Calibration of Stated Willingness to Pay for Public Goods with Voting and Tax Liability Data: Provision of Landscape Amenities in Switzerland

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Controversy remains over the degree of hypothetical bias in contingent valutation method (CVM) estimates of values for public goods, especially for public goods with significant passive-use values. This paper uses an "indifferent voter" approach to calibrate stated WTP for a proposed public good increase with actual WTP implied by voting and tax liability data. Our data are from a CVM survey and an actual voting decision on propositions to increase public funds for landscape amenities protection in the canton of Zurich, Switzerland.

Key words: contingent valuation, indifferent voter, median voter theorem, referendum, valuation. JEL: Q21

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I. INTRODUCTION

Willingness to pay (WTP) estimates obtained from hypothetical survey methods such as the contingent valuation method (CVM) have the potential to provide useful information to policymakers. However, due to the lack of incentive compatibility in hypothetical choices and respondents who are typically inexperienced with public good valuation, researchers have questioned whether reported values truly reflect the amounts individuals would actually pay for proposed policies (e.g., Diamond and Hausman 1994). Hence, intensive efforts are underway to validate stated choices with actual choices, or with WTP estimates obtained from revealed preference studies (Carson et al. 1996). A further aim of these studies is to develop "calibration" techniques for appropriate adjustments of stated values (Arrow et al. 1993, Cummings et al. 1997).

One obvious way of comparing actual with hypothetical WTP is to use experimental techniques. Experiments have been conducted with private goods (Bishop and Heberlein 1979; Cummings, Harrison, and Rutstrom 1995; Loomis et al. 1996; Frykblom 1997) and public goods provided by either individual donation (Seip and Strand 1992; Foster, Bateman, and Harley 1997; Carlsson and Martinsson 2001) or group donation mechanisms (Cummings et al. 1997; Ethier et al. 2000). Some of these experiments have provided evidence of a substantial disparity between actual and hypothetical WTP. However, it is doubtful if these results can be transferred to the contexts in which policymakers are typically interested (Fox et al. 1998; Cummings and Taylor 1999; Carlsson and Martinsson 2001). Such transfer would rely on the unlikely condition that any "hypothetical bias" is not commodity specific. Regarding results from private good proxies this appears questionable because it is, among other things, the lack of market experience in non-market decisions which make hypothetical

payments suspect. Concerning donations, both actual and stated WTP are potentially affected by free riding.

In contrast, the scope of non-experimental validation approaches, such as "convergent validity" tests using travel cost or hedonic pricing information, extends to choices about collectively provided public goods. However, these tests are unfortunately unable to capture passive-use values of such goods, which are important in many public decision issues. Due to these limitations of present validation and calibration methods, alternative approaches remain in demand.

CVM surveys on public goods that are to be provided through taxation are often designed to simulate actual referenda (Arrow et al. 1993; Hanemann 1994). This involves the use of question formats, payment instruments, and hypothetical institutional contexts similar to those of real-world referendum decisions. It had already been noted in the public choice literature that in measuring preferences for public goods, voting choices may be the closest available substitute for (unavailable) consumer choices (Bowen 1943). Based on this observation public choice theorists have successfully applied economic theory to individual non-market decision making such as voting in referenda (e.g., Deacon and Shapiro 1975). More recently, a widely cited expert panel report on CVM discussed and recommended the use of voting decisions as a context for validation and calibration of hypothetical choices about goods with passive-use value (Arrow et al. 1993, p. 4607). Given appropriate data sets, a comparison of CVM survey responses with respondents' actual voting behavior for public good issues might provide insights into the reliability of CVM estimates, and possibly yield empirically based rules for calibration of obtained hypothetical responses.

In this paper we apply such an approach, theoretically developed in Schläpfer and Hanley (2002), for comparing stated and actual WTP using voting information. Section 2 describes the calibration approach which, by its rationale, is closely related to median voter

theory. In section 3 the method is applied to a set of CVM survey and actual referendum data. Section 4 presents the results. Section 5 concludes with a short discussion of the benefits and limitations of the proposed method for validation and calibration of contingent values.

