'NOTHING IS EITHER GOOD OR BAD BUT A DISCOUNT RATE MAKES IT SO'

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ABSTRACT

'Nothing is either good or bad but thinking makes it so' (Hamlet, Shakespeare), and similarly, any project can be seen as good or bad depending on the discount rate used in it's evaluation!

High discount rates require high levels of benefits to validate the initial investment; conversely low discount rates allow investments to be much more easily justified.

Using the correct discount rate, which is neither too high nor too low, is important in selecting worthwhile project, neither investing in poor projects nor rejecting worthwhile opportunities.

Recently there has been a trend to use 'Social Discount Rates' which are by definition amongst the lowest possible discount rates, to justify utility investments in areas such as Transformer Loss Reductions and SmartGrids.

Such use of Social Discount rates may not be appropriate, as these rates do not allow for the financing costs inherent when public goals are being achieved through private investments. This is especially so where the resulting investments are mandated by Governments, where the utility must still evaluate other investments with similar outputs using higher Discount rates, thus resulting in a sub-optimal set of investments.

A better approach would be to either use Real Options in the investment analysis required, or the normal utility WACC which includes both finance and project risk.

INTRODUCTION

Engineers dealing with capital investments are well used to using the Net Present Value (NPV) method of Investment Appraisal. However the apparent simplicity of the calculations hides an enormous amount of complexity, and it is only when the way in which NPV is used needs to be questioned that such issues become evident.

In essence the NPV method is based on the well accepted principal that a €1 today is worth more than €1 in the future. The reason for this is that the opportunity cost (i.e. what it would have produced in alternative use) of having a €1 now to spend on whatever opportunities may arise now and in the future, is more certain and less risky than waiting on payment of a €1 at some stage in the future.

The relationship between the value of a €1 now and in the future is provided by discounting the future payment at the appropriate interest rate, which accounts for the opportunity cost and risk, and takes into account how many years into the future the €1 will be received.

So €1 received in *n* years at a real interest rate *r* is worth $1/(1+r)^n$ today.

If r = 10% this means that a Project with an initial investment of €100 will cover it's opportunity costs if it earns at least €10 per annum in perpetuity, and had the rate been 4% it would also have been justified if it's return were only €4 per annum.

From this simple example it is seen that projects evaluated with low discount rates have a much smaller return to make in order to justify their acceptance than ones where a high discount rate was used in their evaluation.

Note: *The discount rate can either be 'real' i.e. excluding the effects of inflation, or 'nominal' including inflation – both are equivalent approaches, but for simplicity 'real' rates without inflation are currently assumed.*

However the discount rate chosen for a project evaluation should be related to the degree of risk inherent in the project, so that riskier projects require a higher discount rate than low risk projects, with the greater returns paying for the extra risk involved. There are two 'risk' factors to consider in assessing the level of risk, the inherent 'riskiness' of the type of project itself, and the finance risk of raising the funds required.

So an investment in a new generator by an Independent Power Producer (IPP) will require a higher return than a similar sized investment in Distribution Networks by a regulated utility such as a DNO. The IPP will have higher borrowing costs as their credit rating will normally be less than that of a DNO, and their return will depend on the price and quantity of electricity sold, subject to the availability of the generator and it's access to the market. In contrast the DNO will have lower borrowing costs and a guaranteed return for any Regulator approved investments which are installed efficiently.

More formally, the appropriate discount rate can be derived using the Weighted Average Cost of Capital (WACC) :

$$\mathbf{WACC = k_d\, g + k_e(1\text{-}g)}$$

where $\mathbf{k_d}$ is the cost of debt, $\mathbf{k_e}$ the cost of equity and **g** is the proportion of debt in the firms capital structure.

In turn

$$\mathbf{k_e = \beta\ (r_m - r_f)}$$

where $\mathbf{r_m}$ is the general market return on investments, $\mathbf{r_f}$ is the risk free rate so that $\mathbf{(r_m - r_f)}$ is the premium over the risk free rate paid for a typical investment in the market.

As market investments can be riskier or less risky than the average, the coefficient $\boldsymbol{\beta}$ is used to either increase or decrease this premium depending on the relative risk compared to the market.

In the example above from the Generator and the DNO, the generation investment is riskier than the average in the market so that β could be 1.1, whereas for the DNO investments in the network are much safer and may have a β of (say) 0.6.

The upshot of all of the above is that riskier investments required higher discount rates, and this risk is due to a combination of the inherent riskiness of the project and the financial risks associated with the project's funding.

Typically Regulators will set the WACC for DNO investments, and this value for typical low risk Network investments is around 5 - 6%, taking into account that gearing is usually 50% Equity and 50% Debt, as well as relevant tax reliefs.

SOCIAL DISCOUNT RATE

Some investments may have benefits which extend far into the future where the benefits are received by future generations rather than by those who made the original investment. In other cases there may be benefits from investments which are received by society in general but are not accrued by those making the original investment.

Typically such investment are made by Governments where the overall interests of society over time are taken into account i.e. public sector projects using public sector funds [1].

