PRIVATE FUNDING OF PUBLIC INVESTMENTS

A Case of a Voluntarily Funded Public Road

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1. INTRODUCTION

In 1982 *Vägverket* (The Swedish National Road Administration, VV for short) examined the expected social profitability of constructing a new interchange at Bredden, north of Stockholm. Its rate-of-return was found to be positive, but not high enough for inclusion in the 1984–1993 investment programme. Local industry representatives at Bredden were, however, not satisfied with having the venture postponed, so discussions were initiated between major beneficiaries and VV. Finally a solution was found: the interchange was funded by VV on the one hand and a group of firms and two neighbouring local communities on the other. The interchange opened for traffic in mid-1985.

This paper analyses the conditions under which it accords with social welfare maximisation to accept that partially privately financed investments thus "crowd out" other measures – measures that have a superior ratio of net present value – from an investment programme being settled under a tight budget constraint.

The paper is organised as follows: section 2 describes the assumed maximising behaviour of firms and of VV. Section 3 analyses the welfare implications of voluntary funding,[1] both as an isolated occurrence and as a standing opportunity when an investment programme is being prepared. Distributional aspects are also discussed. In section 4 some comments are made on information aspects. Section 5 outlines the conclusions.

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[1] "Funding offers", "voluntary financing" and "funding" will be used as interchangeable terms for offers of voluntary provision of private funds to some normally publicly provided service.

2. THE MODEL

An understanding of the optimising behaviour of economic agents affected by a road investment is necessary as a background to the analysis to come. Here, therefore, the benefits of a new road to firms are delineated (2.1); this reveals the basic rationale for voluntary funding of a new road. Sub-section 2.2 considers how a social-welfare maximising Road Administration decides which investments are to be included in a programme.

2.1 The profit maximising firm

Road transport is essential in the production processes of many firms, both to bring inputs to the place of production and to take the output to the customer. The standard of a road can also be important to retail business and its customers.

An improvement of road standard can affect profit-maximising firms in at least four ways. First, profits increase if the use of transport inputs (vehicle hours) can be reduced and, further, if reduced costs of transport in relation to other inputs call for a change in production techniques (more transport-intensive production). Second, profits increase if, because of the new road, sales are transferred from some other business site. Third, the exogenous change in road standard might induce the firm to replace its previous activity with some other in order to improve profits. Manufacturing could, for instance, become preferable to farming. Fourth, these three changes might bring capital increases in prices of land or other assets, and thus make the owner of the assets better off. It should be emphasised that the last point would represent a redistribution of profits rather than an addition to them.

Changes in (expected) profits explain maximum willingness to pay (*WTP*) of firm i to have a specific road investment (j) implemented.

$$WTP_{ij} = \Delta\pi_{ij} = \pi^1 - \pi^0 \tag{1}$$

Here, π^1 and π^0 denote the present value of profits with and without the change, respectively. It is assumed that there is no substantial doubt about future profits. Normally, the value of $\Delta\pi_{ij}$ is small to most beneficiaries. Some investments could, however, make a considerable improvement in the situation of some agent. If private contributions were allowed to influence VV decisions, large beneficiaries might have incentives to make contributions to the funding of a project, to make sure that some specific investment would be undertaken.

2.2 The welfare-maximising VV

It is assumed here that the public authority in charge of road building maximises social welfare. Under conditions of certainty and in the absence of budget constraints, this means that all investments with a positive Net Present Value (*NPV*) are carried out ((2)).

$$NPV_j = \sum_{i=1}^{n} B_{ij} - C_j > 0 \tag{2}$$

Here, ΣB_{ij} ($=B_j$) represents social present-value benefits of investment j (net of

running costs), summed over firms ($=\Delta\pi_{ij}$) and individuals i. In this sum, B_{ij} may be negative for some individuals. Furthermore, C_j is the investment cost.

Introducing a budget constraint compels VV to choose from the range of possible investments to make sure that the available appropriation is used in the best possible way. Each individual measure is, for the time being, assumed to be infinitely small, and measures are indexed by the real numbers.[2] The optimising problem – that is, the selection of those measures that are to be included in the programme – could then be described as the maximisation of a continuous *NPV* function, subject to the budget constraint.

