



DISCOUNTING THE CLIMATE FUTURE

By: Saumya Malhotra

*Social Discount Rate for India's
Climate Policy*

Key Points

- Public investment and policy intervention need to be scaled up to effectively deal with economic externalities like climate change. Factors such as inter-generational impact of climate change and environmental degradation require due consideration while formulating and evaluating development policies and projects. This needs to be looked at from an economic viewpoint, where the costs and benefits of a climate policy are assessed from an inter-temporal perspective.
- Social cost-benefit analysis (CBA) can be developed as an evaluation and appraisal tool for socio-economic analysis of the decision-making process. From an inter-generational perspective, discounting forms an important part of this CBA, which can be developed as social discount rate (SDR). Applying an efficient SDR for public policies and projects is important as it shows the risk-adjusted opportunity cost, competitive advantage of the project/ policy being chosen, and the perceived marginal social opportunity cost of the resources being used.
- There is lack of consensus on the methodology used for development of discount rates. However, in the Indian scenario, the major gap occurs in the form of lack of adoption and use of SDR. More stringent policies are required to be put in place that allow as well as ensure SDR to be used as a tool for policy evaluation.
- Another major gap recognized in Indian settings is the use of market interest rates, as a substitute for SDR, for evaluating public projects. However, an economy with imperfect capital market needs to have the SDR different from market interest rate, economic rate of return (ERR), internal rate of return (IRR) or financial rate of return (FRR), because the uncertainty and risk associated with climate change and uncertainty around the economic growth needs to be reflected in discount rate.
- The SDR should be developed as such that allows for a holistic analysis of the intervention, and hence from a public project and policy perspective, a range of constant SDRs should be developed in the context of Indian climate. This would not only ensure standardization of project appraisal throughout the country, but would be a significant factor in the integrating the requirements of in the different sectors and projects into the larger national level targets.
- Ensuring the use of SDR for public projects, especially those directly linked with climate action, should be the first step in the Indian policy landscape, which should consequently be followed by a discussion on the theoretical basis of choosing an efficient SDR.

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Abbreviations

Business as usual	BAU
Cost-benefit analysis	CBA
Environmental Kutnez Curve	EKC
Economic rate of return	ERR
Financial discount rate	FDR
Financial rate of return	FRR
Greenhouse gas	GHG
Internal rate of return	IRR
Social discount rate	SDR
Social opportunity cost of capital	SOC
Social rate of time preference	S RTP

INTRODUCTION



SOCIAL DISCOUNT RATE: THEORETICAL FOUNDATIONS



Climate change, from an economic perspective, can be understood as a market failure. The associated risks with this changing climate, as well as impacts on socio-economic systems in form of health, livelihood, food and water security, are projected to be higher with increasing global warming. Further, these effects are also expected to be felt in a non-linear way, with these risks being disproportionately distributed among vulnerable populations (IPCC, 2018). More systematic risk management solutions are required to address these physical climate risks, and there is a need to accelerate adaptation and decarbonization, especially from the regulatory perspective.

Climate change, from an economic perspective, can be understood as a market failure. The associated risks with this changing climate, as well as impacts on socio-economic systems in form of health, livelihood, food and water security, are projected to be higher with increasing global warming. Further, these effects are also expected to be felt in a non-linear way, with these risks being disproportionately distributed among vulnerable populations (IPCC, 2018). More systematic risk management solutions are required to address these physical

climate risks, and there is a need to accelerate adaptation and decarbonization, especially from the regulatory perspective.

Climate change being a market failure, requires large-scale economic intervention, which may allow shifting from high economic, carbon-intensive activities to a low-carbon economy. Even though government intervention and policies towards climate change mitigation and adaptation have been increasing, there still exists a gap in completely addressing these issues (Helm, 2010).

Lack of resources, or lack of technology to access the available resources efficiently, has been seen as an obstacle which prevents developing countries to follow a sustainable path. There is a need for developing countries to follow a less greenhouse gas (GHG)-intensive path, away from the growth trajectories, usually followed by developed countries in Europe or that of US (Clarke, Edmonds, Jacoby, *et al.*, 2007). Public investment has a significant role in enabling the much required shift from this growth trajectory. Scaling up of public investment, especially in low-income countries, is central to the development process.

