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The Social Discount Rate and Project Appraisal

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Abstract

The choice of the appropriate discount rate is crucial in project appraisal given that cash flows occur at different points in time. The traditional valuation regularly employs the weighted average cost of capital to estimate the discount rate in private investments. On the contrary, disagreements exist in the academic literature about the discount rate to be used for public sector funded investments. The choice of social discount rate is of special interest both for the funding of public projects and the Public Private Partnership (PPP) procurement under the condition that a PPP project should only be accepted when it delivers value for money. The intent of this paper is to discuss the discount rate choice in public infrastructure, one the one hand, by examining some aspects of the social discount rate, such as the cost of capital and the time preference rate approaches, and, on the other hand, to discuss recent studies that have important implications for project evaluation, i.e. the discount rate is not constant but it declines over time.

Keywords

Hyperbolic discounting, PPP, Project appraisal, Social discount rate, Uncertainty

1. Introduction

The choice of the appropriate discount rate is crucial in project appraisal given that cash flows occur at different points in time. The conventional valuation regularly employs the weighted average cost of capital to estimate the discount rate in private investments (Garvin and Cheah, 2004, Park and Sharp-Bette, 1990). On the contrary, many questions remain unanswered and considerable practical difficulties exist about the appropriate (social) discount rate to be used in public sector funded investments (Layard and Glaister, 1994). However, discount rates are necessary in the public sector to carry out cost-effectiveness analysis and cost-benefit analysis, as well to cost public sector outputs in order to be compared with the prices of private sector outputs.

The requirements to modernize infrastructure facilities and severe budget constraints have forced governments worldwide to adopt complex forms of private involvement, referred to as public-private partnerships (PPP), in the procurement of facilities and services. The standard test criterion for a PPP project is that the project should only be accepted when it delivers VfM (Value for Money), i.e. the cost to the government is less with a PPP than with conventional public provision (Akintoye et al., 2003, Grout 1997).

Since VfM is substantiated with the use of discounted cash flow techniques, this assessment is sensitive to the rate used to discount the cost of public provision and PPP. For example, the recent decision of UK to switch from a 6% to a 3,5% real rate (HM Treasury, 2003) has as direct consequence that it is more challenging to show value for money in PPP projects, since more private sector efficiency is required. Morever, of particular concern is whether the discount rate used to appraise public provision should be the same as that used to appraise a PPP (Grout 1997).

It is exceptional that discounting has a practical importance for time horizons beyond a few decades. However, a growing interest in how discounting the distant future has been emerged due to projects like radioactive waste disposal and long-lived infrastructure, as well to problems like global warming, that have a life cycle that impacts future generations. Lower or/and declining discount rates over time have important implications for equitable intergenerational resource allocation, since long-term projects yielding significant benefits for future generations become more attractive (OXERA, 2002). Evans and Sezer (2004) point out also a related aspect of the discount rate. Countries in European Union have used very different approaches resulting in different values when setting official social discount rates. This, in turn, may have serious implications for the EU policy co-ordination on investments, especially on sustainable development. For example, in an appraisal of transport benefits in Europe an 8% social discount rate (based on the marginal product of capital) was applied in France, whereas only a 3% rate (based on financial market data) was applied in Germany.

The intent of this paper is to discuss the discount rate choice in public infrastructure, with a special reference to PPP projects. Firstly, we examine some aspects of the social discount rate. Secondly, we discuss recent studies (hyperbolic discounting, implications of uncertainty about the future for discounting) that have important implications for project evaluation, i.e. the discount rate is not constant but it declines over time.

2. The Standard Discounting

The technique of discounting is used in the public and private sectors to compare amounts (costs or benefits) occurring at different points in time. The technique multiplies future amounts by the *discount factor*

$$\frac{1}{(1+r)^t}$$

where t is the number of years after a baseline date, and r is the *discount rate*. *Present value* of the amount F_t is its value after multiplication by the discount factor

$$PV = \frac{1}{(1+r)^t} \times F_t$$

Net present value (NPV) of a project is the total of present values of all the relevant costs and benefits. Following the NPV rule, an investment proposal with positive NPV is accepted, and, when many alternatives are to be considered, the proposal with the highest NPV is preferred because it maximizes wealth. Investments decisions in the private sector are concerned with maximizing shareholder wealth, whereas in the public sector such decisions are concerned with improving social welfare. In any case, r is a constant and does not vary with time. Developed as a means of providing a criterion for public funded projects based on the net social benefits accruing to the investment, cost-benefit analysis uses the so called *social discount rate* that reflects the social time preference value of money.

Higher (lower) rates make long-term projects, with costs (benefits) in the distant future, appear much less

(more) attractive relative to short-term projects with immediate costs (benefits) than they would be if a lower (higher) rate were used. Since there is a bias in favour of the present in discounting, the choice of the appropriate discount rate to be used is crusial at least for two reasons.

