1997: p. 218) puts it, *"democracy is no more than a device for registering preferences"*. I shall place myself in the favourable case where all stakeholders including government have a sufficient desire to use democratic principles, provided they are expected to work and to be efficient. That is, I shall not consider political settings where military, religious, "nomenklatura"[9] or other forms of dictatorship prevail. The criterion of "successfulness" means that, provided any individual accepted the decision-making mechanism, he or she will be satisfied with the outcome, whatever it is.

The ST principle basically refers to transaction costs and is related to communication and co-ordination technology. For instance, the advent of world-wide Internet communication and interaction, including economic transactions and, perhaps soon, political transactions such as voting, must considerably reduce several types of transaction costs. Indeed, the present proposal assumes that "real-time" Internet interactions are easily accessible to most if not all stakeholders, to exchange information or transact using monetary payments[10].

Model of the political decision making system

Given these two minimum requirements, which seem to be met today in most developed "western style" democracies, we need a model of the political system within which the decision making process is embedded. This model is pictured in **figure 2**.

Figure 2 here

Starting from the base, the "general public" can be divided into three categories relative to the development vs. preservation issue: developmentalists, preservationists, and the indifferent. By definition, developmentalists have a positive valuation for the development option, preservationists

have a positive valuation for the preservation option, and the indifferent have a zero WTP. Supporting the preservation option are also the various active conservation groups, which I shall collectively call "the P (preservation) lobby": green political parties, NGOs, local, national or international support groups such as the WWF, the Nature Conservancy (USA), etc. Supporting the development option are primarily those industrial firms who expect private benefits from exploiting the resource (the developers). Pro-development supporters in the general public will usually be confined to potential employees and their families who may benefit from new job opportunities as well as part of the local population, who may benefit from infrastructure development. Their interests will typically be represented and defended by a "D (development) lobby", usually funded by industry.

At the top of the diagram (figure 2), government is modelled according to the political economic view. No assumption of public benevolence is made, though some of that can exist. Rather, governmental agencies are allowed to have agendas and goals of their own which can lead them to economic and political rent-seeking behaviour. In particular, they can compete with each other for resources, power and legitimacy[11]. Here we are concerned with two (possibly more) particular government agencies, each of which has a pre-specified mission. One is assumed to favour the development option, and the other the preservation option. In Western Australia for example, the first is exemplified by the DRD (Department of Resource Development), and the second by the DEP (Department of Environmental Protection). Each is responsible to a different Minister. As a result, no agency neutrality can be *a priori* assumed in solving the development vs. preservation issue. Rather, a competitive approach seems more appropriate. My solution is to introduce an arbitrating mechanism, or more exactly, an arbitrating institution, the description of which follows[12].

The policy problem of deciding between development and preservation will be solved if the following sub-problems are solved:

- the institutional design problem
- the general public individual's problem, whether P or D preferring, or indifferent
- the interest groups' (lobbies') problem
- linking the valuation and social choice problems.

The institutional design setup

If arbitration between competing interests is to be successfully implemented, an arbitrating principle is needed. The most natural in this context appears to be that of a public auction. In a remarkable book, Charles Smith (1990) describes how auctions (of all kinds) serve in the construction of social values. The solution concept (as defined in game theory) is to put the competing policy options up for sale through a public auction. The solution criterion is then to implement the policy of the highest bidder. Compensation can then be considered for the losing party. Such a system implies several things.

First of all, what is the justification for such a scheme? Why wouldn't policies be supplied for free to rightful citizens? The justification lies in the existence of a conflict between equally legitimate interests; that is, in the conflict between interests with equal rights over a public good. Moreover, policies are not really being sold (this is a metaphor); what is being sold is the right to use a resource as best preferred. According to Williamson (1985), Bromley (1991) and other institutional economists, the selling and buying of rights is the stuff existing markets are made of. There is nothing new here. Note however that it is not the resource itself that is up for sale, but the right to use it in certain ways.

In this scheme, the arbitrator's problem - not the government's! - is, *by design*, assumed to be the maximisation of a total social welfare function, which in the present state of the world must be

assumed to represent a national constituency. At the same time, preservation and development stakeholders can each be assumed to maximise the chances of their preferred option winning the bid. The communication of one's preferences is then constrained by design to take the form of monetary payments. Stakeholders are asked to express their preferences and valuation of their preferred policy by "voting with their wallet". They must make a real up-front monetary transfer to a (trust) fund dedicated to their cause (the D-fund and P-fund in figure 2), administered by their respective lobby, and controlled by the arbitrating body - similarly to national elections. Whether the two funds are physically separate or not is immaterial, provided each monetary contribution is correctly tagged; that is, its source is correctly recorded. Tele-communicating computer technology is assumed to make this possible at very low cost (ST principle). We can now detail a little better the workings of this system.

The decision rule is to implement the policy of the highest collective bidder. Value expression relies on a "real WTP" mechanism, where pro-D agents forward a payment to the D-fund, pro-P agents forward a payment to the P-fund, and indifferent agents forward no payment, at least initially (the dynamics will be considered further). Payments, once made, are irrecoverable until knowledge of the final outcome. Time is amply provided to allow several additional payments, or to "wait and see" for further information. Such information refers to the respective values of the policy options (substantive information) as well as to the decision-making process, in terms of how high respective bids are at any given time t (process information). Provision of time (T) is balanced by a clear and well-publicised deadline, a date and time after which no more bids will be accepted and at which the winning bid will be announced. This sets the stage for a dynamic valuation and bidding process, with updating of process information being a key parameter. The frequency of updates on *total* competing bids can vary from just once (static bid) to virtually a continuum in real time, if the Internet is used. For reasons to appear later, we can choose a continuous time approach provided that there is a sufficiently long time between final time T and the before-to-last information update, $T - \tau$. (In other words, the "information blackout" $T-\tau$ must be large enough, though not too

large)[13]. The dynamics remind us of a "telethon" type model, but is bipolar and competitive, and of dynamic auctions, although this is a particular one where collective, rather than individual, bids are confronted. To my knowledge, this is an original and as yet unexplored value-revealing system, tailored to the specific problem under consideration.