II. DEVELOPMENT OF THE CALIBRATION APPROACH

In the institutional context of a "referendum democracy" it is common practice that important decisions about public goods are subject to referenda. Voting choices about changes in public expenditures can be cast in a utility maximization framework (e.g., Deacon and Shapiro 1975). An individual *i*, given a known tax structure (with corresponding individual tax price[1] τ_i) and disposable income I_i casts a vote depending on whether she is better off with or without the proposed change, considering both the change in the public good ΔG and the change of her tax $\tau_i \Delta G$.[2] Thus, the individual's decision will depend on whether the difference between the *status quo* utility, $U(I_i , G)$, and the utility under the changed policy, $U(I_i - \tau_i \Delta G, G + \Delta G)$, is positive or negative. This basic framework is the same as in referendum format contingent valuation surveys. Assuming that the individual approximately knows her expected tax change due to the referendum[3] and strikes a balance between benefits and costs, voting behavior can thus provide "hard" evidence about individuals' actual WTP for public goods. This information may be compared with stated WTP obtained in a closely related context. The procedure would involve conducting a CVM survey jointly with a popular voting

[1] An individual's tax price is the individual's additional tax payment when public expenditures increase by one dollar (e.g., Stiglitz 2000).

[2] It should be noticed that such information can only be derived when the treasury and hence taxpayers "pay the bill". If, for instance, a proposed change differentially affects specific industries (as in pollution control policies) then the cost to the individual voter is difficult to assess and may strongly depend, e.g., on occupation (see e.g. Fischel 1979, Kahn and Matsusaka 1997).

[3] The circumstances under which this assumption is justified are formally developed by Bergstrom and Goodman (1973, pp. 284, 294).

decision, where the survey would need to be appropriately designed to replicate the choice issue of the actual referendum while retaining all other features, including the information context, of a CVM survey.

Some practical difficulties involved in surveying CVM respondents' actual voting behavior aside, consistency testing of hypothetical voting choices can proceed by within-sample comparison of hypothetical and actual binary choices (Schläpfer, Roschewitz, and Hanley 2002). In contrast, calibration of hypothetical with actual WTP requires point estimates of actual WTP. Regarding the derivation of such estimates there is an important difference between the elicitation of values through referendum format CVM as currently practiced and actual referendum voting. In CVM, point estimates of individuals' WTP can be obtained either simply by averaging over responses to "open-ended" questions or through statistical analysis of response distributions in the case of "referendum format" surveys, where payments vary randomly across respondents (Hanemann 1984). In actual referenda, however, the payment instrument is often a tax on income. Payments within a given jurisdiction are thus strictly related to income through the income tax schedule and do not otherwise vary substantially among individuals. The effect of the payment level on the probability of approval, which is the basis for calculating the distribution of actual WTP in dichotomous choice CVM data, cannot be isolated. However, unlike valuation, validation and calibration of hypothetical values can proceed without measuring the whole distribution of actual WTP. Even a single point estimate of actual WTP that corresponds with a known hypothetical WTP would provide an important benchmark calibration factor. Towards this more modest end, assumptions similar to those underlying the median voter theorem[4] can be used to derive estimates of actual WTP from aggregate majority voting outcomes.

[4] The median voter theorem, one of the important early theorems of public choice theory and originally due to Hotelling (1929), is presented in more detail e.g. in Mueller (1989). Application of the model to referendum democracies is discussed in Pommerehne (1987).

A. The median voter assumptions

The two key assumptions for the median voter theorem are that issues are defined along a single dimension and that each voter's preferences are single peaked in that one dimension, as may for example be the case in expenditure issues.[5] Black (1948) proved that when these conditions are met majority rule produces a defined equilibrium voting outcome. This equilibrium lies at the peak-preference point of the median voter (see e.g. Mueller 1989). A detailed list of the conditions of a "median voter equilibrium" in the institutional context of a voter assembly or town-meeting decision process is as follows (Buchanan 1968, Blankart 1998):

I. There is institutional congruence, i.e., the voters are also consumers of the public goods as well as being taxpayers. All potential voters participate in the vote.

II. The sharing of costs for financing the public good is determined independently of the specific project at hand.

III. The budget is balanced (equal income and expenditures).

IV. Each issue is voted on separately. There is no tie with other projects.

V. Preference orderings are single-peaked.

VI. A project is considered accepted if it is approved of by at least a simple majority, that is, by $0.5\,n + 1$ of the n voters.

