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REVIEW OF ARGUMENTS

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1. Introduction

The assessment of the social value of multiperiod effects (costs and benefits) of public policy decisions is usually based on the net present value criterion. The use of this criterion is based on two major assumptions: (i) the possibility of expressing all relevant impacts of a decision in a common cardinal (usually monetary) denominator; (ii) the existence of an appropriate social rate of discount which transforms all future flows into present values. Clearly, these two assumptions are not entirely independent: if no monetary cardinal metric can be specified for the effects of a decision on a plan or project, it becomes also problematic to use a conventional social rate of discount; besides, various authors have argued that in case of intangible effects which cannot be valued in a monetary sense, it may be plausible to adjust the social rate of discount.

The present study will mainly focus on the question whether the social rate of discount in public decision-making may be adjusted for specific circumstances. There is already a vast amount of literature (starting off from Hotelling, Pigou and Ramsey in the 1920s) on the role and the value of the discount rate in general, and there is no reason to repeat what has already been said in the literature on this theme. Interested readers are referred to Arrow and Kurz (1970), Baumol (1968), Bradford (1975), Eckstein (1975), Marglin (1963), Mendelsohn (1981) and Sen (1967), among others.

Theoretically, the social rate of discount should reflect the opportunity cost of postponement of receipt of any benefit emanating from the implementation of a public investment project. This would require an assessment of welfare foregone by not having these benefits available for immediate consumption or reinvestment. However, the assessment of these opportunity costs is far from easy and often an illusion. In this context, Lind (1982, p. 22) remarks:

> "...if one were to establish the social rate of discount so that it properly reflected the differences in the opportunity costs and riskiness of different projects and so that it properly reflected the social rate of time preference as well, one would have to set a different rate for almost every project and the choice of the social discount rate would depend upon many things."

Despite the extensive literature on the social rate of discount, it is striking to observe that no concensus among economists has emerged as to the appropriate value of the discount rate in the practice of public policy. Consequently, policy practice is usually based on ad hoc rules of thumb which are not thoroughly rooted in economic theory. Large international organizations (the World Bank, e.g.) and national or regional governments are facing an unsatisfactory situation in

which their decision cannot firmly be based on economic principles.

It is worth noting that in real-world practice one often uses the market rate of interest as a reasonable proxy for the social rate of discount. Zimmermann (1983) has however recently pointed out several weaknesses inherent in this approach, viz.:

- the existence of a 'defective telescopic faculty' (Pigou) among consumers;
- the neglect of the interest of future generations in case of a decay in their resource base due to the implementation of the project at hand;
- the differences in finance policy between public and private projects;
- the imperfect functioning of the capital market (including the neglect of distributional impacts);
- the difference in handling risks between public and private investments;
- the difference in treating social costs (and their distributional impacts) in public and private investment decisions;
- the difference in institutional patterns of decision-making between public and private projects (in terms of ex ante coordination, procedural planning and the use of a planning horizon).

Another interesting observation is however that it is increasingly argued that a uniform discount rate which treats all public projects equally - irrespective of the context, their effects and their time horizon -, is difficult to justify from an economic viewpoint.

The present paper aims at providing a systematic review of the arguments pro and contra a uniform discount rate. Four main categories of arguments in favour of a flexible social rate of discount will be distinguished, viz.:

(a) the (intergenerational) equity motive
(b) the uncertainty and risk motive
(c) the financial crowding out motive
(d) the externalities and intangibles motive

Each of these four classes of motives will critically be reviewed, while the results of these findings will briefly be included in a systematic survey table. It will be concluded that the use of a flexible social rate of discount, which is dependent on specific circumstances (e.g., the context, the type of project or the type of impacts), can be justified on the basis of these arguments.

2. The (Intergenerational) Equity Motive

In a multi-period situation, the slope of the indifference curve, reflecting the marginal rate of substitution of current for future consumption, corresponds to the rate of time preference, on which basis it may be decided how many units of a commodity will be consumed in subsequent periods. Generally, people prefer current to future consumption, so that a positive rate of time preference implies that future flows of consumption have to be discounted in order to determine their present value. In view of the (frequently assumed) myopic behaviour of individuals, it is often taken for granted that - especially in a long-term planning context (e.g., resource management) - a government has to base its decisions on a longer planning horizon and on a deeper concern for future generations than is normally being done in individual decision-making. This leads to the question whether in public decision-making a social rate of discount should be used that is lower than the discount rate reflecting the (individual) opportunity cost of postponing the consumption of goods or services (see also Nijkamp and Rouwendal, 1985).