Government intervention is required to serve public welfare in the right spirits. It is critical to allow the efficient use of resources, ensuring a societal net benefit in the process. This can be done by ensuring that the policy formulation is complemented by a socio-economic welfare dimension. On this governance philosophy, social cost-benefit analysis (CBA) has been developed as a decision-making and an evaluation strategy, through socio-economic analysis (Chua and Choong, 2016). Social CBA looks at the larger perspective of the economy as a whole, based on the foundations of welfare economics, unlike economic CBA which is limited to analysis of the economic effects of the project being evaluated. Social CBA helps internalize the externalities affecting the society at large, valuing the costs it has to the society and further comparing it with the benefits that intervention will provide.

An important part of the CBA process is discounting, i.e. valuing the benefits and costs of the projects, and putting the future costs into net present value terms. In case of social CBA, this can be understood in terms of social discount rate (SDR). The need for a country to develop SDR for project investment and evaluation can be understood in terms of it, allowing an integration of social perspective into this economic analysis. The chosen SDR has both ex-ante and ex-post implications (Zhuang, Liang, Lin, *et al.*, 2007), in terms of whether the project is economically efficient to receive the funding, also taking account of evaluation of its performance. The SDR methodology, when applied during project formulation, communicates the policy decision makers about the value of future costs and benefits of the project development, in present values, especially, the impacts of public projects on the society.

BOX 1: APPROACHES OF SOCIAL DISCOUNT RATE

There has been no consensus on the most appropriate approach on SDR. In essence, the different approaches reflect differing views and results on how public projects affect domestic consumption, private and public investment, and cost of international borrowing. The two basic ways are SOC and SRTP. SOC points out the opportunity cost of the investment made for the specific project, in terms of forgone resources. It shows the trade-off between resources used for the public project versus being developed for private sector consumption. This rate is mostly expected to be larger than borrowing rate within the public sector. SRTP, on the other hand, is developed with the trade-off being time based. Here the future consumption is valued in present terms, to understand and compare present consumption with future consumption. A low SDR through SRTP shows how much a society is forgoing present consumption for future benefits and vice versa.

The weighted average approach has been developed as a neutral approach, where the SDR is proposed to be the weighted average of SOC, SRTP, and cost of foreign borrowing, keeping in mind the proportion of funds invested accordingly (Zhuang Liang, Lin, et al., 2007). Harberger (1972) emphasized on the need to understand the weightage of SRTP and SOC separately for every economic sector. The use of different approaches brings out different aspects of the investments made for the different public projects.

The indecisiveness on the discounting decision of any policy has always been under scrutiny, specifically from a climate change point of view. Policy evaluation in a long-run analysis is significantly impacted by the choice of discount rate, which has always been contested in literature. If the economy was developed as a single-capital market with perfect competition, then the market interest rate would be suffice to equate the marginal productivity of capital with the marginal time preference. However, the existence of an inefficient market requires the true net benefits of a project, plan, or a policy to be valued with a broader perspective, valuing the distribution of cost and benefits, not only over a large timeframe, but also from the perspective of trade off with other available options.