[5] Regarding the application of these assumptions to expenditure issues we cite Bowen (1943): "In discussing preferred outputs of public goods it is necessary to define the units in which quantities of the public good are measured. Due to the complexity of most public goods quantity changes may relate to both relative priorities of various components of the good and the overall amounts of the increase or decrease. When the priorities in providing particular components of public goods are established, the quantity of public goods can be usefully measured in terms of money costs. This is often the case when experts or representatives determine these priorities. The public decision about the quantity of a public good provided can then be conceived as a one-dimensiona decision about the appropriate level of budget expenditures."

VII. Coalitions among voters are considered impossible due to high costs of bargaining.

VIII. Propositions (proposed public good levels) can be adjusted in the voting process.

An illustration of the median voter equilibrium expenditure is provided in figure 1. The median voter's preferred expenditure given a specified tax system, corresponding with a total public expenditure level G_m, is given by the rectangular area defined by the two provision levels G_0 and G_m and the point P in which the median voter's demand curve intersects with his or her marginal cost of providing the good, τ_m.

Turning to voting on an increase to an existing public good supply G_0 the area ΔT_m defined by G_0 , G_m and P can be interpreted as the median voter's preferred tax increase (given the pre-specified tax structure) for the proposed discrete change in the public good supply. Using the assumption that the median voter is identical to the individual with median income this tax payment can be estimated empirically (Borcherding and Deacon 1972). However, the median voter's *WTP* for the change in the public good, which is of interest in the context of CVM calibration, is given by the *entire* area under the demand curve between the two public good provision points G_0 and G_m. The tax payment ΔT_m thus seriously underestimates the median voter's WTP, which itself cannot be empirically estimated without prior knowledge of the demand function.

B. Inferring maximal WTP

Contrasting to the idealized decision environment described above, assumption VIII will in general not apply in the situation of real-world referenda on public good increases. A median voter equilibrium proposition is unlikely due to failure of the political process before the vote to precisely adjust expenditure to median voter preferences. However, as it turns out,

in such real-world referendum propositions on a *fixed* public good increase there is an identifiable individual whose tax payment yields information about his or her maximal WTP for the public good. To illustrate this, consider the case of a proposition to increase the provision of a public good from G_0 to G_1. Under fairly plausible conditions on WTP and tax prices, the (unobserved) individual probability of approving the proposition, call it y^*_i, will be monotone increasing in income.[6] The conditions for this to be true are examined in Schläpfer and Hanley (2002). These conditions are closely analogous to those derived and used by Bergstrom and Goodman (1973) in equating the median of public good quantities demanded with the quantity demanded by the citizen with median income.[7]

The relationships between income, WTP, and additional tax payments underlying the required distribution of individual approval probabilities are illustrated in figure 2. Apart from the special case where all individuals agree with or reject the proposition (and thus no one's WTP can be estimated) WTP will exceed ΔT above some income level I_p. This is the income of the voter, who is indifferent regarding approval or rejection of the proposition or, in other words, whose approval probability y^* equals 0.5. Thus, in contrast to the median voter case, where the individual with median demand can be identified on the income distribution, the identifiable individual is here the citizen with an approval probability of 0.5.

Suppose now that p percent of the individuals in the jurisdiction vote *against* the proposal. From the assumption on monotonicity, identify the pth individual in the distribution of individual approval probabilities as the pth person in the income distribution. This person is roughly indifferent between voting *in favor* and voting *against* the proposition or, in other

[6] It is perhaps useful to think of y^* as of a "latent variable" underlying observed binary choices, as in statistical models of discrete choices.

[7] Bergstrom and Goodman show that, if for all incomes, $\varepsilon+\delta\xi > 0$ (where ε is the income elasticity of demand, δ the price elasticity of demand and ξ the elasticity of the tax share with respect to income), then the higher a citizen's income, the more he will demand (p. 285).

words, this person's additional tax liability ΔT_p is equal to his or her maximal WTP. The indifferent voter's WTP for the public good change can be illustrated in a graph similar to that above showing the median voter's preferred public good change (figure 3). Graphically, the area under the demand curve of the indifferent voter between the two provision levels G_0 and G_1 (the indifferent voter's WTP) is equal to the area below the indifferent voter's tax price τ_p between the two provision levels G_0 and G_1 (the indifferent voters tax increase ΔT_p). (The indifferent voter's *preferred* expenditure level would be located between G_0 and G_1.).

