Working Paper 2024 – 2

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July 2024

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Ideal Social Discount Rate (SDR) for Public Sector Projects in India – An Assessment

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Summary

Public sector projects are generally funded by either tax resources or borrowings. Household savings help in meeting the borrowing requirements of both the government and the private corporate sector. Hence, before undertaking any public sector project, it may be prudent to have an assessment of the ideal social discount rate (SDR) by estimating the social time preference rate (STPR) – representing the interest rate at which households may sacrifice current consumption to save, and the social opportunity cost (SOC) of deploying resources in a public project – in terms of the rate of return that could be generated if the resources are deployed instead in the private sector. Following the standard methodologies employed in related literature, this paper estimates India's STPR at 4.5 per cent (in real terms). Estimated SOC using market nominal interest rates (average for 2023-24) deflated by CPI inflation works out to 4.04 per cent (for real weighted average interest rate on fresh rupee loans) and 1.84 per cent (for real weighted average G-sec yields). An average of STPR and SOC yields a real rate of 3.72 per cent. To avoid any potential risk of resource misallocation, the minimum real SDR may be set at 3.72 per cent for public sector projects. This is needed to achieve the goal of India becoming an advanced economy by 2047 through, *inter alia*, efficient allocation of resources to productive sectors of the economy and required mobilisation of domestic financial resources.

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Introduction

For India to become an advanced economy by 2047, productivity-led sustained high growth would require strategic planning of ways to mobilise adequate financial resources, both domestic and foreign, and their proper allocation to productive sectors. The decline in saving and investment rate in the country in the post Global Financial Crisis (GFC) period, and relatively low total factor productivity (TFP) growth (as per India KLEMS data) highlight the importance of both resource mobilisation and their productive deployment for achieving sustained high growth in future. Emphasizing that technology and efficiency of resource allocation are the two key drivers of productivity, Mohammad *et al.* (2021) found the magnitude of misallocation of resources across sectors and states in India's formal manufacturing sector to be sizable. On the potential of efficient resource allocation as a driver of higher TFP growth, past empirical estimates for India could provide useful insights. A Gross Value Added (GVA) growth accounting decomposition suggests that resource reallocation effects contributed to 8 per cent of GVA growth in India during 2011 to 2019, and reallocation of resources from low to high productive sectors accounted for 63 per cent of aggregate productivity growth during 2001-2019 (Sengupta and Chattopadhyay, 2023). Significant cost and time overrun in large public sector infrastructure projects (as could be seen from the regularly updated related data released by the Ministry of Statistics and Programme Implementation (MOSPI)) appears to have also lowered the social return on investment compared with the expected return assumed at the time of planning and launch of such projects.

Fiscal policy – through its focus on fiscal consolidation, thrust on capex, and incentives provided to states for more capex – is already driving the needed strategic shift through improved resource allocation and the intent to check potential crowding-out risks. Finance Commission recommendations have also progressively linked tax devolution to reforms undertaken by states, such as fiscal discipline and tax efforts.

Regulatory policies, such as the priority sector lending (PSL) norms support market-based pricing of priority sector loans in a deregulated interest rate regime (unless subsidised by the Government through interest rate subventions), and macro-prudential policies also aim at incentivising flow of resources to productive sectors of the economy while preserving financial stability.

A similar strategic focus is required in every public sector undertaking engaged in the activity of resource mobilisation and/or resource deployment in India. One of the essential prerequisites for planning business expansion strategies by such entities would be greater general awareness about the need to use appropriate social discount rates (SDRs) in their project evaluation exercises.

Avoiding misallocation of resources is the prime objective behind use of appropriate SDRs in public sector projects. Too low discount rates may lead to excess public investment, which may unintentionally hinder achieving the goal of welfare maximisation, by discouraging savings and crowding-out private investment. Too high discount rates, in turn, may erroneously make much of public investment look economically unviable, leading to under investment. It is important, therefore, to estimate SDRs periodically, notwithstanding limitations in estimating an ideal SDR for any country because of persisting academic differences on the right methodology, needed adjustments to any estimate before actual adoption in project evaluation and investment decisions, and the challenge of pursuing social development goals (SDGs) despite resource constraints.

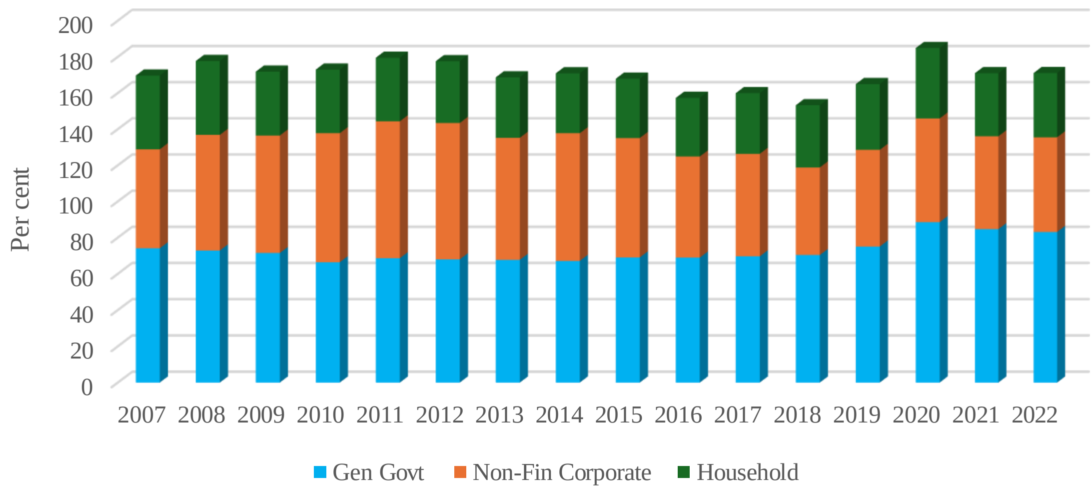
Against this backdrop, the emerging structural issues on resource availability in India are discussed in brief in Section II of this paper, even though the aim of the paper is to estimate SDR for India as a convenient benchmark for resource allocation, rather than to recommend ways to generate more resources for growth. In Section III, a review of the literature is presented along with the range of SDR estimates for other countries. This section also covers a review of limited available research relating to SDR for India. The methodology for estimating STPR for India is set out in Section IV. Empirical results are presented and analysed in Section V. Section VI concludes the paper.