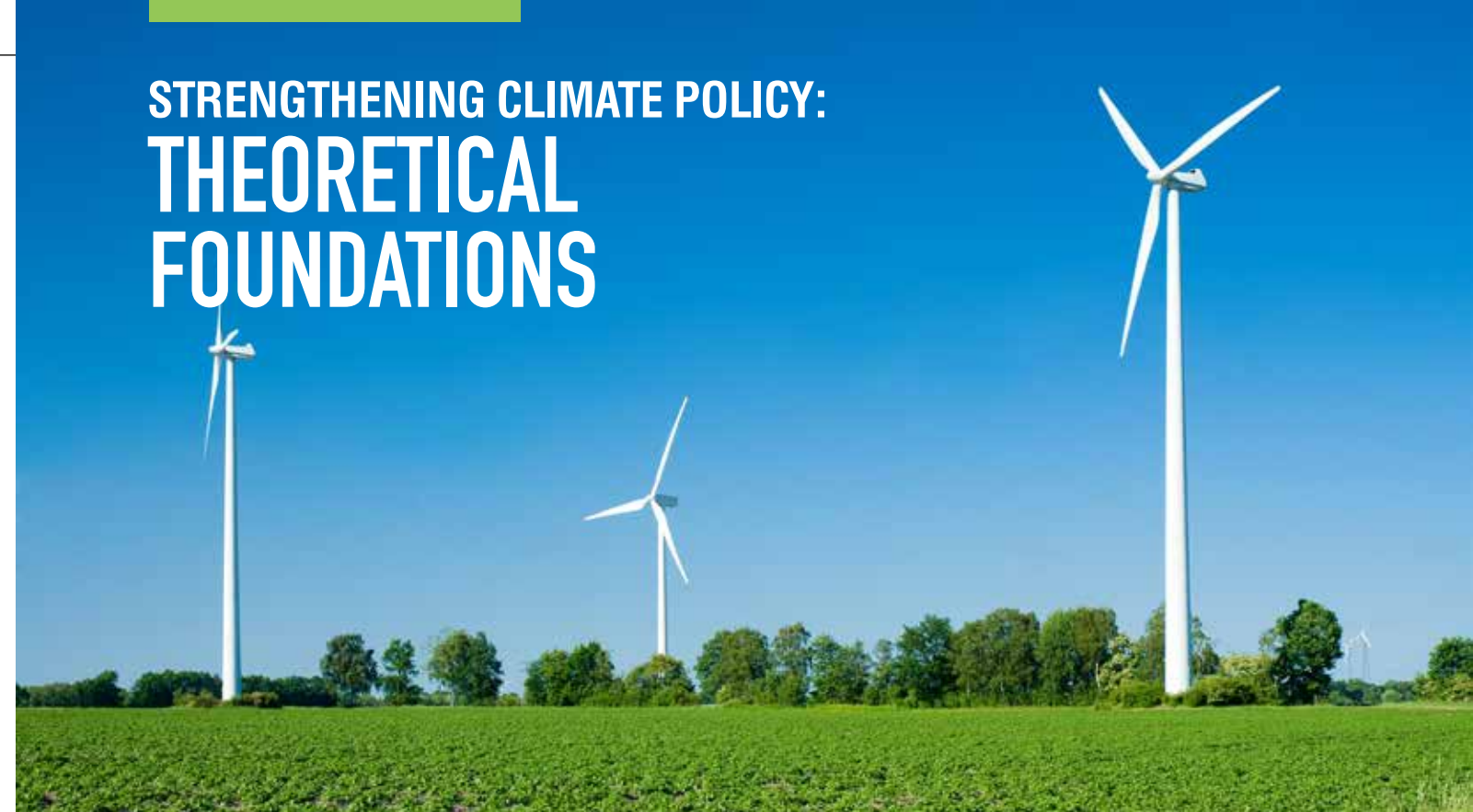
Four methodological approaches have been put forward to understand and evaluate the SDR:

(i) social rate of time preference (SRTP), (ii) social opportunity cost of capital (SOC), (iii) weighted average approach, and (iv) shadow price of capital approach.

The main discussion is, however, on high SDR versus low SDR. The choice of discount rate is subject to intertemporal nature of costs and benefits, and can be seen from the

“hyperbolic discounting” function (Hepburn, 2006). The difference in the choice of a low or high SDR reflects the marginal social cost of public resources. This further highlights the dependence on private consumption versus public consumption, or even current consumption traded off for future consumption, from an inter-generational equity viewpoint. A small discount rate would imply the need for more immediate action to prevent future net damage, not prioritizing the present costs associated with this action. Thus, an aggressive approach can be expected to be adopted to change the climate policy. A high SDR on the other hand, implies valuing the present more, with a ‘ramp-up’ approach towards climate change mitigation, i.e. prioritizing present-day costs over future benefits. Nordhaus (2007) recommended a high discount rate, differing from Stern (2007), who advocated for a small discount rate. Weitzman (1998; 2009) and Gollier (2002) called for a smaller discount rate, even negative, if need be. Presently several papers talk about giving more weight to the future generations, resultantly having a small discount rate (Freeman and Groom, 2016; Arrow, Cropper, Gollier, *et al.*, 2013). A consensus however, on an appropriate discount rate, has not been reached by economists.