Analogous to the median voter case the *p*th percentile voter's additional tax liability, ΔT_p, may be estimated from this individual's tax price and the magnitude of the proposed public expenditure increase, ΔG. Assuming that the tax is raised on income, the indifferent (*p*th) voter's total annual tax burden T_p has the general form $T_p=f(I_p)r$, where $f(\cdot)$ is a fixed income tax function, I_p is the *p*th individual's taxable income and r is a variable tax rate which is set annually in accordance with the total public budget (B). The indifferent voter's tax price is then given by $\tau_p=T_p/B$. The indifferent voter's additional tax burden ΔT_p , or his actual WTP for the proposed public good is thus given by $\Delta T_p=\tau_p \Delta G$, where ΔG is the proposed increase of the public expenditure due to the referendum. Assuming that hypothetical WTP too is monotone increasing in income, the indifferent voter's WTP amount can be compared with the *p*th percentile on the hypothetical WTP distribution. The ratio between the indifferent voter's actual WTP and the hypothetical WTP in the survey $WTPH_p$, which would be the appropriate "calibration factor" for hypothetical WTP C_p is given by $C_p= \Delta T_p/WTPH_p$, where $WTPH_p$ is the *p*th percentile on the WTP distribution in the CVM survey. Summarizing yields an expression for the calibration factor as

$$C_p = \frac{f(I_p)r\Delta G}{WTPH_pB} \ .$$

Referenda on the provision of regional or national public goods are often held at levels of government encompassing several or many voting districts. If sufficiently large samples of CVM responses are available for each of several voting districts the comparison of hypothetical and actual WTP can be made for each individual district. In the following we apply the above approach to voting and tax liability data and CVM responses on similar, although not identical, propositions for regional landscape protection from a group of municipalities in the canton of Zurich, Switzerland.

III. APPLICATION TO EMPIRICAL DATA

A. The actual referendum proposition

The proposition to increase the annual budget for nature and heritage protection (NHP) in the canton of Zurich was submitted to the voters in 1996. The proposition originated from the initiative of a private individual who proposed specific changes to a law[8] to effect an increase of annual NHP fund instalments from a then-current level of 10 million to 30-50 million Swiss Francs (SFR). The initiative won preliminary support in the cantonal parliament in 1994 and was thus delegated to the cantonal executive for review. The executive rejected the initiative, favoring instead its own formulation of a 20 million annual fund instalment and the empowerment of the parliament to allow up to 10 additional million annually to pay off debts of the fund. The cantonal parliament approved this revised proposal. The resultant referendum on a 10 to 20 million increase of expenditures was accepted by 57 percent of the active voter

[8] The "Law on financing of measures for nature and heritage protection and for recreation areas" of 1974.

population. Voter turnout was 29 percent. (Office of the Parliament 1996). Use of the NHP budget was described in the voter information journal summary as:

> From the fund for nature and heritage protection the canton finances measures for creating, maintaining, enabling access to, improving or managing landscapes, townscapes, natural and cultural objects, and recreation areas worth of protection.

The summary ended with the words:

> Only [with this increase] can the canton in the interest of the public adequately meet its nature and heritage protection assignments in the future.

The full text expanded on more detailed expenses such as cost-sharing payments for land use agreements with farmers (Executive Council 1996).

B. The contingent valuation survey

In the northernmost region of the canton of Zurich, comprising 26 municipalities, a CVM survey on a comparable expansion of landscape protection expenditures was conducted three months prior to the actual referendum. Only a short description is provided here (see Roschewitz 1999; Schläpfer, Roschewitz, and Hanley 2002). The CVM survey proposed a regional landscape protection programme, financed by the municipalities of the region, to preserve the landscape of this region “in its current state”. The valuation question was posed as:

> Imagine that on the next weekend there was a vote on this programme to protect the landscape of the Zurich Weinland. If the proposition were accepted, you

> would have to expect a maximal tax increase of SFR [X] per month. How would you vote?