II. The Challenge of Resource Reallocation for Growth in India

In terms of the basic national income identity, and past trends in resource generation and resource use pattern as observed in the Indian economy, the following broad structural aspects may have to be kept in perspective while estimating an ideal SDR for India: (a) net household financial savings and sustainable current account deficit (or net capital flows that get absorbed gainfully for investment and growth) together determine the total resource availability in a year, to meet the financing needs of the two deficit sectors – the government and the non-financial corporate sector. If demand for resources exceeds supply, either primary liquidity created by the RBI could help meet the shortfall (in which case it may be inflationary), and if the excess demand for funds is not accommodated by the monetary authority, increase in interest rates will reflect the impact of the demand-supply mismatch; (b) As regards demand from the two deficit sectors, when private investment demand is sluggish, a larger public sector deficit may not pose any crowding-out risks. Empirical research for India shows that public investment can both crowd-out and crowd-in private investment, depending on the state of the business cycle and pro-growth reforms that may coincide (or otherwise) with a phase of step up in public investment (Bahal *et al*, 2015; RBI, 2022). Thus, conditional on the state of the business cycle, financial cycle and corporate leverage/deleverage cycle, the social opportunity cost (SOC) of a public sector project derived from market interest rates could be time varying; and (c) Net household savings, which is the major component of the resource pool available in a year for funding the public and the private sector resource gaps, can increase with higher disposable income, and in response to changes in intertemporal preferences of households, *i.e*., to save for retirement, or even precautionary savings to deal with unanticipated short-term shocks to income flows and employment. Disposable income (*i.e.*, income net of direct taxes paid) is a key determinant of household savings in India (Athukorala, 1998), and other factors such as dependency ratio, interest rate, and inflation also influence household savings (Samantaray and Patra, 2014). In OECD countries, it was found that taxes tend to lower household savings, with income tax having a stronger negative impact than consumption taxes (Tanzi, 1998). In India, there is another challenge, as highlighted by the report of the Household Finance Committee (2017), *i.e*., households hold 84 per cent of their wealth in real estate and durable goods (such as vehicles, livestock and farm and non-farm business equipment), another 11 per cent in gold and only the remaining 5 per cent in financial assets, unlike advanced economies where a major part of household wealth is held in financial assets.

It is pertinent to note that India's overall debt (as per cent of GDP) has remained reasonably stable in the post global financial crisis (GFC) period, though there have been distinct compositional shifts, marked by corporate sector leverage and deleverage cycle, and public sector fiscal expansion and consolidation cycle (Chart 1). This India specific information highlights why assessment of SOC of a public project is important because if the combined increase in leverage of the private corporate and household sector leaves less space from the available resource pool for the public sector, that too at a time when net household savings available for intermediation in the financial system is stagnant or falling, then the SOC of such public projects may be higher.

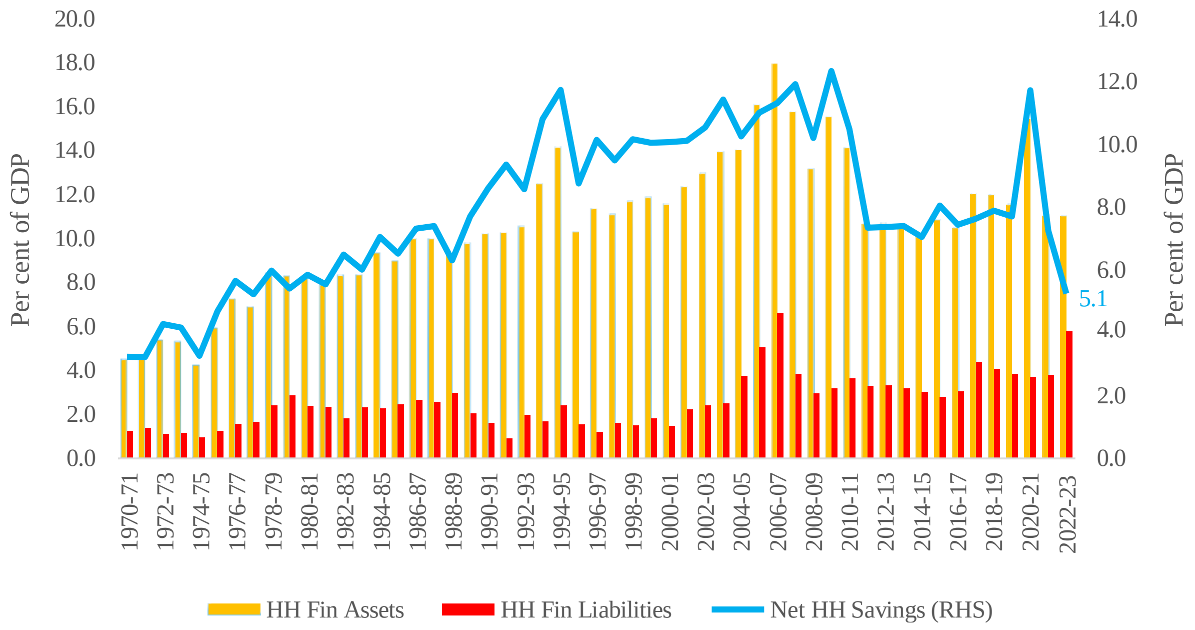
Chart 1: India's Debt as % of GDP



Source: IMF (Global Debt Database)

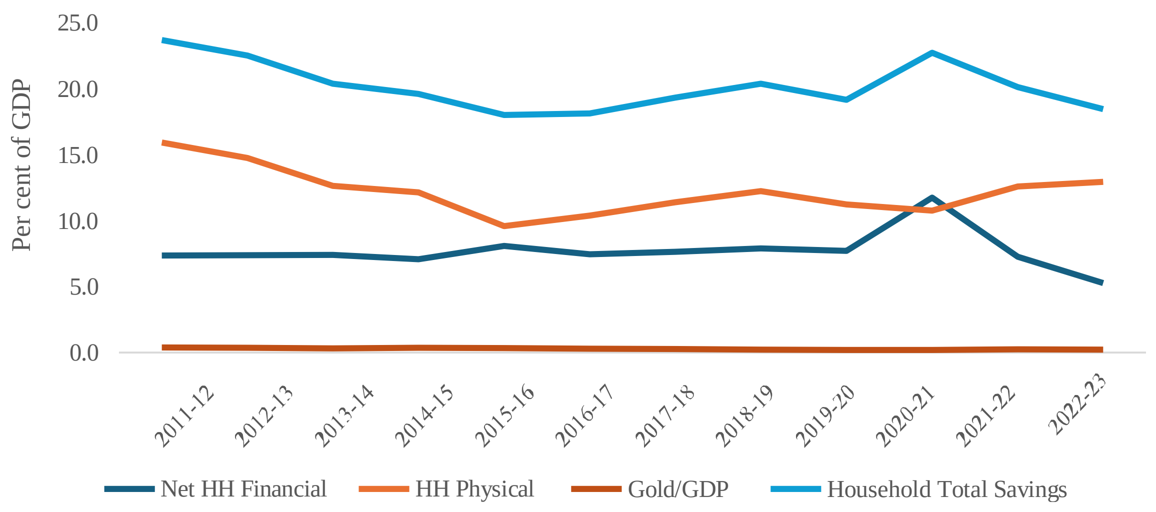
There have also been distinct shifts in household financial savings pattern in the post-COVID period. Gross household financial assets (as per cent of GDP) rose to 15.4 per cent in 2020-21, largely reflecting precautionary build-up of savings to deal with unanticipated (COVID time) possible increase in health expenditure and temporary loss of income, and also reduced opportunity to spend because access to the full basket of monthly consumption items was restricted by COVID waves-induced isolation. While gross financial savings normalised over the next two years (to about 11 per cent of GDP), household liabilities surged to 5.8 per cent of GDP in 2022-23, the highest level since the pre-GFC peak of 6.6 per cent recorded in 2006-07. As a result, net household savings plunged to 5.1 per cent of GDP in 2022-23, the lowest in several decades. (This was also a period of three successive years of negative real interest rate on term deposits, as discussed later in Section V, Table 2. Real interest rates on current and saving deposits were even more negative than that of term deposits.) Low net household financial savings, however, must be seen along with prevailing demand for resources from the private sector during the same period, because an excess saving situation (or saving glut) may arise if demand for investment resources also drops following any contractionary shock, like COVID. It is also important to note that while net financial savings declined in 2022-23, physical savings (in the form of housing) increased, and as a result the decline in overall household savings was relatively moderate (Chart 3).