STRENGTHENING CLIMATE POLICY: THEORETICAL FOUNDATIONS



Variations in SDR do not reflect only the difference in the theoretical approaches used for the calculation but also the practical opportunity cost of funding the project. On theoretical basis, the SDR can show the risk-adjusted opportunity cost and the competitive advantage of the project/ policy being chosen. Additionally, it represents the perceived marginal social opportunity cost of the resources being used (Campos, Serebeisky, and Suarez-Aleman, 2015). A country's SDR preference is also based on the principles of inter-generational equity, sustainable development, and the regional differences in resource allocation, market distortions, and economic growth (Gürlük, 2016). SDR can be understood as a management/decision-making

instrument. On the contrary, an inefficient choice of SDR can be seen as a potential market failure (Goulder and Parry, 2008).

The difference in choice of SDR can also be seen from the perspective of response of the country to climate change or environmental degradation. Differences between developed and developing economies in their response towards environmental degradation and pollution can be theoretically understood on the basis of Environmental Kuznet Curve (EKC). The EKC, in its most basic form, shows an inverted U-shaped relationship between environmental quality and income. It also, in a way, suggests how rising income in countries can help stimulate policy response to a cleaner environment and better natural resource conservation. Chavas (2004)

BOX 3: FINANCIAL DISCOUNTING VERSUS SOCIAL DISCOUNTING

In general, a high discount rate (8%–15%) has been observed in developing countries, while many developing countries are moving towards low discount rates (3%–7%) (Campos, Serebeisky, and Suarez- Aleman, 2015).

Even though there is difference in the methodology used to get to SDR, many countries promote a single SDR, or a constant sectoral SDR within the country. The importance of accepting a standard approach for project evaluation which involves the use of SDR can be understood from the approach followed by the UK. The HM Treasury of the UK came out with The Green Book, as a guiding tool for policy, project, and programme appraisal. It covers the development of policy and programme, looking at evaluation and appraisal of the project and then recommending standard method to the government. A part of this book is dedicated to the importance of developing an SDR, factoring in intergenerational effects, also keeping an eye on uncertainty and risks associated with project formation (HM Treasury, 2018).

From the European context, the European Commission advocates the SOC approach, from the public return on investments' perspective, however, the Commission strongly recommends SRTTP for standard public projects cost-benefit analysis (Lopez, 2008). Reviews by Percoco and Nijkamp (2006) and Zhuang, Liang, Lin, et al. (2007) found that SRTTP approach is more commonly used and accepted in Europe, with variations coming within countries over different times. Within the US, a constant form of SDR methodology is not accepted, with different approaches being adopted by different government agencies. However, for environmental projects, the Environmental Protection Agency is in favour of the SRTTP approach (Campos, Serebrisky, and Aleman, 2015).

countries, shifting the burden of mitigation on developing countries (Antweiler, Copeland, Taylor, 2001). In such a scenario, climate change needs to be understood as a 'public bad' with transboundary effects, which affects the global scenario equally, however 'public goods' such as availability of natural resources, or economic and technical capability to adapt to changing climate, are not disbursed equally. Scaling-up and sharing technology progress for climate mitigation/adaptation has been developed as a solution in the form of international trade, to cover the gap of inequality of resource allocation between countries, although, the intake capability of

countries cannot be ignored in such situations. Further, technological progress as a solution for all future environmental or climate issues cannot be guaranteed (Kelleher, 2012).