Options for answering were "yes" and "no", and "don't know". Following a triple bounded referendum procedure the question was repeated inserting adjusted tax payments taken from one of four search trees ("And how would you vote if you would have to pay…Francs per month?"). Finally, the interviewer added a follow-up question:

> In other words, you agree to pay up to about SFR [12×...] annually in additional taxes for the protection of the Zurich Weinland. If this sum now appears too high or too low, would you like to correct it?

If the answer was "yes" the respondent could then adjust the figure. These final figures of the triple-bounded referendum with follow-up were taken as the individual's WTP. Participation among the 1074 selected target persons was 76 percent, yielding a total of 816 respondents. A total of 688 valid WTP bids were obtained, yielding an effective response rate of 64 percent.

Important characteristics of the actual and the hypothetical voting propositions are summarized in table 1[9]. Both propositions basically suggested a tax increase to cover public expenses for maintaining landscape amenities somehow threatened by development or conversion to other uses. Although there is some difference in both the precise formulation and the amount of detail provided – a 1500 word illustrated description in the voter journal plus media coverage *vs.* a telephone interview – this difference is partly inherent to typical (as opposed to idealized) CVM and real-world voting contexts. We argue that the correspondence

[9] Some issues involved in setting up comparable CVM/referendum pairs and the degree of correspondence between the CVM survey and the real referendum proposition in the present case are discussed in Schläpfer, Roschewitz, and Hanley (2002).

is sufficient to warrant proceeding with the comparison of actual and hypothetical preference revelation.

C. Measurement of variables

The following empirical data were used for calculation. Aggregated (municipality-level) voting outcomes are the percentages of approving votes among all valid votes. CVM respondents could be unambiguously allocated to the individual voting districts (municipalities) based on mail codes. Percentiles of the stated WTP distribution were calculated from the sample of valid CVM survey responses. Income data (mean and standard deviation of log-transformed 1996 net incomes) for each voting district were obtained from the Cantonal Office of Statistics. For each municipality the required percentile of the income distribution was computed from these data assuming normally distributed log-transformed incomes. Most of the cantonal revenue comes from the income tax. It is assumed that tax prices can be computed from income figures alone, implying that the individual with pth income pays the same share of the municipal revenue as he or she does of the income tax. This is an assumption of convenience, which should be modified whenever better information is available. The applicable income tax function $f(I)$ is composed of the fixed income tax schedule of the cantonal tax law (Canton of Zurich 1997) and a variable tax factor r for the year 1996 (period 1994 through 1996) of 1.08 (Office of the Parliament 1993). For the proposed expenditure increase ΔG we used a figure of 15 million SFR, thus including half of the 10 millions that may or may not be allowed by the cantonal parliament in a given year (see description of proposition above).

D. Legitimacy of the monotonicity assumption

Corresponding to the situation described in fn. 5 there was little debate about *how* expenditures should be best allocated, indicating that the expenditure issue can be considered as one-dimensional. Regarding violations of the condition on voter turnout, empirical evidence indicates that (Swiss) abstainers are mostly indifferent or uninterested rather than "frustrated" (Bühlmann et al. 2001). According to this evidence active voters should not represent a strongly biased sample with respect to their WTP for public goods. We tested the monotonicity assumption, which is required for identifying the *p*th individual on the distribution of approval probability with the *p*th individual on the income distribution, using aggregate voting and income data. The following evidence for a reasonable agreement with monotonicity assumptions can be offered. OLS regression of the *logit* transformed approval rates (aggregated voting data) in the municipalities of the canton of Zurich on mean municipal log-transformed net income (among other variables) yielded a highly significant positive income effect in spite of the progressive income taxation (n=171; $p < 0.001$; partial R^2 of income: 0.18). At the mean income level a 10% increase in income yielded an absolute increase in approval rate of the referendum of 2.2% (Schläpfer and Hanley, 2001. WTP distributions obtained in the CVM survey showed the expected positive income effect. For the municipality with the largest number of survey respondents, income was significant in simple regression models of individual WTP (n=348; $p < 0.001$; partial R^2 of income: 0.04).). The condition that individual WTP and approval probability to the referendum, apart from a random effect of taste, are monotone increasing in income thus appears to be fairly well realized in the present voting decision.