Especially in case of multi-generational evaluation problems, the question may be raised whether it is reasonable to use a conventional social rate of discount, based for instance on the market rate of interest. A major problem here is that the rate of interest is co-determined by time preferences of individuals who are neither necessarily concerned with future interests of themselves or of their offspring nor of society as a whole. Immediate consumption is preferred to future consumption of the same quantity of goods, so that the intertemporal allocation of scarce resources is unevenly distributed in the detriment of future generations. This situation is also reflected in the so-called 'isolation paradox' (see Sen, 1967). Thus the market rate of interest may do harm to the next generation: its value is then higher than the level which would correspond to long-term socio-economic interests.

In this context, it is interesting to observe that already more than half a century ago, Pigou argued that the government - being the 'trustee for unborn generations' - should not only be concerned with the interest of the present generation, but also with that of future generations. In the post-war literature on social discount rates the problem of multiple generations has been discussed quite extensively, particularly since the awareness of the exhaustibility of natural and materials resources in the long-run has grown drastically (cf. the deterioration of forests due to acid rain). Often the argument has been used that individuals have a myopic view of future interests and hence tend to underestimate the impacts of current decisions upon

long-term welfare related to the use of a finite stock of resources (cf. Herfindahl and Kneese, 1974, Kirsch, 1984, Krutilla and Eckstein, 1958, Marglin, 1963, Mishan, 1977, and Myers, 1977).

Especially in case of an option value which is not accounted for in the price compensating measure of the consumer surplus of the preservation value of an asset, there is a risk of a misallocation of public resources, because then we do not know whether potential users of a good will effectuate their demand in the far remote future. In the context of resource economics, Weisbrod (1964) has argued that an asset with option values for future generations may have no unambiguous consumer surplus, especially if - in addition to an uncertain future demand - the asset is not readily producible or reproducible and if its services are non-storable, have no close substitutes and have doubtful availability in the future.

It is sometimes argued, that investments in favour of future generations may have the character of a public good, as they may improve the productive potential of a future society without excluding any future generation from relevant option values. Tullock (1964) has pointed out that such a redistribution from present to future generations leaves us with the question why the present generation should give up part of its income to help future generations which are likely to have an income several times its present income. This argument is also shared by Baumol (1968), who states that in our economy, by and large, the future can be left to take care of itself. Consequently, in this view there is from the externalities viewpoint no need to lower artificially the social rate of discount in order to increase further the prospective wealth of future generations. Only in case of specific externalities (environmental irreversibilities, e.g.), investments for preserving assets for future generations seem perfectly proper, although in that case selective subsidies instead of a lower discount rate would appear more appropriate.

Two further contributions to the discussion on multi-generational evaluation problems are worth mentioning here, viz. Solow (1974) and Mueller (1974). Solow's propositions are mainly derived from the social justice theory of Rawls (1971), who has formulated a set of ethical principles for a social contract which state inter alia that an unequal distribution of utility and welfare among individuals belonging to one generation in a society is only justifiable if the least wealthy individuals benefit from this situation. Solow has generalized Rawls' argument for the case of multiple generations and has formulated an optimal control maximum principle for intergenerational equity: maximize welfare of that generation, which derives the lowest welfare level from the consumption of a finite stock of re-

sources. The efficient solution for this distribution problem boils down to an equal distribution of consumption over all generations at the highest feasible level, given all constraints for each generation and given the finite stock of resources. Further contributions to a Rawlsian approach to generational evaluation problems were provided by, among others, Pearce (1977).

A second important contribution in this context has been made by Mueller (1974), who applied the Harsanyi social welfare function to the problem of determining the social discount rate in case of multiple generations. Mueller treats the issue of intergenerational justice by assuming that individuals determine separately the consumption levels of each generation without explicitly knowing themselves to which generation they belong. Thus this approach views the social discount question as one of justice between generations under conditions of individual uncertainty over position, rather than as one generation's paternalism or altruism for the next generations. Mueller then develops a utility maximizing model, in which consumption levels, (implicit) savings levels and social time preferences are determined by the risk attitude of actors and by the production possibility frontier associated with the production function of the economy concerned. An individual is here not regarded as having somebody else's consumption as a component of his utility function, but as evaluating his own utility under different circumstances. On the basis of the first-order optimality conditions for an optimal trade-off between consumption in two different time periods, the social discount rate may be identified. Mueller suggests even a public agency which might be held responsible for determining a correct social rate of discount.