The importance of time provision, a feature usually absent from non-market valuation studies, cannot be overstated. Time provision is typically to be measured in months and can extend to a year. Provision of such time allows for "full context valuation", in that it allows individuals to consider other economic commitments in the context of other ongoing similar projects. It thus allows for sufficient learning and preference formation. The literature criticising the restrictive assumptions of stated preference valuation studies (e.g. Willinger, 1996) is addressed: there is no need to assume that preferences of a particular kind, e.g. continuous vs. lexicographic (Lockwood, 1996), pre-exist to the valuation "event". They can be assumed to be initially undefined and only influx of new information and conflicting value judgements by others gradually "forms" agents' preferences[14].

Moreover, this scheme should endogenously generate optimal information provision to all stakeholders. Given the objective function of each party, each lobby will, in principle, invest in information provision to the general public up to the point where the marginal costs equal the marginal expected benefits (equal to the probability of persuading one more individual to bid for their cause). This includes criticising the opposing party's information provision, resulting in a "courthouse model". In this case the jury is the general public and the verdict is the resulting bids. Contradictory information provision, debate and mutual criticism should also reflect the extent of scientific uncertainties about the benefits and costs of both options.

Because of the ex-ante payment mechanism, the system generates a monetary surplus which can then be (partly) used to compensate the losers (those whose preferred option is not implemented).

This scheme must therefore allow for an actual Pareto-improvement, not just a potential one as restricted by a bureaucratic process based on BCA. It is striking that as early as 1971, Mishan was advocating an increasingly important role for compensatory payments in BCA. As Glass and Corkindale (1995: p. 242) put it, "…CBA…cannot tell us what is politically feasible or ethically desirable unless it…addresses the question of what arrangements can be put in place to ensure that gainers actually compensate losers". Given that the winners' bid is by design larger than (or at least as large as) the losers' bid, full compensation is always possible in the proposed scheme.

Auxiliary mechanisms

Several auxiliary mechanisms can be embedded in the "master mechanism" to free up all WTP potential and capture all aspects of the resource's total economic and non-economic value.

Introducing exclusive entitlements. The nature of the payment with respect to the resource itself can vary from a pure donation (Yen, Boxall and Adamowicz, 1997) to an actual purchase of specific entitlements. For example, if exclusive entitlements are associated with the area of a national park, such as rights of access proportionate to the bid made, then the individual can pay both for the right to see the resource publicly used in her preferred way and for a specified private use of the resource[15]. Another possibility is where the resource can be transformed into a shared asset valued in total by the winning bid, with winning bidders obtaining shares on a pro-rata of their individual bids. Shares can be transmissible or traded in an ad-hoc market, reflecting changes in the value of the resource and in the quality of its management. This captures the future potential value of the resource.

Relaxing wealth-related constraints. Wealth-related ability to pay considerations, in contrast to willingness to pay, can be accounted for in several ways. In the example of destitute local native

populations, people from around the world can choose to contribute to the preservation of their traditional hunting, fishing, or habitat grounds not because they value the resources themselves, but because they value the rights of these populations to a traditional lifestyle[16]. Another more in-house possibility is the ad-hoc creation of a loans market, where wealthier people are willing to further their preferred cause by allowing poorer people to enter the bidding process, without exceeding their own WTP. This can be done by allowing them to lend money at low, possibly zero, interest rates to individuals currently cash constrained, with appropriate pay-back security[17,18].

Post-provision and no-provision rules. The institutional design would be incomplete without specification of post-provision and no-provision rules. The no-provision rule specifies what happens for individuals whose preferred option is not implemented (lost bid). Firstly, their individual bids must be refunded, since the "good" they paid for was not delivered. Secondly, if an *actual* Pareto-improvement is to be achieved, they must be fully compensated for the loss in utility suffered because of the implementation of the opposition's policy. Assuming for now that the bidding mechanism is incentive compatible (generates bids individually equal to marginal valuations of the project), an assumption examined later, marginal costs must equal marginal (expected) benefits. An individual's bid must therefore be equal to her marginal valuation of her preferred option. Consequently, the lost utility is reflected by the amount bid. If this is so, then full compensation of losers means a monetary transfer from winners to losers individually equal to the losing bids.

If the developers lose the bid, government may decide to fully compensate only national firms and not foreign firms. Mixed capital holdings can be compensated on a pro-rata of national ownership (if x% national, compensate (100+x)%). However, no such discrimination is necessary, and could even be harmful if the firm were to withdraw from other investments elsewhere in the economy. This is by itself another policy issue.

Except in the limit case when both bids are exactly equal, the winning bid will be left with a surplus even after compensation of the losers[19]. This surplus can be refunded to winning bidders (those that bid for the winning option) at a pro-rata of individual bids. Alternatively, it can be capitalised and used for earmarked purposes, such as ecological management of the resource (preservation win) or social infrastructure development (development win). The system can be made flexible in allowing bidders to initially specify, with their bid, whether they wish a total refund of their maximum share to the surplus [= individual bid x (surplus / total bid)], or only part thereof. This option separates the WTP for obtaining a right over resource use from the WTP for exercising that right. At terminal time T, the actual non-refunded surplus is thus known alongside the amount of the winning bid.