E. Results

At the level of the entire Canton of Zurich, at which the referendum was held and accepted by 57 percent and rejected by 43 percent of active voters, the monotonicity assumption yielded a 1996 income of the indifferent (43rd percentile) voter of SFR 35,480. This income level corresponded to a cantonal income tax liability of SFR 1400 and to an expected increase in tax liability due to the referendum of SFR 6.25. This figure thus represents a rough estimate of the indifferent voter's *actual* WTP for the proposed increase of the public good. For comparison, the 43rd percentile of *stated* WTP across all individuals of the CVM survey area (in which the above proposition was approved with 55 percent of the votes) amounted to SFR 240. The comparison suggests that survey responses obtained from individuals with median WTP for increased landscape protection overestimated these individual's actual WTP as taxpayers by a factor of about 38. Stated WTP in this case would require multiplication by a calibration factor of 0.026 to yield actual WTP.

Variables involved in the calculation and calibration factors obtained for the *p*th percentile voters and CVM respondents (where *p* is the percentage of disapproving voters), in each of the individual municipalities for which voting and tax liability data as well as CVM responses were available, are shown in table 2. The ratio of stated and implied actual WTP ranged from 19.8 to 49.1 (table 2, second to last row), with a mean value of 34.3. The variation in this ratio was largely due to a high variation in stated WTP distributions, which in turn is due to relatively small sample sizes for stated WTP for the individual municipalities. Appropriate calibration factors for stated WTP accordingly ranged from about 0.02 to 0.05 (table 2, last row). It is important to note in the context of these results, however, that the present CVM had not overcome all potential pitfalls of the contingent valuation method, and calibration factors may be very different in other CVM survey contexts.

IV. DISCUSSION

The use of voting data for validation and calibration of stated values of public goods is attractive because it allows the study of true public good choices in a context with real consequences to the individual taxpayer. Observed individual voting behavior in a public budget decision provides only an upper or lower bound estimate on individuals' actual WTP for the proposed public good, corresponding with their expected tax payment. The purpose of this study was to describe and apply an approach, which enables one to compare point estimates of hypothetical WTP with actual WTP inferred from incentive compatible voting choices. We showed that, given hypothetical and actual referendum choices on identical and one-dimensional public good expenditure issues, an "indifferent voter" approach to calibrating hypothetical WTP is feasible. In contrast to previously used calibration methods, the present approach allowed us to compare actual and hypothetical choices about a public good with significant passive-use value, as public decision-makers typically face them. The empirical application, although subject to several limitations, suggests a strong upward bias of hypothetical values for the present public good issue and CVM study. The calibration factors of around 1/35 are smaller than in most previous calibration studies using private goods or donations contexts which have reported calibration factors in the range of about 1/0.8 to 1/40 (see e.g., Foster, Bateman, and Harley 1997). Circumstances which may have contributed to the large bias in the present CVM survey include a high "social desirability" of the valuation object and a rather vague formulation of the hypothetical voting proposal compared to the actual referendum proposal (Schläpfer, Roschewitz, and Hanley 2002).

The accuracy of obtained calibration factors depends crucially on the extent to which the underlying assumptions can be matched in specific actual CVM and voting comparisons. Assumptions underlying the application of the method include (1) the median voter model assumptions outlined in section II, (2) reasonably accurate identification of "*p*th percentile"

voters, taxpayers and CVM bidders, which may depend on voter turnout, income elasticity of approval probability, and CVM response rate, (3) individuals' realistic perception of their expected tax liability, (4) comparability of the CVM and voting propositions and (5) a best practice CVM survey process that remains unaffected by the actual referendum. Some of these assumptions used in computing estimates are admittedly strong. Great care should thus be exercised in interpreting the calibration factors we found. While this study sets out a basic approach to calibrating contingent values for public goods, the empirical estimates can by no means be regarded as representative of CVM surveys more generally.

