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It is convenient to divide publicly supported investments into those having primarily productivity enhancement goals and those that have welfare (consumption) goals. By and large, "production" type projects are the main target of feasibility analysis. This is primarily due to the fact that production projects by definition can generate measurable benefits and maybe partially to the fact that the more a project appears to create a public good (generate wholly consumptive [ion] benefits) the less concern the general taxpayer has about the incidence of subsidy.*

An explicit assumption imbedded in all proposed (pre) project analysis is that if the expected performance of what is proposed can satisfy a Hicks/Kaldor test, public subsidy, all things equal, is justified.

An implicit assumption of project planning analysis is that the direct beneficiaries will react to the new opportunities as full profit maximizers. We assume for example that farmers always to their best on an irrigation project, when in fact they might not.

Thus, from time to time the question arises as to how well an investment has turned out. Our example is reclamation project in Utah. Various approaches might be employed, but here we are interested in illustrating primary benefits, i.e. in an estimate of realized B/C ratio for a selected time horizon, using ordinary techniques. The local economy is assumed to have benefitted from the subsidy given the

*The distinguishing characteristic of production projects is that they tend to benefit specific groups.
project, so a second interest is to find a numeric measure with which to reflect the benefit to Utah economy of completed projects. Finally, we are interested in how the farmers have made out even if the B/C ratio as recalculated is < 1. Again, we need to find some numeric measure which will reflect the overall usefulness of having storage available to holders of run-of-the-river water rights, and arrange and calculate the data necessary for its estimation.

The general with/without methodology to accomplish the first of these tasks is well known, the approach to the others is not so clear.

In agricultural feasibility analysis, once the data have been arranged and displayed, b/c or irr may be calculated. Positive NPV (b/c>1) implies satisfaction of H-K test only. (H-K test is not sufficient to determine movement towards Parato optima--higher level compensation tests would be required [never have been calculated] for the type of projects discussed here]. Therefore any decision to go ahead on basis of b/c calculations is mostly a political choice about redistribution of resources and rewards and hoped for achievement of ends--deliberate subsidy.

In the absence of results from more stringent compensation test calculations, what is needed are readily calculated coefficients that measure the economic worth of subsidy.

In the case of Federal reclamation projects the subsidy consists of forgiving interest repayment upon the cost of constructed irrigation features of water projects. The primary beneficiaries, the farmers, are required to repay the initial investment over time and are required to pay the recurring costs of ordinary O&M as long as the project operates.
How do we measure the worth of the subsidy to:

The Utah economy?
The Utah farmers?

Rough and ready answers to these questions can be obtained by manipulating and interpreting the data prepared for the b/c analysis in new ways.

Benefit to Utah: \[ \frac{\text{undiscounted sum of incremental net benefits}}{\text{initial cost of program}} \]

[This is a test of whether or not the political decision to redistribute tax burdens actually ended up creating incremental production increases that would offset the compounded values of the taxes paid.]

Benefit to the farm sector: \[ \frac{\text{sum net farm benefits with project}}{\text{sum of net farm benefits w/o project}} \]

NOTE: this ratio not only does not require any discounting of the benefits stream, it can be formed from the time series of current values prepared during data arrangement. No conversion to real terms is necessary.

[This is a test of the value of the reservoir storage. See below for distinction between supplemental and full service]

Interpretation of these New Ratios

Since citizens of Utah do not pay interest upon the capital 'loaned' to construct the local federal projects, they are only concerned with the physical emplacement of the works, i.e. that a thing of beauty or possibly utility has been created. The farmers (and sometimes) the general taxpayer- will actually repay the construction costs. It is logical for pushers and hustlers of all kinds of projects to view the results as 'growth' (there are more physical assets than before) or "development" (the farmers will have better lives and
and incomes.*

However, mere emplacement of more things does not mean that economic G&D (growth and development) has taken place. At the very least, the undiscounted real value of incremental ag sector benefits has to have exceeded investment costs (which must be repaid by citizens of the state). The ratio is summed over the length of the contract repayment in the first instance. This is the proposed convention.

The undiscounted incremental (real) benefits (net of O&M) could be summed over a longer period of time if the facilities are kept up and do not totally deteriorate. In which case, sooner or later, the benefits numerator must exceed the cost denominator. The only way this would not happen would be if the O&M costs rose fast enough to swamp out the incremental benefits altogether.*

Since the direct beneficiaries pay for upkeep, we have a possible explanation for why the Ellis Armstrongs of the water world cannot understand why there should ever be opposition to projects (ASCE redoinder by Wilde, Keith & LeBaron). This point highlights the claim that "looking back, all the projects have been beneficial." (ASCE comment by Armstrong). In other words, there is a sense in which the hustlers have been right all along! Not so fast!