In the light of the above-mentioned facts, it can be unarguably stated that applying an efficient SDR for public policies becomes important for the process of project appraisal. SDR includes many parameters, for instance, development efforts and uncertainty about the future (Pearce, Groom, Hep-burn, *et al.* 2003). The selection of an appropriate SDR hence must also be related to optimal resource distribution.

presents how endogenous dis-counting can be used to understand the underlying economic dynamics in the theoretical foundations of EKC. This represents the transition from a developing economy to a developed economy with the simultaneous movement towards a cleaner environment, and this difference in the discount rates can be used to justify the positive relationship between income and environmental protection in developed countries as compared to developing countries (Di Vita, 2008). Therefore, policy adoption, from an SDR perspective, can be understood as a function of the economic situation of the country. In addition, non-economic variables like political system or cultural values, also play a role in the discount rates (Gürlük, 2016). The different economic structure, coupled with scarcity of resources (or the financial stage of development), and the access of the country

to the international capital market, all form a part of the economic development which directly affects countries' preferences for SDR (Zhuang, Liang, Lin, *et al.*, 2007). Therefore, we cannot expect developed and developing countries to reach the same SDR. However, developing countries should reassess their SDR based on the changing level of their economic circumstances and the international capital market conditions. Similarly, developed countries should cover up for developing countries and also assist in abatement policy technological transfer.

Technological adaptation and foreign trade can be seen as drivers behind the SDR discourse. The productivity in economies of scale, the organizational scenarios of both public and private sectors, can be understood directly related to technological change. Similarly, foreign trade can be seen as a tool of developed

THE INDIAN SCENARIO



India from a climate change perspective requires policy intervention to both mitigate and adapt to climate change. The design of climate policies in the country can be understood from two perspectives, when looking at GHG emissions. On one hand it can be understood from India having the third-largest GHG emissions in the world, however, on the other hand, the per capita emissions are lower than the world average. Additionally, it is still a developing country, with a large population

highly vulnerable to climate extremes. Hence, it is important to understand how climate policy should be developed keeping in mind these scenarios. Climate policy is therefore, aimed to be designed with a development perspective, i.e. establishing climate policy with an equity perspective. This can largely be done by mainstreaming climate policy within the larger gambit of development policies. It is also important to remember that a shift to climate-resilient future comes at a cost. The valuation of

BOX 3: FINANCIAL DISCOUNTING VERSUS SOCIAL DISCOUNTING

Financial discounting considers the opportunity cost of investing, from a project-specific point of view. However, economic analysis/ discounting considers the economic impacts of the given investment on the economy as a whole. In perfectly competitive markets, theoretically, SDR is equal to financial discount rate (FDR). However, in distorted markets, in the presence of externalities, taxes, uncertainty, risk, existence of public goods, etc., economic discount rate is not equal to financial discount rate.

Further, there is understandable difference in economic structure, financial development, capital scarcity, efficiency of political and institutional framework, and accessibility to international capital markets, of different countries. When looking at India itself, there has been a difference in the economic structure and the policy framework over the years, and is expected to grow over the time as India tries to expand its economic growth.

Hence, there is a need to keep in mind all these factors while looking at SDR.

this cost and the valuation of the benefits from the mitigated damages comes into play here. In India therefore, there is a need to understand the efficiency of investment towards a climate change project or policy. SDR in this case will provide a background for decision making.

Project appraisal has always been a significant part for public investment mechanism. Specifically for environmental and infrastructural projects, CBA has been developed as a project appraisal method. The Ganga Action Plan (Markandya and Murty, 2000), project on Delhi Metro (Murty, Dhavala, Ghosh, *et al.*, 2006) and project appraisals by various ministries can be utilized as the basis for evaluating CBA.

In general, for the public policy project, literature has shown that India opts a high discount rate (as compared to developed countries), using the SOC approach (Kula, 2005). The government has however tried issuing basic guidelines on the discount rates that should be adopted for public projects, many of which are based on the use of SRTP as discount rate methodology, with estimation of shadow price of investment (Murty, Panda, and Joe, 2018). However, it is important to update these parameters used for project appraisal, keeping in mind the economic transformation of the country. As per a 2018 report (Study Report: Reassessment of national parameters for project appraisal in India), three different parameters, i.e., the shadow price/discount rate of investment for financial viability analysis, the social rate of discount for economic viability analysis, and the shadow price of foreign exchange rate, were assessed for any government public project appraisal.