This flexibility can also be extended to losing bidders, who can initially choose to be only partly compensated (over and above the refund of their lost bid), the remaining part being capitalised for future similar bids. In this way, bidders can increase the chances of seeing their preferred option in the future winning the bid, provided that the respective P and D funds are managed over time similarly to a financial institution. Just as time provision within a bid links simultaneous bids across space, this mechanism links successive bids over time[20]. As advocated by C. Smith (1990) and Kosz (1998), the present bid, like any such other, is "full context dependent" in both space and time.

The resulting "voting sheet" of an individual, possibly electronic, would look like the one shown in Appendix 1.

We shall now examine the various problems each participating agent must solve for the solution mechanism to work. In this paper, I shall content myself to outline the nature of their problem and that of the solution. I leave for subsequent publications a formal in-depth analysis, which is beyond the scope of this paper. The status of my "solution mechanism" is that of a proposal up for examination, and possibly, for experimentation.

The individual's problem in the "general public"

Preservationists (resp. developmentalists) were defined as not being indifferent between the two policy options and as having preferences for preservation (resp. development). Such a definition is ambiguous because it lacks a time dimension. To be precise, an individual is said to be a preservationist if she determines herself as such before final time T, and at the latest during the last period $T - \tau$. This means she can be undecided before that time (which is to be distinguished from "indifferent"). Learning and preference formation are allowed to take place in a public debate. At any time previous to T, only the latest bid update is known, which informs of the latest preservationist and latest developmentalist bids. The "number yet to come" is itself unknown, especially with constituencies spread world-wide.

The institutional setup creates an opportunity for preservationists at any time $t \geq 0$ to express their preference in the form of an auction bid. By the principle of sufficient democracy, we have assumed that such a procedure has been accepted as satisfactory[21]. An individual's decision-making process may be understood as a two-stage process. The first is deciding which way to go, or be indifferent (for whatever reasons). The second is deciding how far to go in the preferred direction (how intense the preference is)[22]. Let us concentrate for now on this second problem, and note that *the institutional setup, once accepted, does not give individuals another choice but to express intensity of preference using the bidding procedure*. Not only does a dynamic auction mechanism channel existing preferences, it also captures potential preferences by helping to form them. As such, an auction is a "social event" (C. Smith, 1990).

Call t_i^0 the time at which an individual i determines herself and "makes a choice". It is the time of her first bid. Her total bid cannot be known before final T because of the possibility of "topping up"

the initial bid made at t_i^0. t_i^0 is a crucial moment, for only after that time can the individual's "problem" be clearly defined. The objective function is clearly to *maximise the probability of the preferred option winning the bid.* The control variable is the amount the individual is willing to bid. The probability of the preferred policy winning the bid is equal to the probability of the total preferred bid being greater than the total opponent bid. For example, for preservationists:

prob (P wins the bid) = prob (total P bid > total D bid).

Given that the impact of the individual's bid on the total preferred outcome will not be zero, there is a non-zero incentive for her to maximise her bid. However, this maximisation will be subject to the following financial constraints:

- income constraint (or ability to pay)
- payment mode constraint

and to the following information constraints:

- perceived net benefits of preferred policy
- perceived value of use of surplus if preferred policy wins
- perceived probability of full policy enforcement
- uncertainty over other people's behaviour, especially in one's own camp.

Furthermore, bid maximisation will be subject to the basic microeconomic rule whereby

marginal bid cost = expected marginal benefits from preferred policy

At any point in time after t_i^0, the individual's WTP for the preferred policy appears as the solution to a constrained maximisation problem. The informational constraints in a dynamic setting make it a non-trivial one to solve analytically. However, here we are not interested in an analytical solution, but in the fact that all individuals will, one way or another, and possibly in different ways, find their own solution to their WTP decision. The analytical problem is elsewhere.

Because determining the final WTP is a dynamic process under uncertainty, construing WTP as a constrained maximum must be understood as a dynamic equilibrium, or fixed point. Given updated

information after t_i^0, with or without further "top-up" bids, there comes a moment t_i^* where the individual is no longer willing to increase her bid, even if there still remains $(T - t_i^*)$ time left to final time. It is convenient to note $WTP_i(t_i^*) = WTP_i^*$. Of course, if $t_i^* > \tau$, then the individual has left it to the end before making such a decision. The problem now becomes one of potential free-riding: for every individual i, does WTP_i^* truly reflect the individual's valuation of the preferred policy? Or is it a strategic bid meant to ride on other people's money?

A specific feature of the institutional design is intended to address this problem. Updating of bidding (process) information stops at time $T - \tau$, for example one week before the deadline. During that time of "information blackout", both undecided individuals and potential free-riders must make a decision without further information as to what the final outcome might be. *I then ask the question: will the uncertainty thus created be large enough for free-riding to be of no benefit?* The crux of the matter is that "large enough an uncertainty" is a direct function of the value of τ. Clearly, τ cannot be too large nor to small. Too small, and the uncertainty will not be large enough. Too large, and the other benefits of a dynamic setting, namely information updates on the substance of the bid, will decline. Thus, the optimal value of τ, call it τ^*, is important. However, I suspect that solving for this value may prove to be too difficult, and that an easier approach is to determine a minimum value, τ^0, given the uncertainty allowable on any individual i at that time. The issue hinges on measuring this uncertainty[23].