Let j be the project index and let $j \in [0, J]$, where $[0, J]$ is the set of possible projects. Choose m, the marginal measure of the programme, to maximise (3).

$$\text{Max } N = \int_0^m [MB(j) - MC(j)]\ \mathrm{d}j \tag{3}$$

$$\text{s.t.} \int_0^m MC(j)\ \mathrm{d}j \leqslant K$$

The road administration maximises N, the value of social net benefits that can be extracted from the funds (K) given by Central Government. $B(j)$ is the (continuous) benefit function. Consequently, $MB(j) = \partial B(j)/\partial j$, and $MC(j)$ = corresponding marginal cost. In Figure 1 investment projects have been ranked according to decreasing rate of return (r-o-r), and marginal costs are assumed to be constant and normalised to one. Here, maximising N means to select projects in order to make the area between the marginal benefit and the cost functions as large as possible.

The Lagrangean to (3) is given in (4), and (5) gives the first order conditions for a (interior) optimum.

$$L = \int_0^m [MB(j) - MC(j)]\ \mathrm{d}j + \mu[K - \int_0^m MC(j)\ \mathrm{d}j] \tag{4}$$

$$\frac{\partial L}{\partial m} = MB(m) - MC(m) - \mu MC(m) = 0 \tag{5a}$$

$$\frac{\partial L}{\partial \mu} = K - \int_0^m MC(j)\ \mathrm{d}j = 0 \tag{5b}$$

The Lagrange multiplier (μ) indicates the shadow price on public funds from the point of view of the Administration (which in a full optimum is equal to social marginal dead-weight losses of taxes or of prices in excess of marginal costs). Project m is the marginal, infinitesimally small, measure of the programme.

Define r-o-r (s) as Net Present Value ratio (6). Then, (5a) can be written as (5a′).

$$s_j = \frac{MB(j) - MC(j)}{MC(j)} \tag{6}$$

$$s_m = \mu \tag{5a′}$$

[2] The assumption of full divisibility is applied here in order to avoid lumpiness in the subsequent analysis.

An investment is obviously accepted in the programme if its r-o-r is at least as large as the shadow price on the Road Administration's funds. Intramarginal projects must have a return in excess of this; the return on excluded investments is below s_m. Two simplifying assumptions are made about the optimising procedure. First, for analytical convenience, appropriations are supposed to be submitted annually, so that the programme comprises only a single year. Second, the problem of optimal project design in the face of a budget constraint, that is, that the cost of capital (μ) should influence also the standard and design of individual projects, is ignored. We ignore also possible interdependence between investments.

It is now possible to turn to an analysis of the decision problems of the government in the presence of external funding.

3. ANALYSIS

Assume that the one-year appropriation has been presented to VV, and that an optimal programme has been settled. Some private party now indicates an interest in providing VV with additional funds for a specific road investment, not included in the programme. The offer is simply a way for the contributor to put himself in a better position than before. Under what conditions is it in accordance with social welfare maximisation for VV to accept this offer? The answer is found by analysing how the value of the programme (N, see (3)) is affected by accepting funding offers.

This analysis proceeds as follows: section 3.1 considers a single offer of additional funds, and section 3.2 external funding as a repeated event. Section 3.3 evaluates possible Central Government (CG) reactions to voluntary funding, and section 3.4 some distributional aspects. Since welfare maximising under uncertainty might be a different matter from maximising when everything is known, it is assumed in the main part of section 3 that relevant information about the effects of all projects is available.