Specifically, it looked at SDR to understand the economic viability of a project. SDR in this case is understood using SRTP approach. This report suggested, the discount rate for environmental projects to be lower than normal discount rate (6% instead of 8%). Application of lower discount rate for long-term environment/ climate change mitigation/adaptation-related project also came out as a proposition from the report (Murty, Panda, and Joe, 2018). This study report, sponsored by NITI Aayog, was developed to serve the purpose of guidelines that the government can follow when looking at project appraisal, however, with no legal enforcement.

The discount rate in many cases, however, is understood in terms of financial and economic rate of return (ERR). An economy with imperfect capital markets needs to have an SDR different from its financial interest rate or financial rate of return (FRR). A lower welfare preserving rate, based on a time preferential method, as established by the NITI Aayog's Report, implies a compensation through future welfare benefits.

The evolving consumption rate and the growing uncertainty around the same, should be assessed and incorporated into the discount rate estimation (Murty, Panda, and Joe, 2020). It is also important to separately understand environmental and climate change projects in this respect as externalities to economic growth. Uncertainty about environmental conditions/ climate change, coupled with uncertainty around the economic growth needs to be reflected in discount rate.

DEVELOPING SOCIAL DISCOUNT RATE IN INDIAN SCENARIO



Need to Adopt SDR Mechanism

In India, economic growth is at the centre stage of the development process, while accessing the limited resources, with the underlying current of externalities. Adoption of steps to move towards a more sustainable growth can be understood in terms of firstly, a need for enforcement and implementation of more stringent regulations, standards and targets; and secondly the need of consistency in financial allocation for public projects. These two broad aspects of regulations and financial assistance can be looked at from a project appraisal outlook.

From a welfare economics point of view, public investment has to kept in mind the transparency, and the traceability of utilization of the funds. Though there is no common accepted methodology for public project evaluation, it is important to understand and reach a consensus on the ethical as well as economic method of evaluation. The aim should be of reaching social utility, and application of discount rate aids this process. There is thus a need to integrate SDR mechanism into the general policy evaluation process.

Climate investments are based on the social and financial standing of the sectors being targeted. Hence, there exists a variation in the climate policies being developed for different sectors. This heterogeneity can also be seen in the case of SDR. The discussion however first rises on the lack of adoption of SDR rate, even if it varies between sectors. Many a times, economic rate of return (ERR), internal rate of return (IRR) or financial rate of return (FRR) are used instead of SDR. The objectionable consequence that results when using these terms is—the social aspect of the project/policy gets ignored.

There is a need to understand and assess the business as usual scenario (BAU) versus the scenario generated under project intervention. Project analysis, from the climate change standpoint, however, doesn't necessarily involve the business as usual being constant. Due to the changing climate, there are varying impacts, changing the basic scenario, which also needs to be considered. From a CBA viewpoint, climate change will act as an

BOX 4: THE DIFFERENT DISCOUNT RATES USED

In CBA, net present value or IRR is estimated. The IRR further is estimated from economic (ERR) and financial viewpoints (FRR). The difference between IRR and net present value, both using discount rate, lies in the analytical information derived, based on economic or financial analysis. ERR is the economic efficiency analysis of IRR. ERR represents the expected return received back by consumers, at a society level, in terms of economic benefits on investments of the given project/resources. ERR represents the rate at which costs are equal to the benefits of the invested project.

externality to market transactions/rate as well. Therefore, it is necessary to account for these externalities that affect the market rate from a different rate, like SDR. In climate change policy, for CBA evaluation, choosing a market interest rate (like ERR, IRR or FRR) is not efficient because the market interest rate represents the market equilibrium, the productivity of capital used, and investment made in such a case. This hence, doesn't reflect market failures, in the form of externalities, further not necessarily accounting for the inter-temporal nature of climate policy, or market imperfections and distortions (which becomes even more prevalent because of climate impacts). Hence, there is a need to ensure that SDR is used as the evaluation tool, and not substituted by economic or financial tools that do not cover the larger social perspective of the project/policy being assessed.