In trying to predict whether a fixed point WTP_i^* will eventuate for all i and if free-riding will occur, we would naturally assume agents are rational in the *homo economicus* sense. Because we are interested in real implementation, however, such an assumption cannot be taken for granted. As Williamson (1985), Heiner (1983) and Roth (1997) put it, real people are "intendedly rational but limitedly so". Simon's bounded rationality paradigm is better suited to the case. Predicting how boundedly rational agents in a dynamic auction under uncertainty will behave is no simple matter,

but the central question here is: will the proposed mechanism fulfil its purpose and work in practice? Will it be "satisfactory and successful" as previously defined?

The answer cannot escape the other question: how will an individual choose t_i^0, the timing of her first bid? Firstly, if at t_i^0 she is no longer indifferent, will she express her preference straight away, or "wait and see" for strategic reasons, in the hope that others similarly inclined will win the bid for her without her contribution (a case of free-riding)? The institutional design must force a particular kind of behaviour where individuals differ greatly in their response to such situations (Roth, 1997). Secondly, what if an individual is actually indifferent to both policy issues but wants to "cash in" on the compensation scheme? There would seem to be an incentive to "wait and see" which party is most likely to lose the bid, then step in late with a bid to be compensated, when in fact no lost utility will have been incurred, a form of opportunistic behaviour. The answer is that such behaviour will only occur where the expected benefits exceed the cost of bidding. If the uncertainty surrounding the benefits is high, then their expected value will be low and such opportunistic behaviour will be very unlikely. In this case, the expected benefits depend on the probability of being compensated when no lost utility is incurred; this probability is equal to that of the make-believe "preferred" option losing the bid. Again, if $\tau > \tau^0$, then the uncertainty will be large enough for such behaviour not to happen[24]. The solution mechanism thus appears to be foolproof, though, of course, a more rigorous analysis is needed.

On the above grounds, I would conjecture that if free-riding did occur, it most likely would in a very limited way, as confirmed in most empirical and experimental studies to date (Ledyard, 1995; Kagel, 1995). Furthermore, even this limited free-riding may not be seen as a problem, if there exist bidders who not only are "truthful" but also exhibit some degree of altruism: they do not mind free-riders as long as they themselves obtain their money's worth (winning the bid).

The P and D lobbies' problem

Each lobby has a different constituency which is characterised differently: the preservationist (P) lobby needs to "capture" all the potential WTP of a widely disparate and unorganised constituency. The developmentalist (D) lobby may have an easier job, but has two different types of agents to account for: the developer and pro-development individuals. The proposed solution mechanism, however, gives both parties exactly the same problem to solve: *maximise the total sum payment of their preferred option*. The solution mechanism creates a level playing field and puts both parties on a par, without giving the organised concentration of industry a competitive advantage over its opponents (a kind of "fair competition" condition).

This objective function is subject to the constituency's WTP. Note that the P and D constituencies are not initially given: they constitute a state variable in the lobbies' problem. The lobbies need to convince and persuade as many people as possible. The general public's WTP is constrained financially and informationally as described in the previous section. The two lobbies are themselves constrained by their own financial and human resource limitations, and are also subject to the marginal cost = marginal (expected) benefits rule. Each lobby will invest in information provision and distribution, as well as in criticism of the opponent's information supply, only up to the point where the expenses incurred appear justified. In this sense, the solution mechanism can be seen to endogenously generate an optimal amount of information to the public[25]. This is similar to what happens in courtrooms, where both prosecution and defence produce all possible arguments and exhibit all possible evidence to convince the jury one way or the other.

In the light of which, both lobbies have several means at their disposal to pursue their objective: they have the following controls over the public's choice and WTP.

- Maximise the perceived benefits of their policy and minimise those of the opponent (through campaigning and publicity).

- Minimise current income constraints of those who have made an initial bid in their favour (by facilitating an ad-hoc cash loan market at low interest rates).
- Minimise payment and vehicle constraints (easy pay arrangements, choice of vehicle, incremental payments).
- Maximise the perceived value of surplus money in case of victory, by committing to a specific use of the funds (ecological enhancement programs if P wins and social development programs if D wins).
- Maximise confidence in policy and compensation enforcement, by legally binding pre-arrangements.
- Minimise incentives for free-riding, typically by attaching to bids exclusive entitlements over resource use: rights of access, or transformation of resource into a transferable and tradable shared asset (quasi-public goods).

Naturally, both parties are striving to achieve their objective concurrently.

The developer's problem and the production of positive information externalities

The developmentalist story is not quite the same as the preservationist story. On the pro-development side, two different types of agents are involved: the developer (industry consortium), and that part of the general public who supports development against preservation. For these individuals, the problem is similar to that of their preservationist opponents, except that they know it is the total D bid that counts, which includes that of the developer. They may have an incentive to 'wait and see" how much the developer will bid before bidding themselves, that is, an incentive for strategic behaviour. Thus, the developer's behaviour, who initiated the problem anyway, is the primitive in this problem.

First recall two features. The developer does not have the property rights: the resource is public property. Secondly, we assume for simplicity (and without loss of generality) that there are no remaining competitors for the development bid. Some kind of selection process has happened *before* the start of the policy bid. Either one firm only is bidding, or a coalition of firms bid together. Whichever the case, the objective remains that of maximising the chances of the development policy winning the bid. The objective is such because the developer has done his homework and has worked out, using investment analysis, that the expected net discounted profits of the development *project* are largely positive. If this were not the case, the developer would not have initiated the bid to start with.

