An attempt to define the discount rate in the light of the type of investment project

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ANNOTATION

The problem of estimating the discount rate level is a crucial issue in investment project appraisal procedure. The discount rate is strongly determined by the type of investment that sets the scope of decision criteria. The need to apply financial efficiency, economic efficiency or justice criterion impose the frames for theoretically correct measure of the discount rate.

KEY WORDS

discount rate, investment appraisal

INTRODUCTION

The discounting procedure aims at making comparable effect that emerge in different time periods, especially when very long, intergenerational perspective is taken into consideration. The theoretical foundations of the rate level depend on the way that the decision criteria are formulated. However the choice of the appraisal method must be in agreement with the characteristics of the investment project that is assessed.

AIM AND METODOLOGY

The paper aims at defining the theoretical basics of estimating the level of the discount rate used in the appraisal procedure on the basis of the type of the investment projects. For the correct outcome of the investment analysis and optimal investment decision, the crucial part is specifying the features of the project that form the foundations for defining the assessment criteria and, as a consequence, the method of estimating the discount rate level. Special interest is given to establishing the difference in characteristics between short term and long term investments as well as public-private perspective.

The research is designed to establish theoretical foundations for discount rate elicitation procedure determined by the selected characteristics of the investment project.

The analysis is based on the critical review of the investment appraisal literature as well as on the deduction and synthesis process.

RESULTS

The process of defining the discount rate in the project appraisal is twofold. First, it depends on the fact if the project is private or public. Second, what is the time frame of the analysis – within one generation or intergenerational, where investment effects influence people that have not been born yet and, then, have no ability to influence the investment decision taken today [1].

For the purpose of analysing the discount rate level in the project appraisal investments can be divided into the following groups:

1. private short term projects,
2. public short term projects,
3. long term private and public project.

Each of those has some specific features that determine the criteria of decision making process, and – as a consequence – possible tool of appraisal and the optimal definition of the discount rate. The main question here is what method should be accepted to estimate the

correct value of the project which is the value calculated on the basis of all known project inputs and outputs.

Private projects in short perspective

Private investments are projects where all the costs and benefits accrue to the owner-investor. The project does not induce any off-market side effects that would change the welfare of third parties. The decision criterion is formulated as the maximization of the wealth or welfare of the owner which means maximization of project value to the investor. Therefore financial criteria are sufficient here.

Financial methods, like Net Present Value [2], are calculated on the basis of financial cash flow and use market prices as well as market discount rate.

The decision criterion can be formulated as below:

$$FNPV = \sum_{t=0}^{n} \frac{FCF_t}{(1+r_m)^t} \rightarrow \max \tag{1}$$

$FNPV$ – financial net present value of the investment,
FCF_t – financial cash flow in year t ,
r_m – market rate of discount,
t – time period ($t = 0,1,2,\ldots, n$) where n is the last year of project life in the analysis.

The project is accepted if $FNPV$ equals zero or is positive. FCF_t are the expression of project effects: inputs (investment outlays) and outputs (investment gains) calculated on the basis of market prices. Discount rate expresses here the opportunity cost of capital for the investor and is calculated on the basis of market rate of return for alternative investments which stands for the opportunities that are gone when the evaluated project is selected.

The financial efficiency criterion here is relevant when a purely commercial project is evaluated. To satisfy this all the inputs and outputs of the project should be traded on the efficient markets, so the project will not generate any external effect, change public goods, etc. Assuming the financial markets are efficient, the use of market discount rate will lead to the achievement of maximum increase in the wellbeing of the investor. In that case efficiency criterion is satisfied at the same time as the financial one. Although, where some failures on the markets emerge, the private perspective is insufficient and efficiency criterion would give different results.

Public projects in short perspective

Public investments can be defined as projects that change social wellbeing. They are projects that are financed from a public source and aim at satisfying social needs. The inputs and outputs of the project can be both private or public, however some change in quantity or quality of public goods is usually the main effect of the project. The efficiency criterion here means seeking effective allocation of resources to maximize the overall utility. The private perspective is not sufficient here as some of the project impacts are off-market or their market prices don't reflects true social preferences as well as opportunity cost of resources.[1]

Economic criterion can be denoted as[3]:

$$ENPV = \sum_{t=0}^{n} \frac{ECF_t}{(1+r_e)^t} \rightarrow \max \tag{2}$$

$ENPV$ – economic net present value of the investment,
ECF_t – economic cash flow in year t ,
r_e – economic rate of discount (social rate of discount).

[1] Most of public projects are projects that affect public goods that suffer from market failures. However, even if project effects are private, the use of public resources will involve some external effects and social perspective should be taken into account.