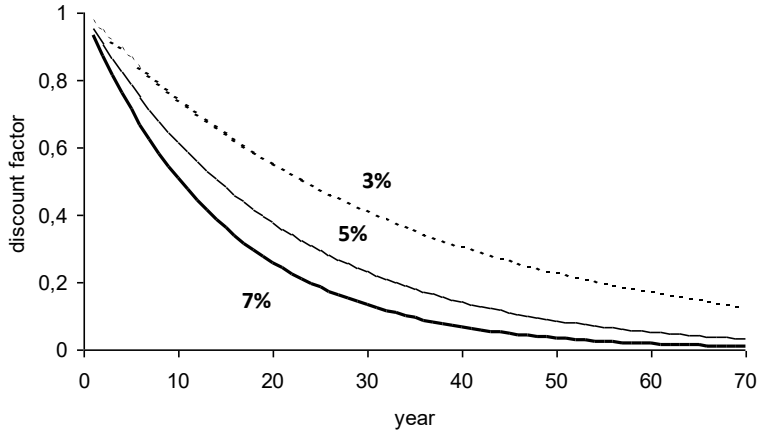

Figure 1: Discount factor as a function of time

First, under the condition that a PPP project should only be accepted when it delivers VfM, discounting has implications for the relative costs of the two methods of financing the project, i.e. financed under conventional procurement methods and under PPP. VfM is measured by the difference of the net present costs of the two methods of financing. However, the capital costs are occured during the construction period under the traditional grant system, whereas the costs are spread over a long period under PPP. Therefore, a relatively lower discount rate increases the net present cost of the procurement under PPP. Figure 1 illustrates the discount factors obtained using discount rates of 3%, 5% and 7%, and the next table show their values for the 3rd and 25th year.

year	3%	5%	7%
3	0,915	0,864	0,816
25	0,478	0,295	0,184

A decrease of the social discount rate from 5% to 3% implies a relative increase of 6% and 62% respectively of the present costs for the two cases. Consequently, a low discount rate implies a bigger difference between the cost of public capital and private finance than a high one, so more private sector efficiency is required to show value for money in PPP projects.

Second, a lower rate of discount has important implications for the allocation of capital funds between short-term and long-term uses (roads and railways), especially for those very long-term projects yielding important costs for future generations, for example, investment in nuclear power. For a project discounted at a constant social discount rate of 3%, the following present values of 1.000.000€ at year *t* are obtained:

t = 50, present value = 179.053€
= 100, = 32.060€
= 150, = 5.740€
= 250, = 184€

The 1.000.000€ of cost is reduced effectively to nothing for *t* = 250.

3. Social Discount Rates

Discount rates are necessary in the public sector to appraise publicly financed projects, as well as to cost public sector outputs in order to be compared with the prices of private sector outputs. In the former case, there are two approaches to estimate the social discount rate, issued respectively from welfare economics and from financial economics. Based on the social time preference concept –a mesure of how much society prefers to have national benefits as soon as possible and to defer costs as long as possible, the welfare economics approach comes to a social discount rate depending primarily on the rate of growth of personal incomes and on how much society is concerned about future generations welfare. On the other hand, the financial economics approach assumes that the discount rate applied to public investments should be the rate of return of private investments, that is, the expected return on the same or similar investments in the capital markets, because funds are diverted from potential use of the private sector to public investments. As the government receives all tax revenues, the before-tax rate of return on private investment must be applied to discount before-tax cash flows (Brealey et al., 1997). In addition to these approaches, there is a eclectic one which suggests that the discount rate should be a weighted average of those two rates. There are many controversies about the appropriateness of each approach, but it seems that the social time preference approach has gained some points in last years due to its adoption by the british government as a method to calculate the social discount rate. Based entirely on social time preference, the tight range of discount rates for six major countries (Australia, France, Germany, Japan, UK, USA) is estimated at 3,5%-5% (Evans and Sezer, 2004).

In the latter case, it is proposed the discount rate that should be used for costing the public capital equals to the opportunity cost of displace capital in public sector assets. This rate is a function primaly of the government borrowing rate and the level of taxation of returns to capital.

According to Spackman (2001), however, for two reasons a government must use the same rate instead of two rates, i.e. a general discount rate based on social time preference and the cost of capital. First, the use of different real rates would be administratively extremely difficult. Second, it seems likely that in many countries the cost of capital and the time preference rate are close enough to be set equal to the same number. In any case, this rate will be greater than the interest rate on government borrowing.

4. Declining discount rates

Recently, many writers have proposed to use declining discount rates for discounting very distant cash flows in order to counterbalance the exponential effect of discounting. The starting point for declining discounting was twofold. First, a growing evidence that assumptions underlying the standard discounting model are violated in practice, for example, preferences are assumed not to change over time, i.e. discounting is based on the difference in time between two events (stationarity), whereas we know that preferences do change over time. Second, the emergence of some problems, such as nuclear waste and global warming, which may have costs on very distant generations. According to HM Treasury (2003), the main rationale for declining long-term discount rates results from uncertainty about the future, that is, any uncertainty about the weight to be given to future interests will be uncertainty about the discount factor.