This knowledge puts an upper bound on how much the developer is willing to bid[26]. Naturally, if he can get away with it, he will try to bid less. This will depend, firstly, on how intensely pro-D individuals support the project, and secondly, on how intensely pro-P individuals support preservation. The greater the imbalance in favour of the latter, the closer to the upper limit the developer's bid, and the smaller the expected net profits. If resistance to the project is strong enough, the developer may want to withdraw from the game before it is over. However, doing so will reduce the amount of compensation. If the developer wants full compensation of lost utility (equal to the expected net discounted profits), then the incentive is there to play the game to the end. The bidding mechanism acts to push the developer to reveal his true private valuation of the development project, while the pro-D individuals reveal its social benefits (new employment, infrastructure, public services, etc.). As a result, there is no incentive for the developer to over-estimate or under-estimate the private benefits and costs of the development project. The mechanism avoids information asymmetry. Instead, it induces private information investment that generates a best estimate benchmark of the private industrial value of the project.

On the other hand, the developer, together with the D-lobby, has an incentive to manipulate the social costs and benefits of the project, as well as the costs and benefits of preserving the resource

in its undeveloped state. The purpose is of course to manipulate WTP(D) upwards and WTP(P) downwards. Expenses will be incurred to do so (advertising, campaigning). These efforts will however be balanced by opposing efforts from the P-lobby and the conservationist activists.

The resulting information structure underlying the valuation process

The result of this interplay between the two interest groups will produce a specific information structure for the general public. This structure is featured in **table 1** and serves as a base for the valuation exercise. What the general public obtains is a matrix of upper and lower estimates on the relative merits and demerits of the two policies, with each lobby pushing in specific directions[27]. Demerits include risks.

Table 1 here

Specifically, individuals are provided with over- and under-estimates of the following key valuation parameters:

- The net social *financial* benefits of D and P outcomes, which provide estimates of their contribution to the total national net value-added to the economy. The net national value-added is defined as the gross value-added plus or minus the net revenue from exports minus imports, minus exported profits by foreign investors.
- Net local and national creation of jobs and training opportunities, with due consideration of skill levels, duration of employment, and job displacements.
- Infrastructure and services development, and possibly their estimated value to locals and to the nation.
- Multiplier effects to the economy.
- Effects on property appreciation or depreciation.

- Impacts on human health and the environment, both positive and negative.

Unlike what happens in benefit-cost analysis, these pieces of information are appreciated, weighed and compared by each individual in their own way, most likely according to pre-set personal values. The weighing of uncertainties and the (implicit) discounting of future costs and benefits is left to each individual to choose. No bureaucratic procedure is necessary.

V. CONCLUSION : PROBLEM SOLVED?

What has been achieved?

The proposed solution mechanism, in the form of a competitive collective bidding process, appears to have fulfilled a number of achievement criteria.

1) Insofar as little or no free-riding occurs in the process, bids will reflect true valuations by all stakeholders, achieving a socially efficient, or Pareto-optimal, outcome. The mechanism is satisfactory in Green & Laffont's (1977) sense.
2) The final outcome achieves an actual, not just a potential, Pareto-improvement. Full compensation of the utility lost by losers is always possible.
3) The full value of the preservation option is revealed and measured by the preservationist bid, including non-use and indeed ethical values, such as rights-based animal welfare or the intrinsic value of life-support systems. No form of preference structure is excluded, whether utility-based or lexicographic. Reliance on a safe minimum standard, or use of a precautionary principle, is allowed, insofar as individuals rely on them in their valuation.
4) The best-estimate value of the development project is revealed, avoiding the problem of information asymmetry between the developer and others.
5) A level playing field is achieved between the concentrated organisation of industry and the unorganised dispersal of preservation supporters.
6) Incentives for optimal information provision allow the public to make its valuation in the best informational environment economically achievable.
7) Multiple decision criteria are not excluded.
8) Free-riding behaviour is minimised. Any occurrence depends on the degree and type of rationality subjecting individuals' behaviour.

9) Valuation and decision making are closely linked. The DM mechanism yields an efficient and unbiased valuation, and the valuation outcome determines the decision outcome. The link works in both directions.

These achievements are predicated on two prerequisite principles, that of sufficient democracy and that of sufficient technology.

More importantly, these achievements are proposed as challenges for investigation and for "proof", not as final results. The exact conditions under which each achievement holds true needs to be studied rigorously. However, the nature of "proof" may not be of the usual kind, obtained with pencil and paper. The proof of the pudding may well be in the doing. Examining the conditions under which each achievement holds may require real experiments, rather than theoretical speculation. Indeed, I suggest to put the mechanism to the test using a *testable prediction:*

"*Implementation of the proposed mechanism will be 'successful' (Green & Laffont, 1977).*"

That is, whatever the outcome, it will satisfy all those who initially accepted the solution mechanism. Thus, what is needed is a test for "public satisfaction" with the outcome, given acceptance of the solution mechanism. It remains to be seen if the test can be carried out meaningfully in experimental, that is, artificial conditions.

Note that the approach implemented in this way is neither normative nor positive. Rather, it is constructive and heuristic, in my view a far better approach to economics[28]. The normative stance suffers from *a priori* assumptions on (*inter alia*) consumer preferences that are not amenable to verification. The positive stance suffers from *a priori* assumptions on people's behaviour that can only be confirmed or disconfirmed with the use of statistical tests that too often lead to indeterminate conclusions. Both approaches suffer from an over-simplistic view of people's behaviour linked with the postulate (however instrumental) of perfect rationality. The proposed

mechanism does not rely on any of these assumptions and is in my view well suited to imperfectly rational agents (March, 1978).