Applying SDR for Public Interventions

Another major concern that needs to be addressed is the need to understand the difference between private projects and investments, and public interventions. Unlike private projects, which use financially different discount rate methods, public projects should be developed using SDR as the methodological basis.

Three considerations can be kept in mind when looking at public projects (Pálinkó and Szabó,

2012). Firstly, it is important to understand public projects look at a larger community scale, and from a varied point of view, including environmental and natural resources. This implies public projects cannot be developed under the light of only one dimension, but should be developed from a multi-faceted points of view. Secondly, social utility of the community is directly related to the timeline of the project, and in case of public projects they are usually seen in long run. India's or any developing country's infrastructure public projects, for example, cannot be looked at from the view of short-run impact, but also need to be considered from an inter-temporal point of view, since these are still in the basic form of development. Lastly, public projects should be developed keeping in mind the whole population. Project development should look at the benefits and costs not only to the directly affected community, but also at the damages caused indirectly to other communities, as well as the environment. Here, discount rate can play an important role, as it can be developed from an inter-temporal perspective. With projects and policies with inter-temporal nature, as in the case of climate-related actions, there is a need to economically value these interventions, and account for the future generations. The uptake of SDR hence becomes important when looking at these conditions because, as an appraisal tool, it allows the evaluation of projects, policies or interventions, keeping socio-economic impacts at the centre. Besides, it allows for a holistic analysis of the intervention.

SOCIAL DISCOUNT RATE AS AN EVALUATION TOOL

Valuing Risk and Uncertainty Associated with Climate Change

SDR, specifically from a climate change angle, can be understood from the aspects of uncertainty and risk. The stochastic changes associated with the environment need to be valued. Gollier (2012) especially points out how economic and environmental discount rate differ on the basis of the uncertainty around the valuation of environmental assets over time. Environmental discount rates, dependent on climatic factors, will change over time and country, and even through a sector within a country, depending on, firstly, how the environment is valued, and secondly, on basis of the uncertainty about the improvement/damage of environment. In such a scenario, not only a separate environmental discount rate, but a discount rate lower than an economic discount rate is preferred and promoted because of the implied justification that economic growth rate is higher than

environmental quality growth rate, which is also surrounded by more uncertainty (Murty, Panda, and Joe, 2018). This has been highlighted by Baumgärtner, Klein, Thiel, and Winkler (2015) which compares and discusses the need for separate discount rates for ecosystem analysis and other consumption goods. The distributional effects also should be accounted for when looking at SDR, especially from an inter-temporal inequality perspective, accounting for both intergenerational, as well as intra-generational aspects.

The risks associated with climate change and uncertainty of the consequences could have various economic, political, social and financial implications. There is a need for climate policy to be developed on a risk management basis, with a continuous assessment and evaluation of the same, particularly when looking at public sector intervention (Institute and Faculty

of Actuaries, 2015). Public projects come with the risk premium associated with large-scale investment. Hence, discount rates in general, and specifically SDR for social projects/policies, can be developed as a compensation for the relation between aggregate consumption and expected net benefits (Harrison, 2010). When looking at social discounting, macroeconomics risks, project risks, catastrophic risks also need to be considered (Freeman, Groom, and Spackman, 2018). Macroeconomic risks look at uncertainty about future economic growth, which when corrected with project risks look at it from a welfare perspective. Catastrophic risks can be looked at from an economic point of view (deep recession), or a natural hazard's viewpoint (mortality rate as put forth by Stern, 2007).

Project risk assessment is a necessary step that should be incorporated into the valuation process of any policy. SDR can be used to incorporate project risk as well as growth risk into the policy. A de-clining discount rate has been accepted on theoretical and empirical grounds through the literature provided, as a correct approach especially when looking at long-term projects and from a risk-free outlook (Arrow, Cropper, Gollier, *et al.*, 2013; Gollier and Hammett, 2014; Cropper, Freeman, Groom, *et al.*, 2014).