There is more to this than preventive maintenance. What may be overlooked is that, under Utah Law, at least, there are various legal entities that have or might contract with the Federal Government. Provision of the act now used, the Conservancy District Act, permit charging general ad valorem taxes upon property values of all persons living within the district boundaries to help pay for the irrigation facilities. Thus, the ub/c ratio, in this case, would have to > 1 by at least the amount of the sum of the tax collections compounded at
rates public treasurers can earn on time deposits. As long as there is some amount of local subsidy, probably the "Armstrong" argument will not hold.

The productive usefulness of the project to the farmer beneficiaries really hinges upon how badly they needed the water in the first place. This is partially measured by how well they handle irrigation water and partially by the fact that cropping patterns may have shifted through time and that long periods of good rainfall reduce the need for storage. Here we have two groups: one group typically already holds some rights to surface water delivery during the irrigation season--supplemental water users. The other group of farmers within the project perimeter own land that had no prior water rights--full service water users. In the case of the latter group, the without project estimated returns per acre presumably would be much less than for the former. Thus the interpretation which follows is mainly but not exclusively directed to the supplemental water users.

A measure of the utility of project water is obtained by correcting the estimated financial annual returns for the supplemental area of the project by making allowance for O&M and contract repayments.* The denominator is composed of the sum of the estimated annual net farm benefits without the project. The important ratio, as mentioned, is the one calculated for the supplemental users since it is unlikely that the full service farmers would not obtain net benefits relative to former dryland operations.

*They may also obtain windfall gains in increased land values.

*Over time, if there is inflation, the real burden of the annual contract repayment falls, but we don't care about this phenomenon while creating a financial time series.
A convention implied in the above is to treat the costs of construction as equal on average (per acre serviced) to both the supplemental as well as the full service users. Possibly relatively higher costs should be assigned to the full service group.

The Level of Irrigation Water Charges

Basically there is no theory. A few things can be said, based on assumptions.

The idea that beneficiaries will pay a defined amount is taken for granted in the Western USA. However, users do get subsidy as explained earlier. The facilities somewhat belong to the users and they are responsible for paying O&M costs. O&M levels are reassessed annually and user payments are adjusted accordingly. Large increments of rehabilitation normally are covered by separate or amended contractual agreement to repay the investment made.

In many nations public authorities do not recover costs. Apparently the Donor Agencies would like to have some theory about why they should or more especially, they seem to think that there is some way to 'theoretically' set the levels of the fees to be assessed.

Argument of why farmers probably have to be assessed some costs—to push production.

It should be remembered that if a project is already in operation, the farmers may not be working and producing at the levels that would extrach of capture the potential economic rents that should be available inside the system. Where subsidy is involved, the farmers start to break even in their operations at output levels below the same point.
for society. This is why some form of charges should be thought about--in order to get them built into the farmers cost curves and force production somewhat.

If they can't pay, the project is misdesigned as an economic production operation, the welfare component should be recognized in the form of non-reimbursible costs. There are two other possibilities, the farmers cannot meet the tech requirements demanded by designers of the facility; or the overall gains in residual net benefit to the farmers is not great enough to cover the extra effort required by irrigated farming.

II There is one special situation for which the fee level can be stated "theoretically." If it is imagined that the State wants to own the facility and if it is imagined that O&M is performed in a reasonable way, and if it is imagined that the careful preventive maintenance stops deterioration of the system, there would be no need to recover the investment costs from the user--the system is in a steady operational state. All that is necessary to charge is interest on the investment. The analogy is can be found in Consols, perpetual bonds that are never paid off. The facilities are passed on to each successor farming generation, who pay in turn interest for their use and (probably actual O&M expenditures as well). There may be some question as to the rate to charge--presumably it would be some current measure of government borrowing power and would be adjusted from time to time. A total deterioration free system does not exist, however certain features of public works are pretty much one-time investments, railway embankments and tunnel bores come to mind. In irrigation works it is true that dams are certain to silt up and so storage capacity is
constantly being lost. However, the actual conveyance systems below the dams or from river diversions can be held at a quite steady level of operational capability. Cost recovery of such features might fall under the console idea.

What has just been described sets a kind of (outer) limit to thinking about how to set the levels of fees to be charged. The real world must find particular answers on a case by case basis. The approach can be purely nominal: decide what is to be accomplished by the charging system and put it in place to the best degree possible.