3.1 VV behaviour: a single investment

Let

$$\int_y^z MC(j)\,\mathrm{d}j = C_{\mathrm{I}}$$

be the total cost of a set (y, z) of small measures, for convenience lumped together into a project and denoted investment I. This package was not included in the preliminary programme. Some private agent wishes to have this investment implemented, and offers aC_{I} ($a > 0$) as a contribution. In order to be able to accept the offer, VV has to delete a number of ($m - h$) marginal measures from the initial plan in order to release an appropriate amount. The package of deleted measures is called investment II. (cf. (7)).

$$C_{\mathrm{II}} = \int_h^m MC(j)\,\mathrm{d}j = (1 - a)C_{\mathrm{I}} \qquad (7)$$

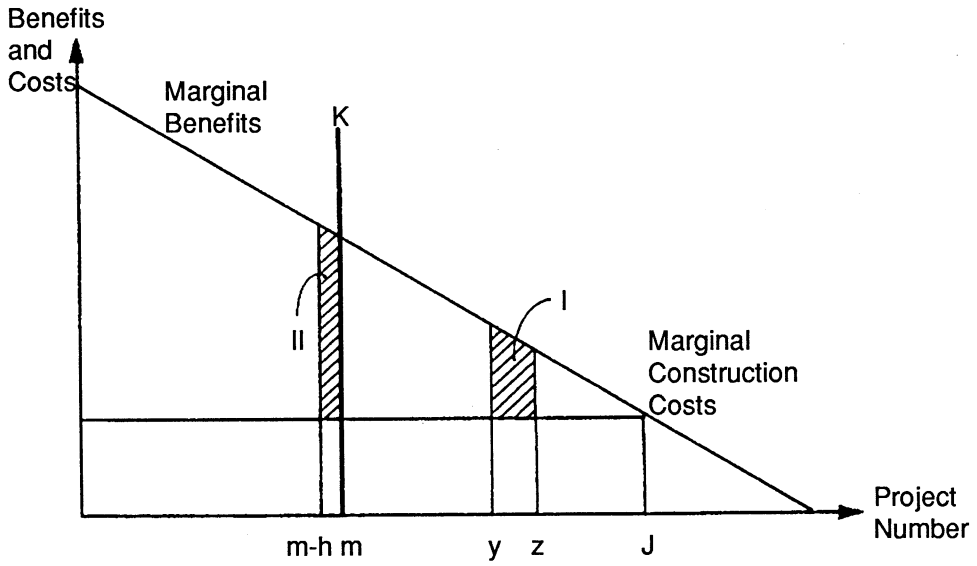

FIGURE 1

Illustration of the Welfare Test

For a voluntary contribution to be welfare-improving, condition (8) has to be met.

$$N^* = \int_y^z [MB(j) - MC(j)]\ \mathrm{d}j - \int_h^m [MB(j) - MC(j)]\ \mathrm{d}j > 0 \qquad (8)$$

In order to give (8) a somewhat more convenient form, let B_{I} and B_{II} denote the value of the integral over benefits of the additional and deleted projects, respectively. Then (8) can be written as (8′) and, using (6) and (7), reformulated to the welfare test (9) where $N^{**} = N^*/C_{\mathrm{I}}$.

$$N^* = B_{\mathrm{I}} - C_{\mathrm{I}} - (B_{\mathrm{II}} - C_{\mathrm{II}}) > 0 \qquad (8')$$

$$N^{**} = s_{\mathrm{I}} - (1 - a)s_{\mathrm{II}} > 0 \qquad (9)$$

Before a funding offer is accepted, a social welfare maximising Road Administration should use (9) to compare r-o-r of the respective projects; the result will indicate whether or not welfare will be improved by acceptance.

To illustrate the properties of this welfare test, consider first an offer of a full cost contribution ($a = 1$), reducing (9) to $s_{\mathrm{I}} > 0$. By assumption, whether s_{I} is positive or not is common knowledge. Suppose it is. Since the investment adds to aggregate welfare, and since nothing else is affected, the contribution increases N^{**} and is (potentially) beneficial to society. s_{I} is, however, not necessarily

positive. An investment might considerably benefit some individual (the contributor) but at the same time might harm others. In this case, the funding offer would not have a potential for welfare improvement. A positive r-o-r of an investment which is wholly externally funded is, therefore, both necessary and sufficient for the full cost contribution to be a (potential) Pareto improvement.[3]

When external contributions do not balance all construction costs, a positive return on the additional investment(s) is not sufficient for welfare improvement. Instead, the additional benefits created by accepting the offer (area I in figure 1) have to exceed those forgone (area II) when some investments have to be "crowded out" from the original plan in order to set free appropriate funds.