The foregoing sample of contributions to multi-generational decision-making shows that an unambiguous way of taking intergenerational effects into account has not yet been formulated. Divergence of views is a rule rather than an exception. As an interesting illustrative example we mention Page (1977), who proposes to confine the role of the discount rate, based on the opportunity costs of capital, to the process of selecting the intergenerationally efficient set of projects. For the purpose of social choice should be narrowed down by using piecemeal criteria (with several rules of thumb) that incorporate concepts of intergenerational equity. In this respect, much confusion among economists appears to have emerged by regarding the social rate of discount as a panacea for both the evaluation of public projects and the treatment of intergenerational equity. In this context, Freeman (1977) has rightly stated that the problem of intergenerational distribution and that of the social rate of discount are not necessarily linked together. A distributional problem would only

arise if the present generation would neglect to offer a financial compensation to future generations in case of damage to these generations (assessed on the basis of the conventional discount rate). Clearly, if such a compensation would not be taken into consideration (which is usually the case), a reduction in the discount rate might assure the same effect as the abovementioned compensation (see also Pearce, 1977).

In conclusion, given the inertia prevailing in most economies to take into consideration the interest of future generations, a downward adjustment of the value of the conventional rate of social discount is justifiable.

3. The Uncertainty and Risk Motive

In addition to intergenerational equity issues, it is often argued that uncertainty and risk may yield a reasonable ground for adjusting the social rate of discount. For instance, in the private sector the (private) rate of discount may be diminished (in case of expected but uncertain future costs) or increased (in case of expected but uncertain benefits) (see Haveman, 1977).

Haveman also criticizes two arguments in favour of the so-called social risk neutrality, viz. the Arrow-Lind theorem (see Arrow and Lind, 1970) and the pooling argument (see Vickrey, 1964). The Arrow-Lind theorem implies that the government may neglect the risk associated with a risky project if the risk is borne by the public sector, as in that case the risk is divided among a large number of individuals, making individual risk assessment useless. Haveman argues that this is only a valid assumption if the number of inhabitants is extremely large (more than approx. 80 million) and if the effects of risks in the public sector are entirely independent from the private sector (which is an implausible assumption).

The pooling argument takes for granted that - due to the wide variety of different public projects - risks borne by the government can essentially be better 'pooled' than in the private sector. This assumption however is only valid if there is no correlation between the change in performance of the economy as a whole (measured in terms of GNP, e.g.) and the net benefits of the project concerned.

Given the deficiencies of these two arguments, the author claims that a downward adjustment of the social rate of discount at the cost side of the project - at least in case of high risks of public projects - is defendable.

In this context however, Baumol (1968) has claimed that for society as a whole the pooling argument is still valid (both for private and public investments), provided the expected net benefits and risks of individual projects are taken into account in order to preclude an

inacceptable low level of anticipated performance of these projects. Therefore, in general, uncertainty and risk do not provide sufficient arguments for a discrepancy between the public and private social rate of discount. However, as it is common in the private sector to include a risk premium discount rate, there is a danger of an artificial - and hence inefficient - reallocation of investments towards the public sector. In such cases, a risk premium may also be included in the social rate of return. In general, there is no reason to assume a difference in risks between public and private projects.

Next, Lind (1982) has argued - on the basis of a partial equilibrium approach - that it is necessary to use a flexible social rate of discount for public projects which is dependent on the specific risks and the way of financing the projects concerned. He uses the concept of a social rate of time preference in the context of an optimal growth model for investments and related market portfolios. The project-specific, social rate of time preference equals in his specific approach to energy projects the profitability of assets with a risk factor comparable to that of energy projects.