Carefully designed further applications are necessary to obtain more reliable results and to investigate differences in calibration factors across different goods and across different CVM survey designs and qualities. A sufficient record of such studies for would have obvious benefits for further improvements of CVM methodology. They should provide a fairly robust means to evaluate alternative designs and develop empirically based rules for CVM applications to public goods with passive-use value. Moreover, they should allow inferences to be drawn regarding the potential for calibrating responses in situations where no opportunity for external validation is available.

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Table 1. Characteristics of the compared hypothetical and actual voting decisions

	Contingent valuation survey	Actual referendum
Proposition	new regional landscape conservation program	increase of cantonal fund for nature and heritage protection
Government level[a]	municipalities of Weinland	canton of Zurich
Question format	triple-bounded referendum with follow-up	simple referendum
Decision rule	simple majority rule	simple majority rule
Payment instrument	municipal tax	cantonal tax
Relevant population	citizens with right to vote	citizens with right to vote
Date	20 June to 20 July, 1996	22 September, 1996

[a] Government in Switzerland knows three subsidiary levels, municipal, cantonal, and federal. Referenda are held and taxes are raised at each of these. The canton of Zurich encompasses 171 municipalities.

Table 2. Comparison of the indifferent (*p*th percentile) voter's WTP estimated from (a) voting and tax liability data and (b) survey responses for 16 municipalities[a]

Municipality	(a) Voting and tax liability data			(b) CVM survey data		Comparison	
	Percentage voting *against* proposal, *p*	*p*th percentile in income distribution, I_p (SFR)	Expected tax increase of *p*th percentile income, ΔT_p (SFR)	Number of (valid) CVM responses[b]	*p*th percentile in stated WTP distribution, $WTPH_p$ (SFR)[c]	Ratio hyp./ actual WTP	Calibration factor, C_p
Andelfingen	55	52,717	12.12	31	240	19.8	0.051
Benken	70	70,924	19.49	13	720	37.0	0.027
Buch a.I.	65	65,474	17.12	12	381	22.3	0.045
Dachsen	57	51,230	11.55	13	240	20.8	0.048
Feuerthalen	41	32,703	5.45	29	240	44.1	0.023
Flaach	68	66,947	17.76	14	436	24.5	0.041
Flurlingen	52	48,839	10.63	17	360	33.9	0.030
Henggart	58	54,832	12.94	25	478	36.9	0.027
Kleinandelfingen	60	53,532	12.44	33	484	38.9	0.026
Marthalen	59	52,964	12.22	25	600	49.1	0.020
Oberstammheim	72	66,499	17.56	14	600	34.2	0.029
Ossingen	57	48,586	10.55	19	256	24.2	0.041
Rheinau	56	50,355	11.21	24	240	21.4	0.047
Trullikon	67	59,977	14.92	15	731	49.0	0.020
Unterstammheim	59	49,859	11.02	15	542	49.2	0.020
Winterthur	40	32,623	5.42	340	240	44.3	0.023

[a] Ten small municipalities of the survey region with less than ten respondents in the CVM survey sample are not included in this table.

[b] See Schläpfer, Roschewitz, and Hanley (2002) for a detailed description of the CVM survey procedures.

[c] The recurring value of 240 is due the fact that many respondents chose a round monthly WTP of SFR 20 in the valuation question.

Figure 1. Median voter equilibrium level of public expenditure (G_m) resulting from an (idealized) democratic budget process