The comparative static properties of the test can be described by assuming unitary marginal costs and by differentiating (8). Note that, under the assumption of unitary marginal costs, the Road Administration's uncommitted budget after contributions are accepted is $h = m - (1 - a)(z - y)$; then the consequences to N of exogenous changes of funding share and size of the new investment can be found by making variations in this budget. These points are summarised in (10a–c).

$$\partial N^*/\partial a = (z - y)[MB(h) - 1] > 0 \tag{10a}$$

$$\partial N^*/\partial z = [MB(z) - 1] - (1 - a)[MB(h) - 1] >/< 0 \tag{10b}$$

$$\partial N^*/\partial y = -[MB(y) - 1] + (1 - a)[MB(h) - 1] >/< 0 \tag{10c}$$

Note, first, that $[MB(h) - 1] > 0$ because of the budget constraint. A larger funding offer does (other things being equal) increase the value of N^*, since a smaller number of investments will be crowded out if the offer is accepted ((10a)). The effect on N^* of an increase in the number of small measures included in investment package no. I is indeterminate.[4] If the "new" investments have a r-o-r below zero, (10b) is negative, since this means that $[MB(z) - 1] < 0$. When we transform the equations into r-o-r terms, it is seen that the limit value for acceptance is $s_z/s_h = (1 - a)$. The relative r-o-r of the "new" and the deleted projects must, therefore, be at least as large as the public share of the costs if the switch is to be welfare-improving. The converse applies for an increase in y, which corresponds to deleting projects from the package.

To summarise, what has been demonstrated in this section is that not only a full-cost, but also a partial, contribution of investment funds has a potential for welfare improvement. Since the influx of new funds can create additional social benefits, a Road Administration receiving an offer of contributions must look thoroughly at the relative benefits of the new and the deleted investment – that is, the condition here formulated as a welfare test.

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[3] Note, however, that if $a > 1$ a positive r-o-r of the new investment is not necessary. By paying more than the cost of investment 1, the Administration gets hold of funds that make possible the fulfilment also of investments $m + 1, m + 2, \ldots$ These funds can create new social net benefits, offsetting losses caused by externally funded investment.

[4] That is, the cost is not increased by an increase in construction cost of a given project (other things being equal).

3.2 VV behaviour: a complete programme

So far, a single investment measure has been considered, in a situation where the initiative for voluntary funding was external to VV. We now examine the possibility of contributions as an integral part of the process of settling long-term investment programmes. The idea is this: if it may be socially beneficial to accept a single offer of funds, this opportunity should be available when a complete programme is being prepared and before it is adopted.

Netural announcement policy

Consider first a simple extension of the single investment case. Before final decisions are made a preliminary programme, made up by ranking projects according to decreasing r-o-r, is made public. It is announced that any one interested can present funding offers for the construction of specified projects.

Incoming offers of voluntary contributions would have to undergo the welfare test. Accepting some offers means that the final plan includes more road investment funds than the initial one, and that the value of the whole plan is increased. An announcement policy is therefore favourable to society.[5]

If offers are accepted, then some investment(s) must be deleted from the initial plan when $a < 1$. Those who would have been beneficiaries of these measures are obviously made worse off. Institutionalised use of "announcement" policies can enable these people to offer contributions. Thus it is possible to notify the public that the marginal $x\%$ of the investments in the preliminary programme bear a risk of being deleted. On the occasion when the funding opportunity is announced, beneficiaries of marginal investments could be encouraged to present (conditional) funding offers. This makes it possible for those who would be significantly hurt by an accepted offer to prevent this from happening.