Implications for non-market valuation and for benefit-cost analysis in environmental policy

The first implication for non-market valuations based on survey techniques is that they cannot be used as a direct informational basis for policy making. This is especially true for stated preference valuations such as contingent valuation or choice modelling. Rather, survey based non-market valuations can be used for improving the institutional design of social preference revelation mechanisms, such as the one described in this paper. They help identify the factors to which the final outcome of the revelation mechanism will be sensitive. They also serve as indicative opinion polls, provided, however, that subsequently the real social choice event happens. Currently, the role given to survey based valuation exercises is similar to the one that would be given to opinion polls before political elections, without ever these elections taking place. It is as if opinion polls were asked to replace the actual election!

As for benefit-cost analysis, it is a bureaucratic or technocratic process that substitutes itself poorly for social valuation. It is essentially based on the fact that a handful of administrators or "experts" allow themselves to value things on behalf of others. The justification lies in the use of the Pareto-efficiency criterion, raised, or reduced, to a purely technical status. Yet it is well known that individuals do not value social alternatives solely on this basis, but include equity and distributional considerations, as well as non-economic dimensions: sense of duty, social norms, and so forth. Furthermore, I have shown why such a procedure simply cannot achieve its purported goal of efficiency. It is a self-defeating mechanism.

This is not to say that BCA has no role to play in a social valuation process. However, my view is that its only efficient role is in summarising information originating in the market, that is, in values revealed through real economic transactions. A typical example would be the computing of net present values from market-priced costs and benefits, and using appropriate procedures (shadow pricing etc.) to correct for market distortions. It would therefore be a mistake to consider that the "development vs. preservation" problem is but an extension of the "which development" problem, as investigated in the 1970s by Little & Mirrlees (1974), Gittinger (1972), Dasgupta, Marglin & Sen (1972) or Squire & van der Tak (1977).

As a result, the relationship between NMV and BCA must be reversed. NMV cannot be fed into a BCA framework as is currently done; instead, BCA results must be fed into a social NMV process. The resulting picture is given by **figure 3**, to be contrasted with **figure 1**.

Figure 3 here

BCA feeds on market-based values (prices) and is fed as information into the social DM process. Unexpressed non-market values, held by people, can be expressed through non-market valuation exercises (e.g. by answering survey questionnaires), or through a social choice mechanism. In the first case they will be constrained by all the factors held fixed by design of the valuation exercise (not full context dependent), whereas in the second they will not be thus constrained: their valuation will be full-context dependent, in space and time. The valuation exercise can nevertheless be useful in improving the design of the social choice mechanism and for predicting the outcome. Finally, the social choice mechanism must simultaneously produce an efficient decision outcome and efficiently value all the alternatives.

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APPENDIX 1 : The individual's "voting sheet"

Development or Preservation of <resource X>?

If you have decided which policy option you prefer:

1. **You can send money to your chosen fund using your preferred means of payment, including the Internet.**
   - *You can thus increase the chances of your preferred policy winning (the policy with the greater **total** bid wins).*
   - *You can pay something now and more perhaps later, as long as it is **before the deadline** (**DAY- MONTH- YEAR**).*
   - *If your preferred option loses, you can be refunded and fully compensated by receiving twice your total bid*

.

2. **Please specify what % of your right to full compensation you wish to receive if your preferred policy loses.**
   - *You can thus contribute to capitalise your voting power for future similar policy bids.*
   - *You will retain the freedom to choose your preferred option, even if it is different from the one you choose now.*

   _____ ***%***

3. **Please specify what % of your share to the winning surplus you wish to receive if your policy wins.**

   You can thus contribute to speed up the implementation of your preferred policy.

   _____ ***%***

Signature: _____ Date: _____

You may also wish to borrow or lend money to increase your ability to contribute to your cause. You can contact **[***preferred trust fund***]** *who will facilitate and guarantee your transaction.*

Table 1 : Over-and under-estimates of P and D benefits & costs

	Preservation		**Development**	
	Merits & Benefits	***Demerits, Costs & Risks***	***Merits & Benefits***	***Demerits, Costs & Risks***
P-lobby	+	–	–	+
D-lobby	–	+	+	–

Legend: + means an over-estimate
– means an under-estimate

Figure 1: The current approach to valuation and public decision-making

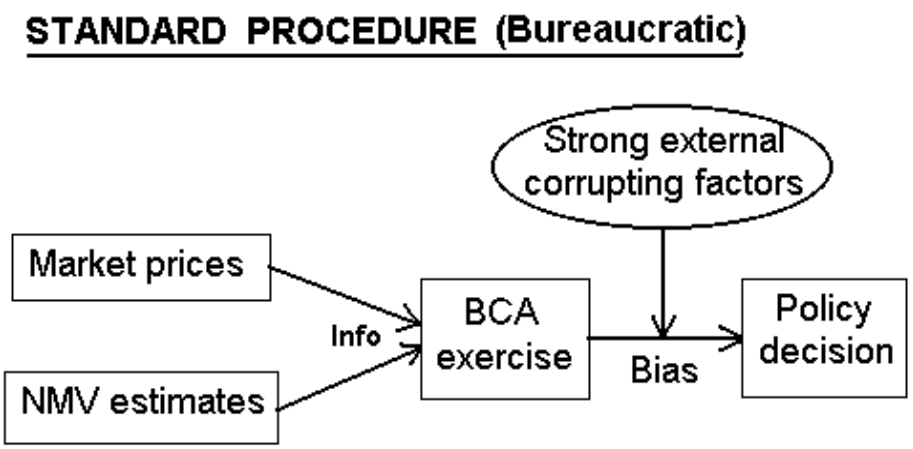


Figure 2 : Model of the political decision-making system
(Western Australia example)