Chart 2: Financial Savings of Households



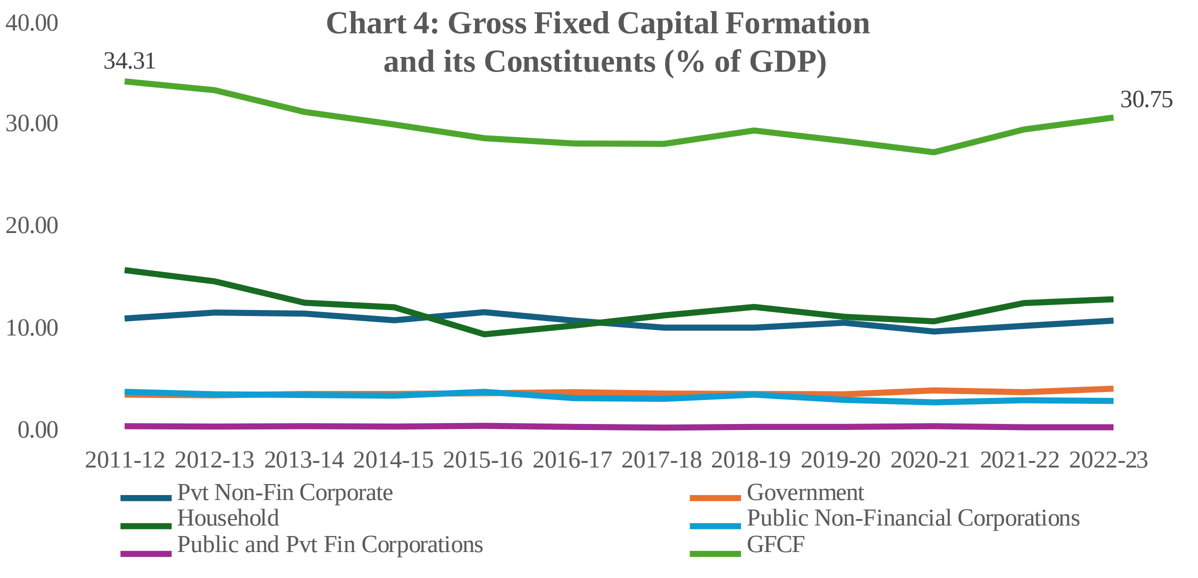
Source: MOSPI and RBI Handbook of Statistics

Chart 3: Composition of Household Savings (% of GDP)

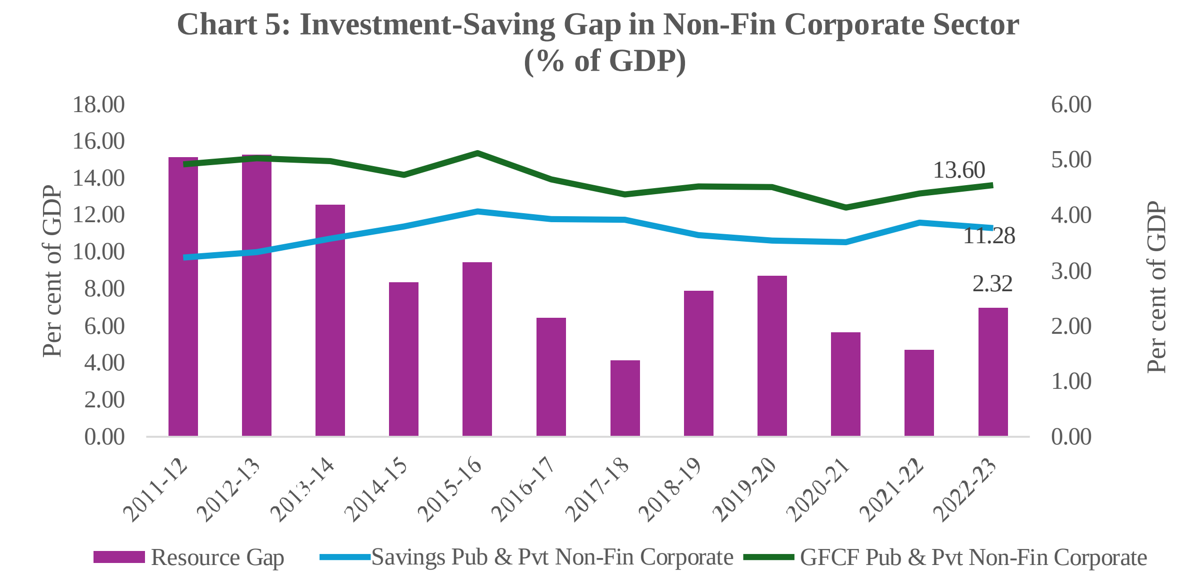


Source: MOSPI and RBI Handbook of Statistics

As regards investment demand for resources, at the aggregate level gross fixed capital formation (GFCF) as per cent of GDP was moderating before COVID in India (Chart 4). Public sector GFCF (government plus public non-financial corporate) has increased thereafter by about one percentage point, when GFCF of the non-financial private corporate sector remained subdued (nearly unchanged as % of GDP). In fact, the resource gap in the non-financial corporate sector (*i.e.*, GFCF of the non-financial corporate sector minus savings of the same sector or own resources) has declined to 2.3 per cent of GDP, from 5 per cent in 2011-12 (Chart 5). As a result, despite moderation in net household savings, the net gap of the general government sector (or consolidated fiscal deficit) did not pose much crowding-out risks. These structural compositional shifts need to be closely assessed (notwithstanding lagged data releases) while deriving SOC from market interest rates.