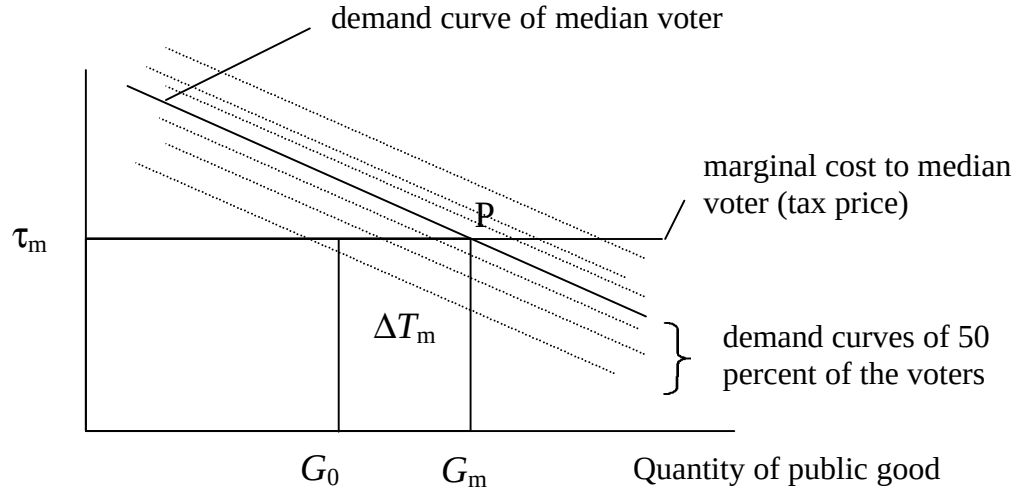

Figure 2 Identification of the indifferent "*p*th percentile" voter with the *p*th percentile individual on the income distribution: illustration of the conditions on individual approval probabilities, incomes, and tax increases.

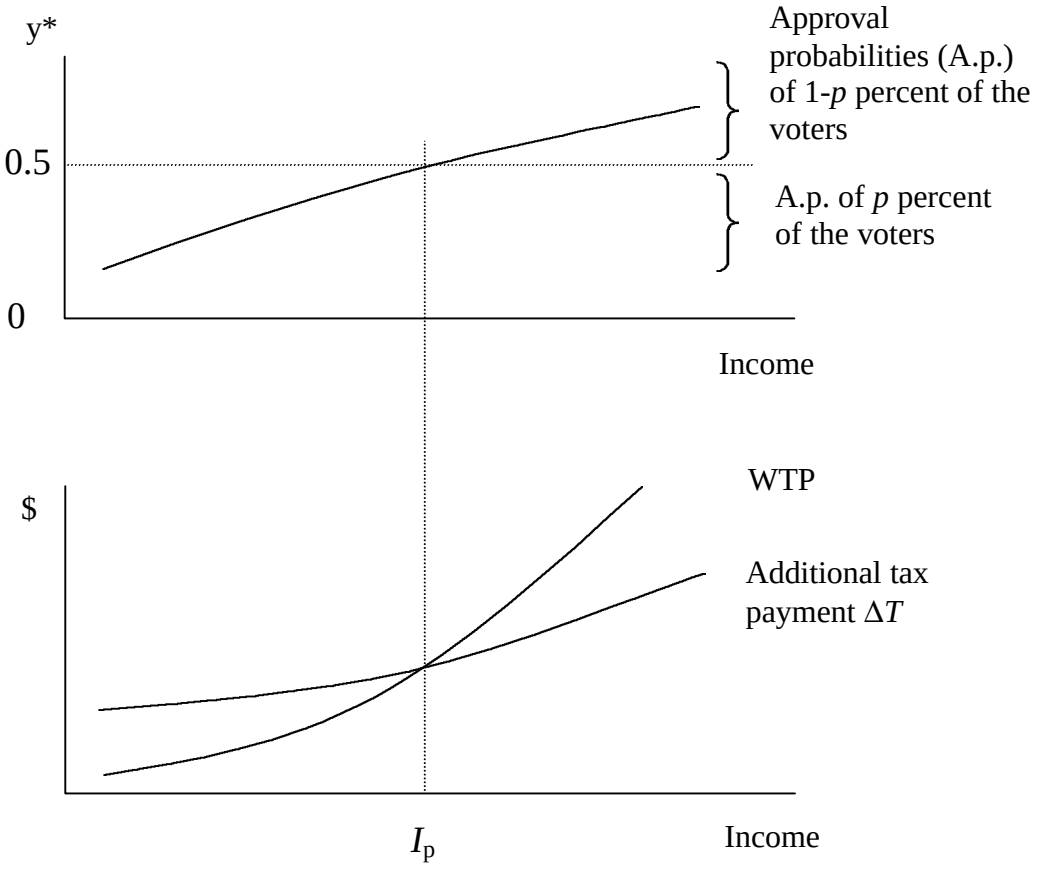

Figure 3. The indifferent (*p*th percentile) voter's WTP for an increase of a public good from provision level G_0 to G_1.