> "On the basis of data on after-tax rates of return, we have taken 4.6 percent to be the approximate risk-adjusted real rate of time preference that should apply to projects with the same risk as the market portfolio. Unless a strong argument can be made that the benefits and costs of a public investment or policy will not be highly correlated with the returns to the market portfolio, this should be the discount rate applied to the benefits and costs. On the basis of data on rates of return on Treasury bills, we assume 1 percent is the real rate of time preference on safe investments and that 2 percent is the real rate of time preference associated with a long-term asset such as long-term government bonds, for which the primary risk is the level of interest rates. This last point is important considering energy policy and investments. If the pay-off to energy projects were uncorrelated with the return to the market portfolio, 2 percent would be the appropriate rate for discounting the net benefits of energy investments because such investments would be riskless except for the risk of interest rate changes."(p. 89)

Related arguments can be found in Bailey and Jensen (1972) who also advocate an adjustment of discount rates for risks, on the basis of marginal capital costs (given the fact that the achievements of public investments follow - analogous to the private sector - a business cycle).

Thus the conclusion is that a flexible social rate of discount may be justified on the basis of risks incurred in public investments, provided at least there is no official risk compensation in the private sector and provided there is a link between the future variability in the performance of the economy as a whole and that of the project in particular.

4. The Financial Crowding-out Motive

The way in which a public project is financed and the extent to which this has an impact on the allocation of investment funds may provide another motive for advocating the possibility of a flexible discount rate. In particular, the crowding-out effect has to be mentioned in this context: if the social rate of discount is not running parallel to the market rate of discount, there is a danger that public projects are implemented that have a lower profitability than (non-implemented) projects in the private sector (see Baumol, 1975, and Bradford, 1975). Such a misallocation of resources is detrimental to private capital formation or consumption. In order to restore the balance, it would be necessary to have precise insight into the financial sources of these public investments and into the degree to which private capital, consumption and idle balances are affected by crowding-out effects of a specific project.

In this context, Lind (1982) has proposed to assess the shadow price of capital, through which costs and benefits of a public investment projects are transformed into private consumption equivalents. He states:

> "By using the concept of the shadow price of capital we can separate the issues of social rate of time preference and the opportunity cost of capital displacement for all public expenditure programs, not just public investments. These costs are likely to be much less significant for public investments that stimulate future private investment than for public consumption expenditures that displace private investment but do not stimulate any investment." (p. 55)

It has to be mentioned in this context that also the re-investment fraction of the net benefits of the project concerned are important for assessing the shadow price of capital: more re-investments would imply a higher shadow price of capital. This element is of course also relevant in the context of a multi-generational evaluation of public projects, as in this case it has to be judged whether current decisions open more possibilities for re-investments by future generations. In the view of Lind the value of the abovementioned shadow price is determined by 4 factors: the social rate of time preference, the marginal profitability of investments in the private sector, the marginal savings rate, and the time horizon of the private investments affected by the crowding effects.

In conclusion, the financial crowding-out effect provides a valid motive for a flexible social rate of discount. The 'shadow price' approach is in this context a plausible way of taking into consideration the specific consequences of a certain public project.

5. The Externalities and Intangibles Motive

In conventional cost-benefit analyses it is often usual to exclude social costs and benefits emanating from externalities or intangibles. Especially the intangible effects which are not measurable in conventional economic terms have to be mentioned here, particularly because they may have a significant influence on the future welfare position of society. In case of intangible social costs, it is often argued that a downward adjustment of the social rate of discount is necessary in order to impose a more strict filtering condition for such public projects (cf. Haveman, 1977). However, in case of irreversible effects it is according to Baumol (1968) preferable to use a selective subsidy policy instead of a downward adjustment of the social rate of discount.

Fisher and Krutilla (1975) argue that the environmental opportunity costs of a project, which involves the irreversible conversion of (some part of) a unique natural environment (for example, a dam for hydroelectric power or open-pit mining), should be calculated using a rate of discount lowered to reflect a shift in tastes over time in favour of the environment (induced by rising income and education levels). The benefits of the project on the other hand should be discounted with a rate that is marked up so as to reflect the annual project-related benefits' depreciation. The latter is caused by technological progress which will expand capacity to produce ordinary goods and services (but not environments) and thus reduce the relative value of these goods and services.