The project is accepted if *ENPV* equals zero or is positive. ECF_t is the reflection of project effects, however they are calculated with use of efficiency prices (shadow prices, economic prices) that are prices cleared off market distortions.
Textbooks on appraisal offer a choice of methods, like Cost-Benefit Analysis, Cost-Effectiveness Analysis, etc., which are based on the calculation of economic cash flows that are estimated with the use of efficiency prices [4]. Efficiency or shadow prices aim at correcting market failures brought about by taxes, subsidies, public goods, etc. and should reflect opportunity costs and true social preferences.
Similar definition applies to the discount rate, which is often referred to as a social rate of discount and its level should be in agreement with social preferences towards trading present for future. The concepts of calculating SDR differ significantly in the literature. The most widely accepted are:
- SDR as an opportunity cost of capital – to reflect opportunities lost by society when the evaluated project is accepted. The level of discount rate based on this concept tends to be the highest as it should show private investments forgone in order to implement public project. Here the rate is often calculated on the basis of market rate as a measure of private rates of returns;
- SDR as a consumption rate of interest – based on social preferences towards deferring consumption in exchange for future profits [5].
When analyzing public projects one more issue must be taken into account – utility maximization within one generation [6]. The satisfaction of economic efficiency criterion that leads to maximizing consumption doesn't tell anything about how the resources are allocated between members of the society (eq. 2). The project costs may be incurred more often by some groups, while benefits will apply mostly to the others. The solution is to use utility criterion (eq. 4), that can offer i.e. an allocation based on diminishing marginal utility of consumption that forms the weights for the groups affected by the project [7]. Social net present value (*SNPV*) is calculated as a weighted sum of discounted economic cash flows. Maximization of *SNPV* means maximization of social welfare within one generation. The equation above concerns short perspective (within-generational), where the use of social discount rate is justified by the opportunities that the contemporary society loose deciding to invest in the project and is similar to the definition in the economic efficiency criterion.

Intergenerational private and public projects

Intergenerational projects are the investments which affect more than one generation. Usually, there are projects where the costs are incurred by the present generation and the benefits accrue to the future people, however there can be projects that diminish the welfare of the following generations to improve the utility of the present one.
The private and public projects are here treated in the same way on the assumption that as the time span extends, the effects that accrue only the individual investor disappear. In the intergenerational perspective the range of affected parties is significantly broadened, so the individual efficiency measurement is not sufficient any more. Taking into account few generations makes in fact any project public, although not in static but in dynamic sense.
The criteria for decision making cannot be based solely on financial or economic efficiency. The utility maximization criterion used within one generation is not sufficient either. There are few reasons for this.
First, financial criterion involves using market prices to calculate financial cash flow of the project. Even assuming that all the markets are efficient, so the project is purely private and no market failures exist, relying on present market prices cannot ensure reflecting future preferences and opportunity costs. Market prices show only present state and they include no information about future people interests. The investor take into account only his life-time,

sometimes enlarged by his direct successors, so any effects emerging further in time will be omitted. And even if some calculation would be done (i.e. on the basis of altruistic motives), using market discount rate will diminish the value of any future effect to almost zero.
Second, economic analysis is based on calculating efficiency prices and the outcome of the appraisal is the answer whether the project gets the society closer to the Pareto optimality state. Prices reflecting opportunity cost as well as people's true preferences will not satisfy the condition of including all effects into the analysis for the same reason that the financial criterion – the methods of measurement opportunity cost and willingness to pay are based on present generation preferences. Any measurement of long-term effects will only reflect present generation interests and omit the preferences of the future.
Third, social appraisal takes into account the issue of just allocation of resources on the basis of some social welfare function. The function is also based on present knowledge and preferences that shape weights of each group importance, usually on the basis of the assumption of diminishing marginal utility of consumption, which also reflects only present preferences. Within-generation justice of allocation doesn't guarantee the fairness between generations.
The appraisal process needs then further extension. Including moral principles towards unborn generations into the analysis allows to take into account the interests of future people. The defining of those criteria should be contingent on some ethical approach towards future [8] and it will affect the outcome of the analysis by defining the level if the discount rate [9]. The appraisal criterion for the intergenerational investment project can then be denoted in the following form:

$$INPV = \sum_{T=0}^{p} \frac{SNPV_T}{(1+r_i)^T} = \sum_{T=0}^{p} \lambda_T SNPV_T \qquad (3)$$

$INPV$ – intergenerational net present value of the investment,
$SNPV_T$ – social net present value of the investment for generation T,
r_i – intergenerational rate of discount[6],
λ_T – weight for generation T, discount factor $\lambda_T = \frac{1}{(1+r_i)^T}$.

The discount rate can be denoted as a discount factor that in fact reflect the importance and rights of each generation. Discount rates are constituted on the basis of weights of generations in intergenerational welfare function The weight of the generation depends on the accepted philosophical approach – it becomes a function of ethical rule that shapes the stand of the decision-maker/society.[2]

CONCLUSION

The distinction of intra- and intergenerational perspective as well as private and public features of the investment projects is crucial for defining the range of the decision criteria. They, in turn, can be formulated as financial efficiency, economic efficiency and justice decision criterion. In the short perspective they can be apply for private or public projects where, market or social discount rate can be applied, respectively.
However, moving the analysis into the very long time period, the justice criterion must be used both for private and public investments. The method of defining the discount rate also changes from the reflection of opportunity cost of capital and society willingness to trade

[2] In well functioning democracy the views of the decision-maker should be in agreement with the view of the society that chooses the leaders. That is why society and decision-maker can be treated as synonyms.

present for future to the image of the scope of rights and duties that unborn generations are given by the contemporary one.

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