Adoption of an announcement policy does not mean introducing a complete system for appropriation of benefits from road investment. As was observed in section 2.1, a prerequisite for presenting funding offers is that the benefits to the provider(s) are substantial, whereas the normal situation is rather that there are numerous small beneficiaries. An offer from a group of, or all, beneficiaries, would have to be preceded by cost-sharing negotiations. These transaction costs can be assumed to grow with the size of a negotiating group.[6] Voluntary provision

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[5] It is assumed here that there are no extreme market imperfections, government regulations, etc., that might cause a firm to abandon ventures that are more positive for social welfare than the road investments under consideration.

[6] In order to increase the possibility of offers being presented, the government could try to make these negotiations easier. In Sweden, a considerable number of non-public roads (mostly roads with low traffic density) are funded partly by public grants and partly by the prime beneficiaries of the respective roads, primarily those living adjacent to them. The beneficiaries can form "road associations" (*vägförening* or *vägsamfällighet*) responsible for maintenance, etc. The law also specifies how the associations' share of the costs is to be split up between the members; this reduces cost-sharing negotiations between the parties. In principle, the government could in this or some other way aid beneficiaries who want to get together in order to present funding offers.

of funds is therefore not likely to become an everyday occurrence. It does, however, provide individuals and firms with an institutionalised possibility of affecting the supply of road services.

"Manipulation" policy

For some investments in the preliminary programme it might have been possible to raise funds if they had *not* been included. This evokes the idea of "manipulating" the programme to facilitate external funding. If some projects are excluded from the initial plan, these might instead be funded by major beneficiaries. Alternatively, if the projects are included in the preliminary plan, it could be explicitly indicated that a certain share a_j^* of the construction costs has to be externally financed if they are to be included also in the final programme ($a_j^* C_j$ being an investment fee).

The essence of programme manipulation lies in the possibility of achieving an (*ex post*) value of the manipulated programme in excess of the original. This is really no problem, given the assumption of perfect information maintained so far in this section. Transaction costs would, however, still be incurred, so that only investments having a limited number of large beneficiaries would be eligible for "manipulation" policies. If there are deficiencies of information, the *ex post* value of N under a "manipulation" scheme will depend on the ability of VV to make correct guesses about which projects it might be possible to fund from external sources.

For a number of reasons "manipulation" policies might be open to question. There are, however, at least two reasons for mentioning this possibility. First, it should be noted that throughout the paper it is assumed that VV maximises social welfare. This does not necessarily give an accurate description of actual policies. Assume instead that the administration in reality is trying to maximise its budget – that is, the total number of projects to be constructed; that information is less than perfect; and that it is difficult for the CG to audit the performance of VV. If "announcement" policies are accepted by CG, VV can in reality pursue a "manipulation" policy, by excluding from the initial programme investments judged to be eligible for funding offers. The present discussion has demonstrated that the latter policy is not necessarily negative to social welfare, though it may well be controversial for other reasons. It is, furthermore, possible to use the welfare test to examine the welfare properties of externally funded investments, even if the administration is not pursuing welfare-maximising policies in the first place.

Second, it is of some interest to note the relation between investment fees, the US system of impact fees,[7] and "matching funds". Impact fees are determined by local governments and levied on a mandatory basis. If the impact fees

[7] In the USA, impact fees are levied by some local communities on developers according to some estimated impact from new developments (such as residential housing, industrial activity, etc.) on the future need of new roads. The purpose is to make major beneficiaries of public investments pay for the construction. See FHA (1984) and Sandler and Denham (1986) for examples.

happen to be computed so that no beneficiaries are forced to pay fees in excess of their actual WTP, the two systems match. One idea with "matching funds" is that the state only pays part of the construction cost, leaving the rest to some other party with an interest in having a measure constructed. The "manipulation" policy therefore has several features in common with systems actually in use.

3.3 Voluntary funding from a Central Government perspective

We have demonstrated in sections 3.1 and 3.2 the conditions under which external contributions, augmenting in effect available VV funds, are socially beneficial. This inflow of resources to road construction would, however, also affect the preconditions for CG decisions about public sector appropriations and taxes.