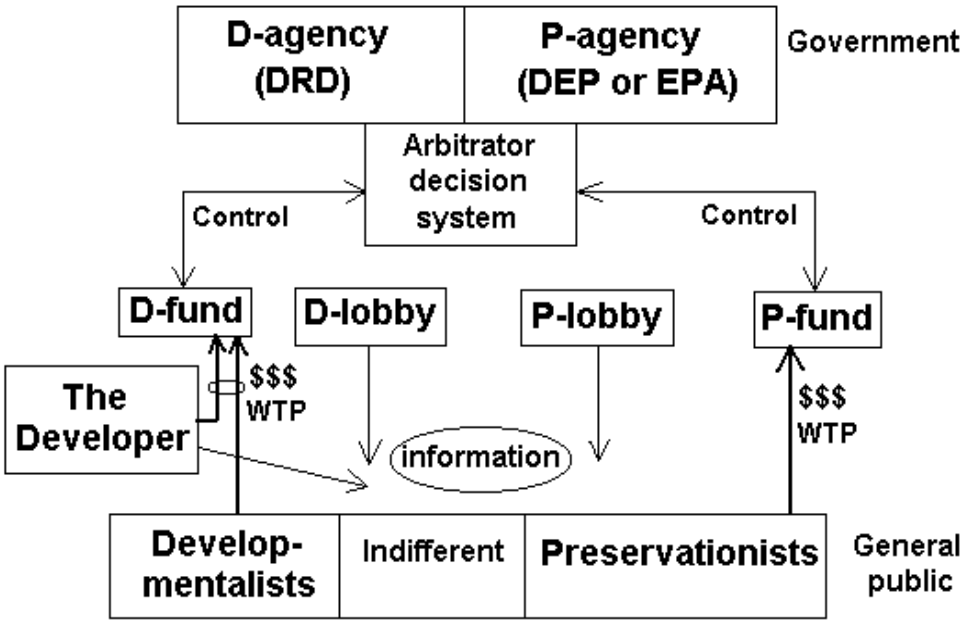
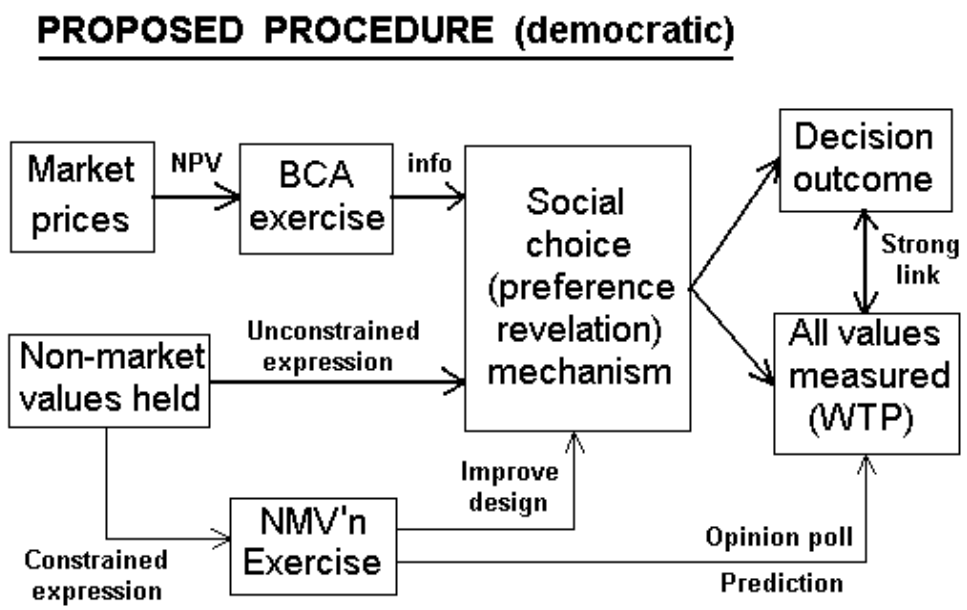


Figure 3 : The proposed approach to valuation and public decision making



NOTES

[1] Indeed, development can be thought to 'overshoot' preservation if environmental-enhancing and restoration activities are thought as just another type of development. The characterisation is two-dimensional rather than one-dimensional: one axis measures economic development and the other ecological development. The strict preservation scenario (the don't intervene policy) then appears as the (zero, zero) node of both axes.

[2] This statement would need to be investigated, of course, as would the necessary conditions for it to be in each stakeholder group's interest to provide the only 'best' option against that of the opponents.

[3] I assume here the reader is familiar with this well-established concept.

[4] The irony is that Vilfredo Pareto himself was a sociologist before being an economist!

[5] It also holds, to a lesser extent, for hedonic pricing and travel cost methods, given the numerous debatable assumptions that have to be made to carry them out. Statistical tests do help, but their message is usually one of caution! For the present purpose, we can concentrate on SPV insofar as non-use values are an important ingredient of nature conservation policies.

[6] See for instance Boyce et al. (1992), Swallow (1994), Neill et al. (1994), Shabman & Stephenson (1996), Loomis et al. (1996), Foster, Bateman & Harley (1997), Champ et al. (1997), Frykblom (1997), Shechter, Reiser & Zaitsev (1997), Lunander (1998), and Nestor (1998).

[7] Note that these experimental WTP bidding procedures frequently take the form of auctions, a point to keep in mind for further reference.