It should be noted that alternative procedures have been proposed in the literature. For instance, Lind (1982) shows that it is possible to transform environmental effects - analogous to crowding-out effects - by means of a shadow price for available income into consumption equivalents. Another possibility to take into account intangible effects has been proposed by Schulze et al. (1981), who points out the analogy between the extra payments for dangerous work on the labour market and the necessary compensation for environmental risks in case of public investment projects (see also Thaler and Rosen, 1976). The authors make a clear distinction between voluntary and compensated risks on the one hand and involuntary and uncompensated risks on the other hand. However, it is worth mentioning that these authors pay little attention to the uncertainty regarding the financial evaluation of social costs (and benefits) for future generations.

In this context, the option value theory may be important, as then it may be possible to assess the monetary value of the aggregate consumer surplus, which is attached by future generations to this value (see Haveman, 1977, and Nash, 1973). Especially in case of irreversible effects this may be a relevant approach. This may ulti-

mately also lead to a change in the social rate of discount, as this is closely related to risk-avert behaviour (see also section 3). It is worthwhile to quote Haveman (1977) here:

> "All of these adjustments can be translated into a reduction (or increase) in the discount rate used to estimate the present values of future damages (benefits) and, hence, an increase (decrease) in the social evaluation of these effects from the ones indicated by their expected value... Many of the major technological developments - for example, nuclear power - appear to carry with them irreversible negative effects, often having the character of a public good. Assuming that individuals are risk-averse... The cumulative adjustment for uncertainty in these cases implies a need for substantial caution in appraising requests for the commitment of additional social resources to these activities." (pp. 372-373)

Similar arguments can be found in Pearce (1977, 1983).

In case of exhaustible resources, it has been argued (see Dasgupta and Heal, 1974) that it is important to include also a probability factor for finding suitable substitutes for the resource concerned; this factor is of course determined by technological progress. Furthermore, Myers (1977) has argued that in case of exhaustible living resources a very low social rate of discount (e.g., 1 percent) may be desirable in order to prevent an extinction of certain species.

In conclusion, the externalities and intangibles motive may lead to a valid argument for adjusting the social rate of discount for public investments, either via shadow prices or via option values. Irreversibility and replenishability appear to be of decisive relevance in this respect. Clearly, it has to be admitted that also a direct adjustment of costs and benefits for such intangibles (instead of an indirect adjustment via the discount rate) may still be a useful option.

6. A Systematic Review of Arguments in Favour of a Flexible Social Rate of Discount

Having discussed now in sections 2-5 four major motives for using a flexible discount rate, we will in the present section provide a representative overview of authors who have discussed in the past the various arguments pro and contra a flexible social rate of discount for public investment planning. For the ease of presentation we will use a systematic survey table, which gives a listing of the abovementioned four motives, as well as a listing of successive authors. It has to be added that this table is mainly indicative: absolute judgements or statements are hard to draw from the wide variety of contributions in the literature. But an attempt has been made to present each author's position more precisely by making a distinction between the following aspects of an affirmative argument supporting the use of a flexible social rate of discount:

(i) the judgement of public projects should explicitly take into account the effects associated with (at least one of) the four abovementioned motives for using a flexible discount rate.

(ii) the judgement of a public project may be based explicitly on a social rate of discount that may vary among different projects.

(iii) the use of a flexible social rate of discount for judging a public project as a whole may implicitly be defended in the light of the intention or way of reasoning of the author concerned.

(iv) the judgement of a public project may explicitly be based on a social rate of discount that varies among the components or aspects of a particular project.

(v) the use of a flexible social rate of discount which varies among the components or aspects of a project may implicitly be defended in the light of the arguments used by the author concerned.

Table 1 gives a comprehensive overview of our literature search, based on 24 authors.

It is interesting to observe that problems of intergenerational equity receive much attention in the literature. The remaining motives receive less attention, although the frequency of occurrence of these motives is more or less equal. The final conclusion from our previous analysis is rather straightforward. Economists have provided a wealth of arguments that justify the use of a flexible social rate of discount, based on four classes of motives. Our typological approach does not lead to the normative conclusion that flexible social rates of discount are by definition necessary, but to the more modest conclusion that - in a particular context with a particular project and particular impacts - the use of a flexible social rate of discount is plausible, as it may be defended on economic grounds.