To see this, consider first the relation between the Central Government and the Road Administration in the absence of any external funding. A social welfare maiximising CG decides on the appropriations that it will allocate to different public administrations. The demand for public funds emanates from the benefits of the numerous projects – ordered according to r-o-r – that each public authority presents to the CG. On the other hand, public funds are supplied at a cost that exceeds nominal costs. That is the result of dead-weight losses caused by the different mechanisms that are used to fund the appropriations: that is, the socially detrimental effects on resource allocation of public funding, giving rise to distortions (see for instance Hansson (1984)). Appropriations, *inter alia* to the road sector, are the result of a trade-off between these benefits and costs.

This situation will be affected in at least two ways by external funding. First, the average r-o-r from future road investment programmes will increase (but see also the discussion on uncertaintly in section 4). That is because higher return projects are removed from the present programme, and this increases the relative return from road investments in comparison with other public-sector projects.

Second, the CG could consider the possibility of voluntary funds as a new instrument in its arsenal of funding possibilities. This might lead to future cuts in road sector appropriations, making the road sector to some degree self-reliant with regard to funding. Consequently, the benefits of voluntary funding would not be kept within the road sector in the form of an increased volume of road investment. Instead, this road funding procedure would, to some extent, be used as an indirect method of reducing total dead-weight losses to society, since the raising of funds by "announcement" policies in no way distorts the efficient use of resources.

The attitude of the CG towards voluntary funding might also be affected by existing taxation rules. This is because fund providers (with possible exceptions from the rules) will make tax deductions corresponding to the amounts that they actually pay. Deductions increase the public share of the investment cost. In order to neutralise the effects on the public treasury of the introduction of voluntary funding, these deductions must be considered in the welfare test, for instance in the simple way described by (11).

$$N^* = B_I - C_I - (B_{II} - C_{II}) - atC_I > 0 \qquad (11)$$

where aC_I is the deduction made by the fund provider and $t(0 < t < 1)$ is the tax rate. The welfare test (see (8)) is adjusted to allow for that part of the provider's share which in reality is paid for by the government; this reduces the chance that an offer will be accepted.

3.4 Distributional aspects

Throughout the text, the word "potential" has been added to conclusions about the social desirability of voluntary funding. The reason is naturally that a change that is beneficial in the aggregate may still impose negative effects on some individuals. If these are considered to be important for distributional reasons, the verdict on social desirability may be reversed.

One such matter was taken care of in the section on announcement policies. Agents that are harmed by the crowding out of some project from the initial programme can make their own offers of contributions. This is positive for reasons of both efficiency and distribution. Another distributional question is which individuals in society actually gain if an offer is accepted. It is known that, for an offer that passes the welfare test, both the fund provider and society in the aggregate are made better off. But that tells us nothing about the size of the fund provider's share of the aggregate gain.

Consider, for instance, the following situation. Assume that an offer of less than full cost, made by firm i, passes the welfare test. Assume also that the merit of the investment to all others except to firm i is positive but small. Some part of the project cost has to be made up by the collective of taxpayers. Therefore some individuals are harmed, because their projects have to be excluded from the preliminary programme. The fund provider buys himself a better position, but since he is not paying the full cost of the project, other agents (indirectly) have to pay for this.

In an attempt to reduce this sort of result, a modified version of the general welfare test may be justified. To derive this modified test, consider first (12), a reformulation of (8′):

$$\left(\sum_{k \neq i} B_{k,I} + B_{i,I}\right) - [aC_I + (1 - a)C_I] - (B_{II} - C_{II}) > 0 \qquad (12)$$

Here the consequences for the potential fund provider (firm i) have been singled out from the effects on the rest of the group affected by the offer. Using (7), this can be rewritten as (12′).

$$\sum_{k \neq i} B_{k,I} - B_{II} + B_{i,I} - aC_I > 0 \qquad (12')$$

Since it is the consequences of the offer to all individuals other than the fund provider that is in focus in the present discussion, the effect on individual i can be ignored. It is also assumed that the i^{th} agent is not affected by the eliminated investment(s). This gives (13):

$$\sum_{k \neq i} B_{k,I} - B_{II} > 0 \qquad (13)$$

To ensure in the aggregate there is no loss to people other than firm i, not only

(8) but also (13) must be met. The increase in benefits, brought by the new investment to other individuals and/or firms than the i^{th} one, has to exceed the benefits forgone when some investment(s) have to be deleted from the initial programme. The extended test makes sure that the collective of road users except firm i does not lose if the offer is accepted.