[8] Indeed, his doubts stem from the current approach to quasi-market schemes, monitored and controlled bureaucratically.

[9] By "nomenklatura" I am referring to what was de facto a bureaucratic dictatorship in the former Soviet and "Eastern Block" nations. However, it is still thriving there and elsewhere, particularly in some less industrialised countries.

[10] This concept of "electronic democracy" is not purported to be without its own dangers. Mark Wheeler, 1997 (chap. 8) critically describes the political and economic dimensions of new communication systems, and particularly of the Internet. These considerations should be of no concern here, however, as the Internet is only considered to be a technology allowing for low-cost two-way interactions between consumers of goods, services or policies, and their respective suppliers. (I borrow the concept of supply and demand of policies from D. North, 1990, and R. Challen, 1998).

[11] A huge literature in the field of the positive theory of government regulation exists on these issues, mainly of American origin, which I shall not bother the reader with. A particularly relevant application is by Ando (1997).

[12] One may question the legitimacy or efficiency of allowing such "consumer sovereignty" to prevail. How would one know that individuals as consumers are more knowledgeable than government agents and technocrats in making rational decisions? My solution mechanism addresses this issue by appealing to individuals both as "consumers" and as "citizens" (Blamey, Common & Quiggin, 1995), so as to practically allow for behaviour as suggested, for example, by the Bergson-Tintner-Samuelson model (Kohn, 1993).

[13] This is linked to the key role of uncertainty as well as to the possibility of strategic behaviour, namely free-riding. This is detailed further hereafter.

[14] There is a possible analogy here with quantum physics, though I suspect there is more than just an analogy. Just like a measurement or observation event "collapses" all the possibilities of the Psi function in the Schroedinger equation, an economic "choice event" collapses preference indeterminacy. More specifically, outside the realm of repetitive market transactions where experience has had time to build up, the initial stage is where the probability of a new option A being preferred to a new option B is equal to the probability of option B being preferred to option A. This initial symmetry breaks down when a choice event appears. Preference formation could therefore be modelled as a breakdown of probabilistic symmetry. Unlike physics, this breakdown can take a long time and may never be complete (an individual may never be 100% sure she prefers A to B or B to A). I leave such considerations for the future, however.

[15] This implements the solution to models based on the consumer/citizen distinction, as referenced earlier (BTS model described by Kohn, 1993, among others).

[16] In the last decade, large sums of money were contributed by Europeans and Americans to Brazil for preserving the lifestyles of several native tribes in the Amazon rainforest, endangered by the "onslaught of bulldozers".

[17] For example, a lender can pay directly to the trust fund of their choice (D or P fund) on behalf of the borrower, and on his explicit written demand. Such contracting can happen with low transaction costs, given that the borrower simply cannot "take the money and run". Also, there is no incentive to ask for

a loan unless there is a strong enough disparity between ATP and WTP. The success of such an auxiliary mechanism warrants of course further study.

[18] Relaxing wealth or income related constraints allows the efficient implementation of a large class of mechanisms that rely on quasi-linear utility functions, of the Clarke-Groves or Groves-Ledyard type. See Fudenberg & Tirole (1991) and Mas-Collel, Whinston & Green (1995: chapter 23), for an overview.

[19] Note that in the mechanism design literature, notably with Clarke-Groves mechanisms, such a surplus is termed a 'waste". It will become clear why 'waste' would be an inappropriate descriptor here.

[20] See Sunder (1995) on experimental asset markets, and particularly (pp. 480-1) on generations of bids and asks.

[21] The problem of the acceptance of such a procedure, a legitimate question to investigate, lies beyond the scope of this paper.

[22] Note that "deciding" to be indifferent is very different, too, from deciding not to bid before a given time, a behaviour that may be strategic and not reflect real preferences (see hereafter).

[23] The opposing parties would have an incentive in this scheme to carry out polls in order to reduce this uncertainty and "ride the information". Two things can be done to avoid this problem: 1) the general public can be made aware of the problem and of the necessity of an informational blackout during $(T - \tau)$; 2) polling can be prohibited after time τ, as already happens in some countries during general elections time (e.g. France, where also political parties are not allowed to debate directly, via the media, in the last week leading to the election.)

[24] Given that individuals vary greatly in their degree of risk aversion, could some consider the situation from a gambling perspective and be willing to risk a bid? This is highly unlikely, given that the payoff is very limited from a gambler's point of view: at most, twice the amount bid. With $\tau > \tau^0$, the probability of "losing" the bid (as desired) is very close to 0.5, which makes the expected net benefit very close to zero.

[25] There is a possibility where slander and misinformation from both sides could supersede the "clean" informative outcome. I believe this possibility can easily be arrested with simple rules of the game regulations, where, for instance, any slander could be subject to lawsuit and tort compensation with high penalties (and certainly the courtroom model is highly regulated). Furthermore, the long term reputation effect cannot be under-estimated, in that more similar policy issues are to be expected in the future.

[26] This is likely to be the general case. However, in certain sophisticated settings where political aspects are taken into account, or where the present project is seen as an investment towards obtaining future projects, the developer may be willing to incur a net loss on this project and bid more than its net value. I leave this possibility for future analysis.

[27] Again, because this issue cannot be considered in isolation of future similar issues, neither party will have a strong incentive to exaggerate one way or the other, because doing so will affect their

credibility in future bids. Thus the bound intervals will reflect true uncertainties rather than strategic exaggeration.

[28] In Schilizzi & Boulier (1997), I advocated a similar attitude in a totally different context.