Source: MOSPI and RBI Handbook of Statistics



Source: MOSPI and RBI Handbook of Statistics

III. A Review of the Literature on SDR Estimates

A cost-benefit analysis of any project invariably requires the use of an appropriate rate of discounting, to convert the expected cash flows (benefits and costs) into net present value (NPV) enabling assessment of whether a project is positive NPV and hence worth undertaking. Social discounting is different from private discounting as the former prioritises social welfare considering the national budget constraint, whereas the latter is guided by the objective of profit, implying that a firm's own weighted average cost of capital (WACC) as the discount factor must ensure that the project has positive NPV (Chua *et al*., 2016). Despite the critical significance of an estimated SDR for evaluating public sector projects, there is no consensus yet among economists on the right approach and the choice of methodology. As a result, three broad approaches are used: STPR, where the decision makers assign importance to the society's time preference; SOC, where the current resource availability and opportunity costs of different avenues for resource deployment are given importance, as such a rate is easy to justify by linking SOC to prevailing market interest rates; and shadow price of capital (SPC), which is a weighted average of STPR and SOC (known commonly as the Harberger approach). When markets are efficient, STPR and SOC should ideally converge. Market rates, however, reflect the impact of multiple frictions and policy interventions (monetary, fiscal, regulatory). Since STPR reflects the society's preference (not an individual's preference), ideally that should set the SDR of a country, provided a reasonable estimate of STPR is available. When an estimated STPR is not available, SOC may be used, notwithstanding the limitations of market rates.

Moore *et al*., (2018) argued against the use of market-based interest rates on the ground that private returns on market investment would not be ideal to measure the opportunity cost of public projects, particularly when market rates are influenced by taxes and transactions costs, information asymmetry, missing markets and monopoly rents. Credit rationing may prevent some households and firms from borrowing. Moreover, some individuals may simultaneously borrow and lend, repay mortgages, save for retirement, and borrow using credit cards, each at a different rate of interest. On the choice of methodology, they suggested that if a public project is funded by tax revenues, that would primarily affect consumption (*i.e*., reduce household consumption rather than private investment), and therefore STPR would be suitable. In turn, if the public project crowds-out private investment – which is likely when the project is debt funded, particularly in a closed economy setting – shadow pricing may be useful. Country practices, according to them, point to increased adoption of STPR, with longer-term projects generally discounted at lower SDRs than shorter-term projects.

At times, particularly when public projects in infrastructure, hospitals and schools require initial lumpy investment whereas benefits accrue later after several years, that may benefit even future generations, an exclusive focus on efficiency of resource use in setting SDR may not be appropriate[2], but in practice, in most cases, a single constant rate is used (Campos *et al*., 2015) – while multilateral and regional development banks use a rate in the range of 10-12 per cent, developed countries typically have lower rates (3-7 per cent) than developing countries (8-15 per cent), and rates have generally been reduced over time.

In most research work on SDRs, it is often not specified whether the estimated rate is in nominal terms or real terms. Harrison (2010), however, clarified that normally a cost-benefit analysis would use all costs and benefits in real or constant dollar terms (and reported examples, such as the UK Treasury using 3.5 per cent real, which is the estimated STPR, that declines to 1 per cent for projects with costs and benefits accruing over more than 300 years; the Stern Report used 1.4 per cent real rate to discount the benefits from greenhouse gas emission abatement policies.) The Council of Economic Advisors Issue Brief (January 2017) also emphasised that discount rates are usually in real terms.

Harrison (2010) suggested that the ideal rate could be some weighted average of an investment (or producer) before-tax rate of return i and the consumption (or consumer) after-tax rate of return r. Given the arguments for and against STPR and SOC, a more practical approach has been to use some average of the two[3]. As succinctly captured by

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[2] In case of carbon emissions projects, benefits may last for centuries but the mitigation costs have to be borne today and in the near future (Arrow *et al*., 2014).

[3] Harberger and Jenkins (2015) used a simple numerical example to explain the weighted average SDR concept. Assuming that the gross-of-tax rate of return on investment in

Burgess and Zerbe (2011) and Spackman (2018), "*The discount rate should be consistent with choosing a project that is more productive over another that is less productive. The rate then must cover the productivity that is forgone as a consequence of displaced investment and the [social costs of] newly induced savings …. Any lower rate than the weighted average represented by the SOC will fail this test. … Any higher rate will forego desirable projects*." For a comprehensive review on cross-country approaches and estimates of SDR, please refer to Gelsomina *et al*. (2022); Groom *et al*. (2022); and Freeman *et al.* (2000) and Chart 6. ADB provides detailed guidelines for economic analysis of projects and its minimum required economic internal rate of return (EIRR)[4] for investment is specified at 9 per cent, while for social sector projects (such as rural roads and rural electrification) and projects that primarily generate environmental benefits (such as pollution control, protection of the ecosystem, flood control, and control of deforestation), the minimum required EIRR can be lower at 6 per cent (Zhuang, 2017)[5]. It is important to also recognise that SDR may change over time for a country, if its key determinants change over time, though usually in a slow-moving pace. For example, in Korea, the real SDR was at 7.5 per cent in 1999, which

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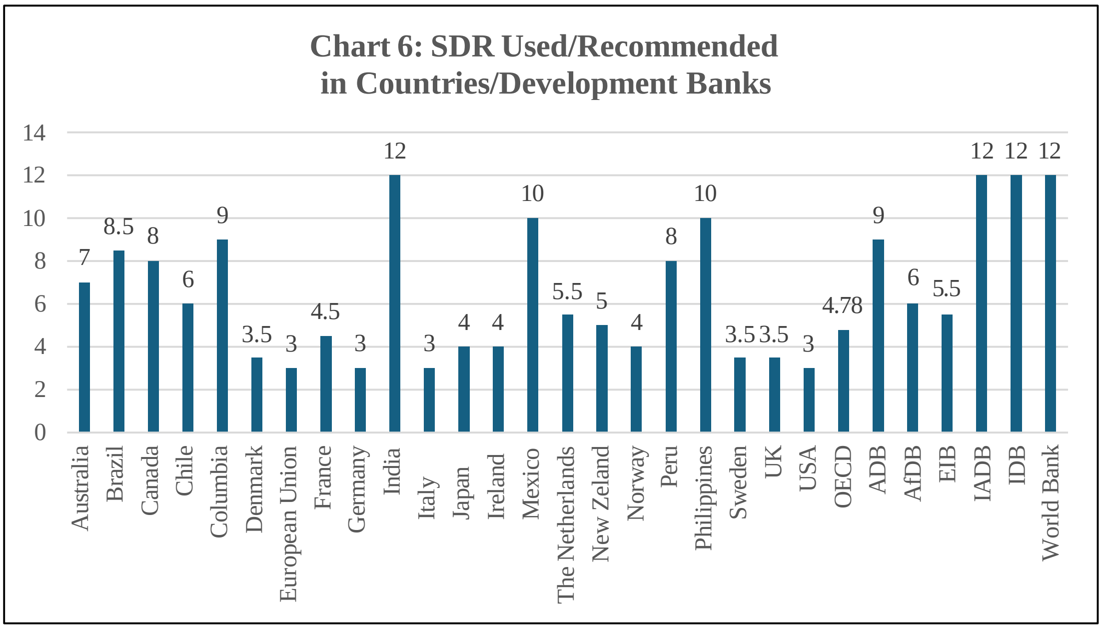
the private sector is 12 percent and the net-of-tax return on savings is 4 percent, if USD 1 million of funds are raised for a project that displaces USD 750,000 of investment and USD 250,000 of consumption, the weighted average cost w = (0.75*12%) + (0.25*4%) = 10 per cent. This would mean that in displacing USD 750,000 of investment, the economy may forego a steady future flow of 90,000 (= 750,000×12%) per year and also incur an annual cost of 10,000 (= 250,000×4%) covering the supply price of new savings to finance the project.