Given that $B_{i,I} > aC_I$, the fund provider gets some profit from his funding offer. This means that more benefits than costs are eliminated from (12), and this makes the distributional test harder to meet than the original one. It should be stressed that the new version of the test does not preclude the possibility that single agents may lose if a funding offer is accepted. It is merely a way to circumscribe one specific kind of possible undesirable effect.

4. VOLUNTARY CONTRIBUTIONS AND INCOMPLETE INFORMATION

So far, full information on all aspects relevant to investment decisions is assumed to be available. But there is a well known general problem of getting access to information about the merits of projects benefitting a large number of individuals. It is relevant to ask, therefore, whether financing offers – beside being a source of additional funds – could not be used also as a device to gather information about the effects of road investments. If new information could be collected, this alone might suffice for the adoption of a new investment programme.[8]

In the discussion of this opportunity, "true" benefits of investment j (B_j) should be distinguished from the value $E(B_j)$ (where E denotes the expectations operator), estimated by VV. Consequently $E(B_{i,j})$ indicates the estimated value of investment j to agent i. Furthermore, the agents' actual (maximum, see (1)) Willingness to Pay ($WTP_{i,j} = B_{i,j}$) has to be deduced from the value reported as a funding offer ($WTP^*_{i,j} = aC_j$) since $WTP_{i,j} \geqslant WTP^*_{i,j}$.

New information might become available if $E(B_{i,j}) < WTP^*_{ij}$. This, however, would not be sufficient to identify information that is of relevance to the social welfare maximising decision maker. A first reason is that the Hicks-Kaldor version of welfare maximisation, employed here, does not explicitly include transfers of benefits between agents. For example, if a funding offer is based on the fact that a firm expects increases in sales and profits because of a new road, it does not give information on a socially relevant benefit if sales symmetrically fall off elsewhere.[9] VV must, therefore, try to make sure that the offer is based on real changes if it is to be used as information input in the decision process.

Second, in much CBA work, benefits are assessed by using methods that present information at aggregate level, not by making calculations on the level of

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[8] Alterations to programmes due to new information could not relieve the firm making a funding offer from an obligation to give the money to VV. Otherwise, beneficiaries would certainly be given free riding incentives.

[9] More precisely, total benefit of investment j is obtained by summing over all individuals and firms i affected, i.e. $\Sigma B_{ij} = B_{1j} + \ldots + B_{hj} + B_{ij} + \ldots + B_{nj}$. For those effects where $-B_{hj} = B_{ij}$ the benefits to agents h and i cancel out, and do not affect the aggregate estimate.

single firms. The value of cuts in travel time is, for example, normally estimated by multiplying total number of vehicle hours saved by some average value of time, not by calculating savings to specific firms. It might, therefore, not be possible to find a $E(B_{i,j})$ value to compare with $WTP^*_{i,j}$.

To summarise, the programme prepared by VV does contain (unknown) deficiencies due to incomplete information. The plan is assumed to be optimal according to available knowledge, but its value would be improved if an offer of contributions provided "better" information. The present discussion has demonstrated that the conditions under which this is possible are indeed stringent.

5. CONCLUSIONS

In this paper the social desirability of voluntary funding of new public roads has been demonstrated. The exact conditions for (potential) social desirability of less than full-cost offers of contributions are formulated as a "welfare test": net benefits from investments that are added to an investment programme have to exceed benefits in investments that are excluded in order to keep to the total construction cost. The main reason why funding offers might be accepted is that the additional resources save a part of the shortfall of budget funds that prevents implementation of socially beneficial investments. Voluntary funding would not be of social interest if non-distortionary taxation were available to the government.