Choosing the Right Rate

There is also a need to not only adopt SDR as a compulsory tool for project evaluation and appraisal, but also formulate and regulate a country constant or sector constant discount rate. A constant discount rate becomes important because of the sense of partiality that can be recognized when looking at discounting public projects/ interventions. Specifically,

political bias may result in a skewed assessment of projects, where costs and benefits are looked at only in the short-run, and not from an inter-generational perspective, which is significantly important in climate change-related projects/ regulations (Moore, Boardman, Vining, *et al.*, 2004).

Developing a constant discount rate may face difficulty of heterogeneity in the projects with respect to the sectors, geographical location, social or economic outcome being covered. Hence, sensitivity analysis can be developed to determine how the input variables in form of costs, benefits or discount rates can be designed to get to the optimum point of analysis under uncertainty. However, it is important to keep in mind that inconsistency of SDR results in inconsistency of CBA and hence an inconsistency in project appraisal and evaluation in an economy may occur. Frank and Sunstein (2001) mentioned the reduction of legitimacy of CBA due to lack of consistent SDR. A range of a constant SDR should be developed to ensure a homogeneity in project appraisal in the same economy, but also to factor in the different aspects of different sectors and projects.

It is also necessary to keep in mind the ethical perspective when choosing the discount rate. It can be based on perspective laid out by Stern (2007), where the consumption discount rate should not be based on expected market interest rate. Nordhaus (2007), however, on the other end of the spectrum advocated for the discount rate to be based on the behaviour of the market interest rate. With the basic assumption that rate of return on investment is positive, many a times, SDRs are also taken to be positive (Dasgupta, Male, and Barrett, 2000). However, it is important to understand the changing consumption and production patterns, especially due to the presence of externalities like climate change. This can

imply a zero or even negative rate of return of investment. Hence, it is necessary to understand climate change as a market externality and put this into consideration the risk and un-certainty associated with it during project/policy appraisal. As climate change projects rise, and if discounting these projects becomes a necessity, then the idea of declining discount rate can also

be developed. Most economists prefer a low SDR, however they point out that in climate change sce-nario CBA, and further discounting do not always play a significant role. This again comes back to the uncertainty associated with the consequences of climate change, which can nullify the result of discount rate (Dietz and Matei, 2016; Weitzman, 2009).

CONCLUSION

Discount rates play an important role when looking at regulatory cost-benefit analysis. The regula-tions directly affect consumption (e.g. policies affecting consumer prices), or alter the funds being invested (e.g. opportunity cost of funds being used for the public project/policy rather than for private investment) (Council of Economic Advisors, 2017). Hence, there is a need to understand how proper and constant SDR can be developed, especially when looking at long-run projects, dependent on uncertain events of climate change. The discount rate chosen has a direct consequence on the public policy implementation.

Discount rate has mostly been seen in the form of lack of consensus on the use of the method. At a global level, there is also a debate on low SDR versus high SDR, where the rate is influenced by a time consideration. The preference of short-time costs and benefits over long-term costs and benefits, can be used to understand the adoption of a high SDR, or vice versa. This difference is especially significant when comparing the rates used between developed and developing economies, where many developed countries have started to move towards lower discount

rates, for project appraisal. With the changing economic scenario of countries, as well as the need to ramp-up climate action, developing countries, like India, need to re-assess the chosen SDR for different policies and projects.

In India, however, there is still a lack of the adoption and use of SDR. This hence should be the first step, i.e. ensuring the use of CBA and SDR when evaluating the climate polices and project devel-oped, especially in the public sector. More stringent policies are need to be developed that allow SDR to be used as a tool for policy evaluation. Further, with varying polices in the country, based on different sectors, there is a need to decide on a constant SDR at least at every sectoral level. A well-defined SDR may allow climate policies and projects to be evaluated and consequently enforced with a larger outreach, from even a social perspective.

Ensuring the use of SDR for public projects, especially the ones directly linked to climate action, should be the first step in the Indian policy landscape, which should consequently be followed by a discussion on the rate that can be chosen, i.e., a small SDR or a high SDR.

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