4 For an example on the use of EIRR in project evaluation, please refer to ADB(2023) (https://www.adb.org/sites/default/files/linked-documents/46168-001-efa.pdf) which found the EIRR of a project as 15.5 per cent, and under alternative scenarios, the EIRR remained above 12 per cent.

5 ADB also clarifies the distinction between economic viability analysis and financial evaluation of a project. Financial evaluation helps assess whether the project can generate adequate incremental cash flows to recover its financial costs. Economic analysis, in turn, helps in evaluating the overall impact of a project on the welfare of all the citizens of the country.

was lowered to 6.5 per cent in 2004, and further to 5.5 per cent in 2008 (reflecting lower interest rate and growth in the economy). SDRs invariably remained higher than Korean Treasury yields, both short-term and long-term (Song, 2017). The rationale for SDRs exceeding risk-free rates is the uncertainty about cashflows from new investment projects[6]. It has nevertheless been also argued that the discount rate used in public projects should be lower than in private sectors, and that decreasing discount rate should be used for longer-term projects, such as those aimed at successful green transition and/or benefitting future generations (Greco, 2023).



Source: Gelsomina *et al*. (2022); Groom *et al*. (2022)

Note: OCED (Infra projects) at 4.78%, and 4.64% for transport projects; EIB range of 3.5-5.5 %; World Bank range of 10 -12 %; AfDB range of 6-9 %; US a range of 3 – 7 %, reduced to 2% as per the White House Brief of February 27, 2024 (other countries also use a range for different projects and for different life cycles of projects, and the rates have also changed over time).

For India, Tewari and Pandey (1991) had estimated the STPR at 6.44 per cent, as against then prevailing average real interest rate of (-) 1.6 per cent (over the sample period

6 In India, for example, based on the high growth experience during 2003-07, large scale investment expansion funded by credit was undertaken by the private sector as per inflated cash flow projections, giving rise to the subsequent problem of high NPAs and the twin balance sheet stress. In public sector mega infrastructure projects also, toll collections may at times fall short of cash flow projections over several years.

1960-61 to 1984-85) and concluded that the government may have kept a low rate for undertaking social investment, leading to gross misallocation of resources and sub-optimal levels of social welfare. Murty, Panda and Joe (2020) estimated India's STPR for a later period, at 8.5 per cent (based on data for the recent decade) and 6 per cent (for data over six decades and using the extended Ramsey rule). Murty, Panda and Joe (2018) reported that, since 1994, the norm for social projects in India has been a minimum of 12 per cent "financial and economic rate of return" and recommended that the discount rate for general government projects may be set lower at 8 per cent; for environmental projects at 6 per cent; and at less than 6 per cent for long-term climate change mitigation projects. Kula (2005) found India's SDR at 5.2 per cent. Since STPR must be viewed as equivalent of a real interest rate, wherever nominal rate is used it may also be taking into account implicitly/explicitly (say) the average inflation expected during the life cycle of the project/inflation target[7]. Shukla (1997) had earlier proposed an economic discount rate (EDR) of 10.2 per cent (real) for India. Since the time these estimates were generated for India, structural changes in the economy, in terms of the key drivers of SDR (as specified in Section II), warrant a reassessment, particularly in the context of public sector capex and credit-induced household investment driving the post-COVID revival in investment cycle, and the general expectation of a pick-up in private investment demand going ahead.

IV.: Methodology for Estimating STPR

The following Ramsey workhorse rule is commonly used for estimating STPR:

$$r = \delta + \eta g$$

where r is the social discount rate (SDR), δ is the pure rate of time preference (arises from impatience and the chance of death, or the probability of not living in future to postpone current consumption); g is the average per capita consumption growth rate and η (absolute value) is the elasticity of marginal utility (Groom *et al.*, 2022). From

[7] The White House Issue Brief of Feb 27, 2024 (Valuing the Future) clarifies that SDR is a real concept (*i.e.*, discounting of inflation adjusted cash flows relating to benefits and costs of projects).

the perspective of a representative consumer, the utility discount rate, δ, indicates the weight assigned by him to future utilities *vis-à-vis* today. The probability of death (as could be derived, say from mortality rate as per census data) can reveal the implicit preference/readiness to trade consumption over time. η reflects the sensitivity of a consumer's marginal utility to changes in consumption. Because of decreasing marginal utility from higher levels of consumption, if he expects to become wealthier in future (because of higher values of g), and the more averse he is to consumption inequality across time (*i.e.*, higher the value of η), higher will be the discount rate (or less importance will be assigned to public projects that pay off in the future). A high value of η would mean that consumers are not willing to substitute consumption over time, and therefore large increases in interest rate would be required to get them to save and postpone consumption. Countries with high g and η would naturally find their estimated values of STPR higher.

The Ramsey rule, thus, essentially reflects both a "time effect" and a "wealth effect" – people prefer to receive goods and services now than in future, and the current generation may not be alive to benefit from projects that generate benefits only in the future. Moreover, if in future one is expected to be wealthier (say because of better growth outlook), then the value of Rs. 1 today will be more than that in future (or sacrificing current consumption today will be less likely).

If g is high (with a positive outlook for g), households may borrow now to increase current consumption, and may also save less (as future wealth effect, because of higher g, is expected to enhance access to more consumption). When most consumers borrow more/save less, that should increase interest rates. But in reality, this may not happen if simultaneously the corporate sector deleverages, and fiscal consolidation also continues. Thus, while STPR based assessment would emphasise mobilisation of savings for productive deployment, in a situation of weak investment demand to absorb savings, market interest rates (deflated by inflation) may rule much lower than STPR. It is important to recognise, therefore, that the assessment of time varying risk-free real interest rate or "natural interest rate", using any risk-free market rate of interest for estimation, may be appropriate for guiding the conduct of business cycle stabilisation policies, such as monetary policy (Pattanaik *et al*., 2022). However, STPR estimates, meant for evaluation of long-term public projects, must account for the fact that the investment horizon may encompass several monetary policy cycles, and periods of robust private investment activity and fiscal expansion that would require higher household savings. Accordingly, despite falling estimated values of natural rate of interest globally, the estimated STPR may remain relatively higher, posing a conundrum. The Ramsey rule does not help address this puzzle (*i.e*., why the estimated STPR for a country may exceed on a sustained basis its estimated natural rate of interest[8]).