In many cases distributional considerations place restrictions on results based on efficiency analyses. An instance of this type of restriction is also described here. An alternative version of the welfare test is therefore suggested, which avoids one class of results that might be distributionally objectionable.

Another possible objection to the original welfare test may be relevant if, as a result of the external influx of funds, Central Government makes future cuts in appropriations to road investments. At least the Road Administration could be expected to object strongly to such behaviour. Yet this is merely another way in which society can make use of the funding system, and a way that works by means of reduced financial dead-weight losses.

Furthermore, attention has been given to the behaviour of a Road Administration that does not maximise social welfare. This might take the form of manipulation of the initial programme, by blackmailing major beneficiaries into "voluntarily" making contributions in order to have important projects constructed.

One essential rationale for an economic agent making voluntary provision of funds lies in the possibility of appropriating future land rents. The idea that the government could use increased land values for funding purposes was mentioned by Walters (1968), who said: "The best tax is the tax on the increment of rent generated by the road" (p. 5). One problem about using publicly induced increases in land rent for taxation is that the tax authority – *ex post* – must decide on the size of the increase in land value emanating from a specific investment. The present paper has turned this problem upside down. If taxation is not used to appropriate the increase in land value, but instead – *ex ante* – landowners

are confronted with the possibility that a specific investment might not be implemented, beneficiaries have incentives to indicate at least part of their actual WTP in order to guarantee the construction. In particular, the "manipulation" policy is of this nature.

Voluntary contributions have been considered for applications within the road sector. The basic postulates for welfare improvement are, first, that the Administration has insufficient resources to implement all measures that are socially beneficial, and, second, that there exists private beneficiaries who are prepared to pay. Application of the concept outside the road sector means that these postulates have to be met. Meeting the first one should be no problem. Finding private agents or other public authorities willing to submit resources in the way described may, however, be more difficult. Voluntary funding should in any case be more likely if privately appropriable increases in asset/land values can be expected. One guess is that other parts of the transport sector – not least urban mass transport – to some extent meet also this second qualification.

It is, moreover, of some interest to note the similarity between voluntary funding and the class of demand-revealing mechanisms known as Clarke-Groves taxes (see, for instance, the description in Broadway and Wildasin (1984), pp. 161 ff).[10] The welfare test also resembles the Samuelson optimality condition for production of public goods.

Finally, then, was it correct to accept the offer that funded the Bredden interchange? Was it correct to spend 500,000 VV crowns to make this 4-million-crown investment (that is, $a = 0.875$), with the implication that the 500,000 crowns could not be spent as profitably on other measures? The answer lies in comparing the Bredden r-o-r ($s \approx 2$) with the marginal rate ($s \approx 2.2$). This comparison gives a N^{**} value of [2 – (1 – 0.875) 2.2 =] 1.73, meaning that social benefits increase by [2*4.0 – 0.125* 4* 2.2 =] almost 7 mSkr. To apply the distributional version of the test, note first that $B_{II} = 1.6$ (since $C_{II} = 0.5$ and $s_{II} = 2.2$ and using the definition of r-o-r). By the same argument, $B_I = 12$. $B_{i,I}$ is at least 3.5 (= the offer), but its exact value could not be known. Since $B_{II} = \Sigma B_{k,I} + B_{i,I}$, (13) can be reformulated ($B_I - B_{i,I} - B_{II} > 0 \Rightarrow B_{i,I} < B_I - B_{II}$). The benefit to the fund provider cannot exceed 10.4 if the second version of the test is not to be violated. Therefore 10.4 mSkr is the upper limit for benefits to agent i. This distributional qualification to the general welfare test should not be impossible to meet. Even an economist seems to accept the Bredden deal – at least as a unique case of voluntary funding!

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[10] It is, thus, possible to reformulate (12) as

$$B_{i,I} > C_I + (B_{II} - C_{II}) - \sum_{k \neq i} B_{k,I} \qquad (14)$$

The right hand side of (14) could be conceived of as (net) social costs. Agent i would have to pay this sum if the original test is to be fulfilled. This resembles the marginal tax payment of a Clarke-Groves tax.

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