Constant discounting theory is based on the principle of stationarity, that is the choice between two payoffs depends only on the absolute time interval separating them. There is, however, strong empirical evidence that people are more sensitive to a given time delay if it occurs closer to the present than if it occurs farther in the future, i.e. people's impatience is decreasing. In other words the discount rate that applies to near-term consumption tradeoffs is higher than the discount rate that applies to long-term consumption tradeoffs.

Unlike conventional discounting, which is exponential, in hyperbolic discounting the weight assigned to each period *t*, declines as a hyperbolic function of time (Loewenstein and Prelec, 1992). Such preferences are described by the following generic hyperbolic discount function

$$f(t) = \frac{1}{(1+at)^{h/a}} \quad a, h > 0$$

The parameter *a* measures the deviation of the hyperbolic discounting function from the standard exponential model. As $a \to 0$, *f(t)* approaches the exponential function. When *a* is very large, *f(t)* approximates a step function, implying that all periods after the first receive approximately equal weight. The hyperbolic discount function *f(t)* lies below the exponential function at low values of *t* and above it at high values of *t* (figure 2). The parameter *h* indicates how fast time is perceived to pass. If $h \to 0$, individual time periods are perceived as passing extremely fast. As $h \to \infty$, time is not perceived to pass at all. A special case, the so called proportional discounting, is obtained when $h/a = 1$,

$$f(t) = \frac{1}{1+at}$$

Gollier (2002) analyses the effect of the uncertainty about future growth on the social discount factor. Based on the concept of prudence, i.e. an individual is prudent if his willingness to save increases with future income risk, Gollier shows that prudence justifies taking a smaller discount rate than the one that a certain growth justifies.

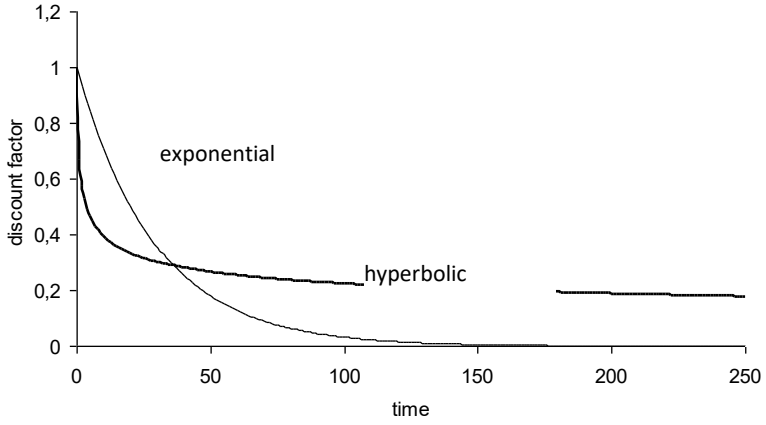

Figure 2: A comparison of hyperbolic rate with exponential rate.

One reason to discount the future is related to a wealth effect, that is, the expectation that the quantity of available consumption goods will increase over time. Since individuals have preferences for the smoothing of consumption over time, a project in a growing economy should be accepted only if its rate of return is large enough to compensate for this negative impact on welfare. The larger the growth rate of the economy, the larger the social discount rate. However, there is a potentially counterbalancing precautionary effect: the increased risk of longer horizons due to the accumulation of period to period growth risks. The longer the horizon is, the larger is the uncertainty on future wealth, the smaller should the discount rate be.

Therefore, there are two opposing effects on the discount rate, desire for income smoothing and attitude to risk. The magnitude of the effect depends upon the degree of prudence and the degree of uncertainty on growth. He shows that the precautionary effect dominates the wealth effect when relative risk aversion is decreasing and when there is no risk of recession and he concludes that it is socially efficient to reduce the discount rate per year for more distant horizons.

HM Treasury (2003), based on the assumption that the main rationale for declining long-term discount rates results from uncertainty about the future. recommends that for costs and benefits accruing more than 30 years into the future, appraisers use the discount rates 3%, 2,5%, 2% 1,5% and 1% for the periods of years 31-75, 76-125, 126-200, 201-300 respectively.

5. Conclusions

Construction industry depends to a large extent on the publicly financed projects. A lower discount rate makes less attractive long-term projects yielding significant costs for future generations and procurement through PPP more expensive in today's terms. Despite the importance of the social discount rate for the appraisal of a project, there is no agreement on how to estimate it. In any case, a more rational long-term discounting policy is needed to take account of the implications of today's decisions for the very long term. For this purpose, recent advances that support the declining discount rates over time provide better alternatives to the standard discounting. Even though this paper has emphasized the choice of the social discount rate, we must remember that "there are many issues in appraisal and evaluation which are much more important than the choice of discount rate… Profoundly important too, of course, are the quality of contracting, of project management during construction, and management of subsequent operation and maintenance" (Spackman, 2001. p. 245).

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