Based on an assessment of empirical estimates available in the literature, (Harrison, 2010) was of the view that for reasonable parameter values, such as $\delta = 0$ to 2 per cent, $\eta = 1$ to 2, g = 1 to 2 per cent and standard deviation of consumption (σ_c) to capture uncertainty = 1 to 2 per cent, a risk-free SDR could be between 1 to 6 per cent. Cross country experiences reviewed by Gelsomina *et al*. (2022) corroborate similar findings (Table 1). In the next section, these four relevant parameters are estimated using time series data for India.

Two adjustments to STPR are proposed in the literature before using them for discounting public projects, though in practice they are not very common. First, adjusting for risk factors by adding a risk premium. Shepherd (2020) shows how UK's SDR of 3.5 per cent in real terms is derived as ($r = \delta + L + \eta g$), where the corresponding values are 0.5, 1, 1, and 2, and L represents the (additional) risk parameter, representing risk factors that could lower benefits from a project in the future. Using updated relevant parameters (0, 0.2, 1.5 and 1.5), however, it argues that the discount rate may have dropped to 2.45 per cent in the UK. [For a discussion on adjusting SDR (or otherwise) for risk factors, please refer to Spackman (2018)]. A δ of 0 would imply placing equal weight assigned to people's current and future wellbeing, unlike greater attention paid to the current generation with $\delta > 0$ in estimating STPR.

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8 Unlike natural rate, which also uses Ramsey growth framework but a risk-free market interest rate, STPR does not require any market rate for its estimation.

Second, by using an extended Ramsey rule, to account for uncertainty, with variance of consumption ($\sigma_c{}^2$) capturing uncertainty. The STPR then can be derived as $r = \delta + \eta g - (\eta^2 \sigma_c{}^2)/2 = \delta + \eta g - 0.5(\eta^2 \sigma_c{}^2)$. Real interest rate is expected to decline with a rise in risk aversion (or higher precautionary savings) (Harrison, 2010; Moore *et al.*, 2018). Gollier (2002) proposed the extended Ramsey framework, *i.e.*, to add a third term in the STPR rule, just to account for the reality of precautionary savings (to deal with potential sudden adverse shocks to consumption and income, as was experienced globally after COVID) that could lower real interest rates and hence the estimated STPR. High degree of risk aversion (or more precautionary savings) could depress real interest rates.

Table 1: Estimated STPR Parameters Used (Select Countries)

	δ	***g***	**η**	**STPR**
Austria	1.03	0.71	1.48	2.07
Belgium	1.10	0.74	1.68	2.34
Czech Republic	1.21	2.25	1.30	4.13
Denmark	0.94	0.76	1.44	2.04
Finland	1.00	0.88	1.63	2.43
France	0.99	0.52	1.52	1.78
Germany	1.19	0.95	1.33	2.45
Greece	1.22	-0.22	1.69	0.85
Hungary	1.45	2.42	1.00	3.87
Ireland	0.65	3.28	1.95	7.06
Italy	1.25	-0.40	1.81	0.53
Luxembourg	0.73	0.80	1.82	2.19
Netherlands	0.97	0.76	1.98	2.48
Poland	1.26	3.59	1.08	5.13
Portugal	1.20	0.47	1.62	1.97
Slovak Republic	1.08	3.46	1.32	5.65
Slovenia	1.14	1.75	1.23	3.30
Spain	1.04	0.42	1.65	1.74
Sweden	0.95	1.12	1.68	2.82
UK	0.90	0.59	1.65	1.88
Switzerland	0.88	0.78	1.57	2.11
Norway	0.75	0.63	1.47	1.67
Turkey	0.53	3.91	1.33	5.71

Source: Gelsomina *et al.* (2022)

The Frisch formula is often used by relying on an estimated demand equation for food to arrive at the value of η (Groom *et al*., 2022; Evans, 2008; Kula, 1987). The Frisch formula presumes the existence of additive preferences (or strong separability or independence of demand for different consumption items). Thus, if a group of items like food is considered, the extra utility obtained from consuming more units of food would be independent of the quantity consumed of other consumption items. A similar approach is adopted for estimating STPR of India in the next section.

V. Estimated STPR for India

Households borrow and lend at different rates, and no risk-free rate like treasury bill (TB) yield could be representative enough, particularly when households do not save in the form of TBs (CEA, 2017). In India, for example, effective borrowing rates for consumers are higher than risk free rates (and they borrow at different rates from banks, NBFCs, MFIs and money lenders). Hence, no representative market rate may be available to estimate SDR from a consumer's perspective. Moreover, because of CRR, SLR, priority sector norms, monetary policy and liquidity interventions and macro-prudential measures, a market rate may not reflect fully the impact of free market forces. It is important, therefore, to estimate STPR directly for India.

Following the steps used in Kula (1987), STPR parameters are estimated for India, where *g* is real per-capita growth rate of consumption (private final consumption expenditure), η is the elasticity of marginal utility of consumption, and Π is the probability of survival (the same approach is also used by Tewari and Pandey, 1993). η is measured as the ratio of income elasticity (e_i) to compensated price elasticity (e_H).

The compensated price elasticity (e_H) is derived from the uncompensated price elasticity (e_D), with the latter estimated from a food demand equation of the following variant:

$$\text{Log (QF)} = a - e_D \text{ Log (pf/pnf)} + e_i \text{ Log (PFCE/pnf)}$$

where QF is quantity index of food (from national accounts data), pf/pnf is the relative price of food (pf) over non-food (pnf) (as derived from price deflators implicit in national accounts data), and PFCE/pnf is nominal per-capita private final consumption expenditure (PFCE) divided by price of non-food, which is a proxy of real income[9].

Since changes in pf can alter the variable (PFCE/pnf) (*i.e.*, have price induced income effect), after estimating the uncompensated price elasticity (e_D) from this equation, compensated price elasticity (e_H) has to be derived from the following Slutsky condition:

Uncompensated price elasticity (e_D) = compensated price elasticity (e_H) – w*(e_i), where w is the share of food expenditure in total consumption expenditure (both in per capita terms). (For details, please refer to Kula, 1987). For derivation of the steps, please refer to Box 1.