The Government then have the issue of what is the appropriate interest rate that should be used in their own investment analysis, the difference between this rate and that used by private firms being that the Government can raise funds in a 'risk free' manner through tax, and that all benefits and costs arising from the investment 'net out' within the economy, so that the residual benefit is received by society.

There is still the particular risk associated with the intended project e.g. large Dam, Flood barrier, and this can best be addressed by incorporating the projects risks into the actual cash flows that are to be discounted.

In comparison, private firms have a portfolio of projects and use an average project risk, incorporated in their WACC, to allow for risk.

In the EU the 'Social Discount Rate' is calculated using the formula below

$$\mathbf{SDR = p + \mu G}$$

Where p is the time preference of society to consume now rather than later, $\boldsymbol{\mu}$[1] is related to how much society appreciates the ability to consume more in the future taking into account that future generations will be wealthier (i.e. how much pain is willing to be suffered now for an increase in the future), and **G** is the Growth per capita in the economy.

So in the UK, the Treasury 'Green Book' [2] estimates $\boldsymbol{\mu}$ at 1, **G** at 2% and **p** at 1.5%, giving a Social Discount Rate of 3.5%

In the EU [6] the figures provided are 5.5% for Cohesion countries and 3.5% for others, reflecting the greater opportunity costs in less well developed countries which in turn requires a higher return for projects, although for the EU EcoDesign Directive projects a rate of 4% is used, apparently based on Internal Guidelines related to the real yield on long term Govt debt up to 2009 [5].

APPLICATION OF SOCIAL DISCOUNT RATES TO CERTAIN UTILITY INVESTMENTS:

In normal utility investment appraisal the one discount rate is used for all projects, so that the return available from the last €1 invested in any project is no less than that which would be obtained in any other project.

This means that there is no sub-optimal investment and that all investments yield similar benefits.

Governments /EU can however have polices which they wish to implement through private companies such as utilities, and in assessing the benefits of such policies have used Social Discount Rates to decide the optimal value of investment in (say) Transformer losses.

1 μ is the marginal utility of consumption

There are three problems with this approach :

(a) The utilities financing costs have not been included in the discount rate used

(b) Investments by utilities which produce the same outcomes are evaluated using different discount rates so that sub-optimal allocation of funds occurs, resulting in lower benefits to customers.

(c) Project Risks are not included in the Social Discount Rate used, and are unlikely to have been included in the cash flows during the EU/Govt evaluations due to the complexity involved.

The political benefits of using a low Social Discount Rate is that it is much easier to justify the policy desired, especially if risk is not included in the associated cash flows.

Two examples of such polices will now be examined:

(1) EcoDesignTransformer Loss evaluation

(2) Justification of SmartGrid Investments

(1) <u>EcoDesign Transformer Loss Evaluation</u>

As part of the EU's EcoDesign policy, the performance of transformers was examined by looking at the values of savings in electrical losses produced by using more expensive, lower loss transformers, with the intention that savings in losses would pay for the extra capital costs incurred.

This has been analysed extensively by Eurelectric [5] but the relevant aspect here is the use of a 4% Social Discount Rate in the EU analysis.

There are three problems in using such a Social Discount Rate :

(a) Sub-optimal Investment Portfolio due to use of inappropriate discount rates

By calculating transformer efficiency using a Social Discount Rate of 4%, the utilities will now find that investments in (say) voltage uprating which would produce a more significant decrease in electrical losses, with returns of over 6% , will now be displaced by legislated Transformer investments at 4%.

This in turn will drive dysfunctional investments in Transformer efficiency by the utility and reduce the overall value to society from the investment portfolio.

(b) Not accounting for Risk in Social Discount Rate

The use of a Social Discount Rate – which is entirely risk Free – requires that risk is incorporated in the individual cash flows, using Expected values i.e. the probability weighted cash flow. However this is quite complex to carry out in practice and was not take into account in the original evaluation. The alternative to incorporating risk in cash flows is to use a higher, risk adjusted, discount rate. So discounting non-risk adjusted cash flows at a low Social Discount Rate produces results that are overly favourable to the project being evaluated and results in poorer projects being accepted.

(c) Use of a 4% Social Discount Rate where Public Policy Objectives are to be achieved through Private Sector investment:

The use of Social Discount Rates is in economic justifications of projects is very complex, particularly where the objective is to be achieved through Private Sector investment and without subsidies.

In the direct use of public funds to achieve a social investment there is no 'crowding out ' – extra Public Funds can be raised to meet the requirement rather than displace other investments, and in the economy as a whole any individual gains and loss will be netted off. This is not the case where a utility has a fixed amount of funding set by their Regulator, so that over investment in one area necessarily leads to underinvestment in others.

The application of a Social Discount Rate in the context of achieving similar Public Policy Objectives but through the use of Private Sector delivery is much more complex, because extra issues are involved such as the financial risk to the companies of raising the extra funding, the 'crowding out' of better investments as capital is rationed and other opportunity and uncertainty costs.

These issues are being looked at in detail by the UK

Government's 'Committee on Climate Change'[4], who have carried out a significant amount of work with sophisticated economic consultants such as Oxera [3], and engineering consultants such as Mott McDonald and PB Power.