author	brief characterization	motive: intergenerational equity	motive: risk and uncertainty	motive: financial crowding-out	motive: externalities and intangibles
Baumol (1968)	risk mark-up is needed in private and public sector, if no risk subsidy does exist in order to prevent crowding-out.		(i) (ii) (v)	(i)	(i)
Bradford (1975)	social rate of discount should be based on social rate of time preference and use a shadow price for capital equal to 1			(i)	
Dasgupta and Heal (1974)	for exhaustible and non-replenishable resources a variable term has to be included in the social rate of discount that reflects the probability of finding a substitute	(i)	(i) (ii) (v)		
Fisher and Krutilla (1975)	mark-up for technological progress when discounting the benefits of project-related services; lower the rate of discount to account for a shift in tastes in favour of the environment when discounting the environmental opportunity costs of a project	(i) (ii) (v)		(i) (ii) (v)	
Fisher (1981)	create option value if new information is forthcoming on the benefits of a project, which involves the irreversible conversion of a unique natural environment, and on those of the preservation alternative	(i) (ii) (v)	(i) (ii) (v)	(i) (ii) (v)	

author	brief characterization	motive: intergenerational equity	risk and uncertainty	financial crowding-out	externalities and intangibles
Freeman (1977)	intergenerational distribution problems have to be separated from the social rate of discount problem	(i)			
Haveman (1977)	it is necessary to create option values in case of irreversibilities; the social rate of discount has to be adjusted if the risk of a public project rests with the private sector, or if there is a relationship between the variability of the performance of the project concerned and that of the whole economy	(i)	(i) (ii) (v)	(i)	(i) (ii) (v)
Kirsch (1984)	no emphasis has to be placed on the intragenerational conflict on the intergenerational distribution and the related assurance problems	(i)			
Klaassen and Iwema (1981)	the level of generational preference rate depends on intangible elements in the project	(i) (ii) (v)			(i) (ii) (v)
Lind (1982)	the social rate of discount may be adjusted for risk, the financing aspects, and intangibles	(i)	(i) (ii) (v)	(i) (ii) (v)	(i)
Marglin (1963)	the reinvestment fraction, the private opportunity costs and the social rate of time preference are of decisive importance	(i)		(i) (ii) (v)	

author	brief characterization	motive: intergenerational equity	risk and uncertainty	financial crowding-out	externalities and intangibles
Mendelsohn (1981)	the reinvestment fraction, the private opportunity costs and the social rate of time preference are of decisive importance			(i) (ii) (v)	
Mishan (1977)	intergenerational distribution problems are essentially socio-ethical problems	(i)			
Mueller (1974)	the social rate of discount may be based on a Harsanyi intergenerational equity viewpoint	(i)		(i)	
Myers (1977)	there are two social rates of discount, i.e. a low one in case of exhaustible living resources and a higher one (based on the social opportunity cost rate) in other cases	(i) (iii) (v)	(i) (iii) (v)		(i) (iii) (v)
Nash (1973)	opportunity costs arguments provide a robustness motive in case of long-term or irreversible effects for future generations	(i) (ii) (v)	(i)	(i) (ii) (v)	(i)
Page (1977)	discount rate serves as intergenerational efficiency criterion; intergenerational equity may be based on simple rules of thumb	(i)		(i)	
Pearce (1983)	long-term detrimental effects require essentially ethical criteria outside the realm of economics	(i)	(i)		(i)

author	brief characterization	motive: intergenerational equity	motive: risk and uncertainty	motive: financial crowding-out	motive: externalities and intangibles
Pigou (1924)	the government is better informed than individuals and is able to take care of future interests	(i)			
Schulze et al. (1981)	in case of long-term or irreversible effects ethical criteria become of paramount importance	(i)	(i)		(i)
Sen (1967)	the isolation paradox is practically closely associated with the multigenerational problem	(i)			
Sen (1982)	beside a utilitarian and a Rawlsian approach one may adopt a socalled freedom approach	(i)			
Solow (1974)	the social rate of discount can be adjusted for a Rawlsian intergenerational allocation approach	(i)			
Zimmermann (1983)	the deficiency of the market rate of interest leads to the necessity to use alternative values for the social rate of discount	(i) (ii) (v)	(i) (ii) (v)	(i) (ii) (v)	(i) (ii) (v)

Table 1. A Review of Arguments in Favour of a Flexible Social Rate of Discount

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