Box 1: Calculation of STPR

If X = Present Consumption

Y = Future Consumption

r = STPR

then the present value of consumption, Z is given by

$$Z = X + \frac{Y}{1+r}$$

and $\Delta Z = \Delta X + \frac{\Delta Y}{1+r} = 0$ (if Z remains constant)

This implies,

9 PFCE is not deflated by GDP deflator (or a price index, like CPI) because in that case the estimated price elasticities from a double-log specification would be neither Marshallian (uncompensated) nor Hicksian (compensated). Whereas by deflating all right-hand side variables pf, pnf and PFCE by only pnf, the needed homogeneity restriction becomes implicit, and the estimated elasticities represent Marshallian elasticities. The elasticity with respect to pnf could then be extracted from the homogeneity restriction that all three coefficients add up to 0. [Please refer to Alston *et al.*, (1993) for a detailed explanation].

$$- \frac{\Delta X}{\Delta Y} = \frac{1}{1+r}$$

$$- \frac{\Delta Y}{\Delta X} = \text{MRS} = 1 + r$$

∴ STPR (r) = MRS – 1

Given the Utility function: $U = \frac{A.C_1^{(1-e)}}{1-e} + \frac{\Pi\ A.C_2^{(1-e)}}{1-e}$

where,

A = constant

Π = probability of survival from period 1 to 2

C_1 and C_2 = consumption in period 1 and 2

e = consumption elasticity of MU

Then,

$$\text{MRS} = \frac{\Delta C_2}{\Delta C_1} = \left(\frac{C_2}{C_1}\right)^e \left(\frac{1}{\pi}\right) = (1 + g)^e \left(\frac{1}{\pi}\right)$$

where g = growth of real consumption

$$\therefore \text{STPR (r)} = \text{MRS} - 1 = (1 + g)^e \left(\frac{1}{\pi}\right) - 1$$

For estimating STPR from above equation, an estimate of ‘e’ (consumption elasticity of MU) is required.

$$e = \frac{d \ln u'}{d \ln m}$$

where u' = MU of consumption

Since $u' = \lambda\, p_i$ are the necessary conditions in equilibrium,

$$\therefore e = \frac{\partial \ln \lambda\, p_i}{\partial \ln m}$$

$$= \frac{\partial (\ln p_i + \ln \lambda)}{\partial \ln\ m}$$

$$= \frac{\partial \ln p_i}{\partial \ln m} + \frac{\partial \ln \lambda}{\partial \ln m}$$

(Since we assume constant $MU_m = \lambda$ w.r.t. m, *i.e.*, $\frac{\partial \ln \lambda}{\partial \ln m} = 0$)

$$\therefore e = \frac{\partial \ln p_i}{\partial \ln m}$$

$$= \frac{m}{p_i}\frac{\partial p_i}{\partial m}$$

$$= \frac{m}{p_i} * \frac{\partial x(p,u)}{\partial p_i} * \frac{\partial p_i}{\partial m} \Big/ \frac{\partial x(p,u)}{\partial p_i}$$

$$= \frac{x(p,u)}{p_i} * \frac{m}{x(p,m)} * \frac{\partial\, x(p,m)}{\partial m} \Big/ \frac{\partial x(p,u)}{\partial p_i}$$ [since for initial point, x (p, u) = x (p, m)]

$$= \frac{m}{x(p,m)} * \frac{\partial\, x(p,m)}{\partial m} \Big/ \frac{p_i}{x(p,u)} * \frac{\partial x(p,u)}{\partial p_i}$$

$$\boxed{\therefore e = \frac{e_i}{e_H}}$$

where,

e = consumption elasticity of MU_m

e_i = income elasticity of demand for food

e_H = compensated price elasticity of demand for food

The relationship between food prices and food demand may not be straight forward, particularly in an agrarian economy, or when the food basket is dominated by essential items or staple food, as a result of which aggregate price elasticity of food demand, when estimated empirically, may turn out to be positive (Bardhan, 1969). If high food prices persist over time, then the diversification of the food basket away from staple food or essentials in favour of discretionary or high value items may also reverse, accentuating undernourishment (Kumar *et al.*, 2011). With diversification of the economy (*i.e.*, significant decline in the share of agriculture in GDP) and higher levels of per-capita income accompanied by falling share of food in the consumption basket, own aggregate price elasticity of demand for food, however, must be negative in sign and statistically significant, though the size of the elasticity may be less than 1 (inelastic) or greater than 1(elastic). It is important to recognise nevertheless that the price elasticity estimates could be highly data and methodology sensitive, and a change in the sample period may completely alter the size, sign, and statistical significance of the estimates, as found in this paper.

Data on relevant variables for the period 1980-81 to 2021-22 (latest year for which disaggregated national accounts data are available) are sourced from MOSPI and the RBI Handbook of Statistics. All variables Log (QF), Log (pf/pnf) and Log (PFCE/pnf) or Log (MPNF) are found to be I (1), as per ADF stationarity test results, and accordingly Johansen-Juselius co-integration methodology is applied to check the presence of any co-integrating relationship between the variables. Both trace and maximum eigenvalue tests suggest the presence of one co-integrating vector[10]. The coefficient of the relative price variable, however, comes as positive, and is also not statistically significant. During the period 1980-81 to 2002-03, it appears from the data that per-capita consumption of quantity of food continued to rise, not influenced by any changes in relative prices (*i.e.*, GDP deflator of food/non-food). In the post 2003 period, starting with the high-growth phase of 2003-2007, however, per-capita consumption of food appears to have become sensitive to changes in relative prices. Since the data period from 2002-03 to 2021-22 (19 annual data points) does not support the use of a co-integration technique, a single equation Generalised Method of Moments (GMM) is used, recognising the problem of endogeneity in right hand side variables of the food demand equation. Two instrument variables are used [food production-gap, *i.e.*, food production relative to trend food production, and agri-credit-gap, *i.e.*, flow of agri-credit in a year relative to trend agri credit, as both higher food production (from supply side) and higher-agri credit (as a demand push factor) are found to be correlated with relative

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[10] Log (QF) = 0.766157 + 0.110962*Log (pf/pnf) + 0.672772*log (MPNF)
SE (1.24295) (0.32336) (0.09470)

price of food]. Durbin-Wu-Hausman Test supports endogeneity of Log(pf/pnf) in the GMM equation[11].

Log (QF) = -1.173502 – 0.661850*Log (pf/pnf) + 0.42184* Log (PFCE/pnf) + 0.664508*Log QF (-1)

t-values: (-0.82) (-2.35)** (3.74)* (2.69)**

Adjusted R^2 =0.97,

Durbin's h = 0.117096 [DW=2.001961, sample size =19, and standard error of Log QF (-1) = 0.246992].

***, **, * significant at 10 per cent, 5 per cent and 1 per cent level, respectively.

Long-run (uncompensated) price elasticity = 0.661850/(1-0.664508)= 1.972774

Long-run income elasticity =0.42184 /(1-0.664508)= 1.257377

The average share of food in total consumption expenditure (as per national accounts data) works out to 0.34. Using this information, the compensated price elasticity (e_H) is estimated as:

1.972774 – 0.34*1.257377= 1.545266

Hence, $\eta = (e_i)/(e_H)$ = 1.257377/1.545266 =0.813696

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11 The following variant of the food demand equation is also estimated, to show the difference in the approach required (as used above) for estimating STPR from a food demand equation:

Log (QF) = $\alpha - \beta_1$*Log (pf/pnf) + β_2*Log (PCGDI)

Where QF is per-capita quantity of food consumed, pf/pnf is the ratio of price of food to price of non-food (as per respective GDP deflators) and PCGDI is per-capita real disposable household income, which is a proxy of income (*i.e.*, nominal per capita GDI/GDP deflator).