(2) Justification of SmartGrid Investments

In the EU report on SmartGrids [7] a suggestion is made that a Social Discount Rate should be used in order to '*recognise the Societal value of SmartGrid Investments, the impacts of which go beyond project developers and affect a wide range of stakeholders and society at large'.*

This is also because *'if the discount rate is to give a fair reflection of the relative risks of projects, then a higher discount rate should be applied to 'smart investments' that have a higher risk level than conventional investments In this case, however discounting could lead to seriously undervaluing Smart Grid benefits, particularly systemic benefits that only come into play over long time periods.'*

Later it is suggested that different values could be used for the discount rate, ranging from 3.5% to 5.5% and that the regulatory framework may provide a risk premium to SmartGrid Investments over traditional investments.

Overall there is no clear direction on which way to value SmartGrids, nor why a Social Discount Rate should be used rather than some other calculated rate, except that a Social Discount Rate is the lowest possible rate that could technically be used.

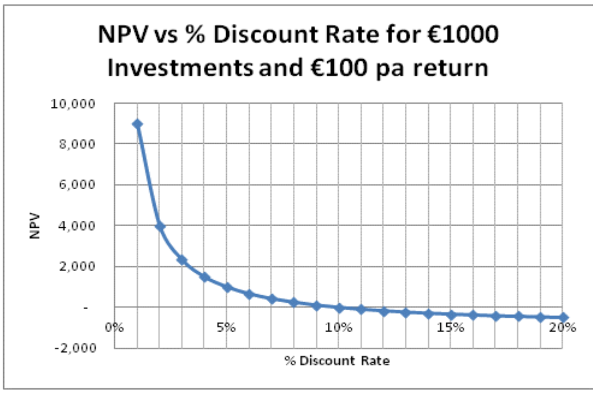

Fig. 1

The impact of the Discount Rate used is illustrated in Fig. 1 above where an initial investment of €1,000 makes an annual return of €100 in perpetuity. It is seen that at 3% return the investment yields just under €2,400 as the NPV, but at 5% this has reduced to €1,000 i.e. the correctness of the investment decision is very sensitive to the discount rate used, particularly at low interest rates.

Accordingly a decision to use a very low discount rate such as a Social Discount Rate must be carefully justified by calculation, as the difference between a Social Discount Rate of 3.5% and a WACC of 5.5% is very considerable in terms of NPV.

The other issue in relation to the use of very low discount rates such as SDR's, is that the benefit of delaying the investment in the hope of improved technology or greater information is considerable – the opportunity costs of the loss on the initial return caused by such a delay is very small, yet the potential gain, which applies to the totality of future cash flows is very large.

In contrast, using a higher discount rate makes it more critical to invest immediately and make the more valuable early returns now.

USE OF REAL OPTIONS

An alternative approach to the analysis of utility investments is to use Real Options.

The full NPV equation is:

$$NPV_{Project} = NPV_{Cash\ Flows} + NPV_{options}$$

This means that not only should the NPV of the Cash Flows be taken into account but also the NPV of the option to invest further, divest or delay further investment, at each stage.

Traditionally NPV calculations assume one initial investment and then a fixed pattern of future investments and returns, whereas a more sophisticated approach would take into account that Management can make decisions to invest more heavily in good projects or halt further investment in bad projects, thus reducing the risk and improving returns. Benefits are also obtained by staggering the initial investment so as to provide the opportunity to ramp future investments up or down.

In such a scenario the risks are built into the cash flows, and the cash flows then discounted at a risk free rate – the finance and project risk already being explicitly incorporated.

The full value of the project also takes into account the NPV of the options available, particularly the ability to halt further investment, so that investments which might be rejected under a traditional NPV analysis can find acceptance under a Real Options assessment.

The use of Real Options is considerably more complex than a simple NPV analysis using a Social Discount Rate, but is worthwhile for more significant investments e.g. the initial EcoDesign Transformer Loss proposals involved an extra expenditure of €500m per annum in transformer costs.

However it would still not prevent situations arising where mandated investments in one technology , justified by one approach, were inconsistent with other, non-mandated investments which had a better return.

CONCLUSION:

This paper has shown that investment decisions are very sensitive to the Discount Rate used, and that the use of one Discount rate such as the SDR by Governments can cause sub-optimal investment by utilities, especially where other investments can produce the same results at lower costs.

In the case of Energy Efficiency for EcoDesign Transformers, a better approach would have been to require that all utilities incorporated the capitalised value of losses in all investments, thus ensuring an even ‘playing pitch’ for all investments. However because the EcoDesign legislation is product specific, the level of losses on the product involved was instead mandated, resulting in possible conflicts with other investments.

Overall the use of a Social Discount Rate is seldom formally justified by analysis, and, where it is suggested it be used, the requirement that it only be applied to cash flows which have been adjusted for Risk and expected values is ignored.

This means that the application of the SDR can be seriously flawed as it does not take account of project risk, nor the financing risk when public projects are delivered through private sector investments.

Accordingly it would be more appropriate to use the normal utility WACC for such investments, as is the case in other jurisdictions such as Australia.

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