Log (QF) = -2.1191 – 0.5353*Log (pf/pnf) + 0.3873*Log (PCGDI) + 0.6872*Log QF (-1)

t-values: (-1.60) (-1.80)*** (3.66)* (2.76)**

Adjusted R^2 =0.97,

Durbin's h = -0.17087 [DW=2.033749, sample size =19, and standard error of LogQF (-1) = 0.248612].

***, **, * significant at 10 per cent, 5 per cent and 1 per cent level, respectively.

For generating the value of g (trend growth in real per capita consumption), Log (per capita PFCE) is regressed on a time trend, which yields the value 0.045668, *i.e.* 4.6 per cent.

For arriving at the survival rate, the average of number of persons that survived out of 1000 individuals (as per 2011 census) is used, which is 992.25, yielding the probability of survival at 0.9923.

The STPR, using the above parameters, is estimated as:

STPR = MRS – 1 = $(1 + g)^e \left(\frac{1}{\pi}\right)$ – 1 = (1+0.045668)^0.813696*(1/0.9923) - 1 = 0.04505, or 4.5 per cent.

4.5 per cent real rate of STPR would mean that future cash flows (*i.e.*, both costs and benefits of a project) must be taken in real terms before discounting. Wherever a nominal interest rate is used, the project specific inflation assumption (during the life cycle of a project) may be added to derive the nominal discount rate, though as a concept, STPR is always a real rate, and therefore cashflows ideally should be taken in real terms.

Given the observed volatility in per capita PFCE (Standard Deviation of 2.3), and the role of precautionary savings in depressing real rates, there could be a case for lower real STPR, though adjustment for risk (to projected cash flows) may also warrant adding a risk premium[12]. In view of the *ad hoc* nature of such adjustments, it may be appropriate to avoid any adjustment, and instead compare the estimated STPR against market-based information on opportunity cost of capital (Table 2).

In India, the capital (K), labour (L), energy (E), materials (M) and service (S) inputs (KLEMS) manual, based on the argument that investors make their investment decisions considering the prevailing interest rates in the economy, states that for compiling KLEMS database, an external rate of return, proxied by an average of real return on government securities and prime lending rate obtained from the Reserve Bank

[12] Gollier (2013) suggested adding a premium for systemic risk = $\eta\beta\sigma_c^2$, where β measures the correlation of the rate of return on the project and the growth rate.

of India is used. Accordingly, if one uses real weighted average lending rate (WALR) on fresh rupee loans as the proxy of opportunity costs, it was 4.04 per cent in 2023-24, and in terms of the weighted average real G-Sec yield, the corresponding rate was at 1.84 per cent. An average of the two yields a Social Opportunity Cost of Capital (SOC) of 2.94 per cent.

Table 2: Annual Average Interest Rates (in per cent)

	WADTDR[1]	WALR[2] (Fresh Loans)	GWAY[3]	CPI-Inflation	Real-WADTDR	Real-WALR (Fresh Loans)	Real-GWAY
2014-15	8.57	11.07	8.51	5.9	2.67	5.17	2.61
2015-16	7.73	10.47	7.89	4.9	2.83	5.57	2.99
2016-17	6.97	9.74	7.16	4.5	2.47	5.24	2.66
2017-18	6.67	9.34	6.97	3.6	3.07	5.74	3.37
2018-19	6.89	9.69	7.78	3.4	3.49	6.29	4.38
2019-20	6.38	8.71	6.85	4.8	1.58	3.91	2.05
2020-21	5.28	7.92	5.8	6.2	-0.92	1.72	-0.40
2021-22	5.03	7.63	6.28	5.5	-0.47	2.13	0.78
2022-23	5.13	7.94	7.32	6.7	-1.57	1.24	0.62
2023-24	6.55	9.44	7.24	5.4	1.15	4.04	1.84

[1]WADTDR = Weighted Average Domestic Term Deposit Rate
[2]WALR = Weighted Average Lending Rate
[3]GWAY = G-Sec Weighted Average Yield
Source: RBI (Annual Reports and Handbook of Statistics)

Thus, SDR for India as per the current assessment presented in this paper could be in a range of 4.5 per cent (STPR) and 2.94 per cent (SOC). Since no information is available on weights (*i.e.*, whether a public project is funded by displacing private investment or displacing current consumption), a simple average could be used, which will yield 3.72 per cent as the real SDR for India at present.

VI: Conclusions

For a national planner, while undertaking public sector projects, the overall resource availability position in the country, the cost of mobilising additional resources from the savers, and the return on investment generated in the private sector need to be kept in perspective, to avoid the scope for resource misallocation and the associated potential loss of productivity. In India, in the context of the recent decline in net financial savings of households and the constraint of limit to sustainable absorption of foreign capital (set by sustainable current account deficit), resource allocation among sectors/projects may have to be better aligned to the national objective of fostering sustained high growth, for India to become an advanced economy by 2047-48.

Notwithstanding the challenges faced in precisely estimating the social discount rate (SDR) of a country, and valid arguments in the literature justifying discretionary adjustments to SDR before use in project evaluation and award, it is essential to have a reasonable estimate of SDR as a benchmark to guide investment decisions in the public sector, as it can help in ranking projects based on their potential to generate social return, which in turn, can help improve resource allocation.

If resources in the private sector were deployed (in 2023-24) at 4.04 per cent interest rate (in real terms), it may be hard to justify a SDR of less than 4.04 per cent for a public sector project unless the social return (including positive externalities generated by such projects) are assessed to be high. Similarly, when the Government borrowed at a rate of 1.84 per cent (in real terms) in 2023-24, current net household savings, despite declining, supported that order of borrowing, and any SDR of less than 1.84 per cent may discourage households from postponing consumption to save now, leading to lower net savings. When interest rate subventions support projects with high social return, it may be recognised that the cost of such subventions would have to be ultimately met from either tax or borrowed resources, implying the binding constraints from associated implications for net household savings and crowding-out risks for the private sector. An average value of the two (2.94 per cent) as the SOC approximation for 2023-24 would still imply some resource misallocation (as this rate of return is lower than what the private sector can generate), but this risk can be contained at the margin by incentivising households to save more (as the rate of return will be higher than the cost of government borrowings).

Any STPR estimate may have limitations and depending on the sample period and model used, key parameters of STPR may change. Nevertheless, it is appropriate to use a measured STPR for setting SDRs, instead of relying only on market rate of interest, because it is equally challenging to estimate SOC when economic agents borrow at multiple rates, often exceeding the risk-free market rate, and some households and firms may not also have access to formal financial markets. The advantage of STPR is that it does not use any market interest rate to arrive at the estimate and relies on society's preference. The estimated STPR for India at 4.5 per cent (in real terms) is marginally higher than the real weighted average lending rate (WALR) on fresh rupee loans (4.04 per cent in 2023-24) as the proxy of opportunity cost. As an alternative, an average of STPR and SOC yields a rate of 3.72 per cent (in real terms). In undertaking new public sector projects, thus, 3.72 per cent (real) interest rate may be considered as an ideal SDR, given the range of 4.5 per cent STPR and 2.94 per cent SOC.

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