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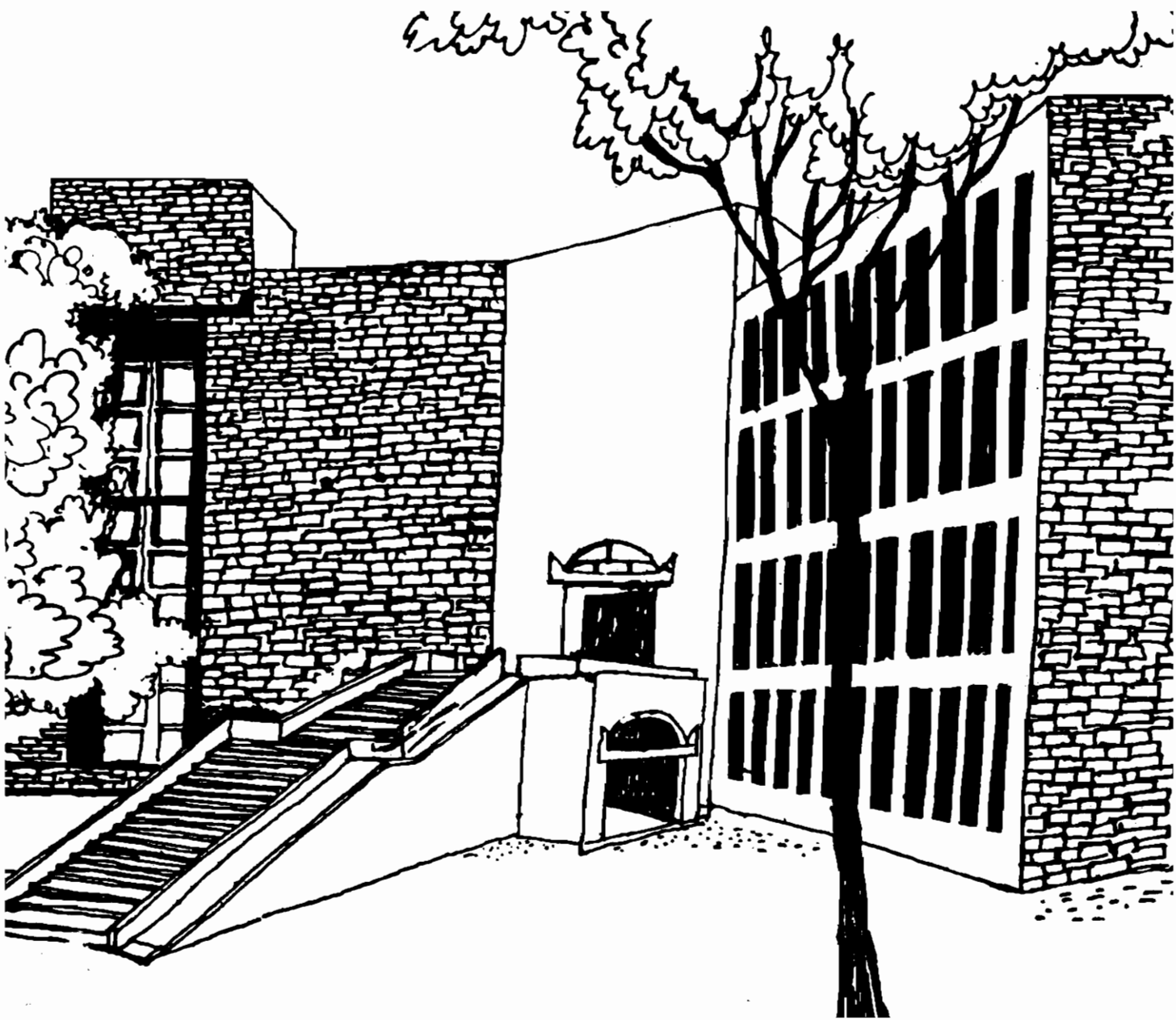

AN ESTIMATION OF SOCIAL TIME PREFERENCE RATE FOR INDIA AND ITS PUBLIC POLICY IMPLICATIONS

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INTRODUCTION

As we know, the market rate of interest is not suggested for appraisal of social/public projects which produce goods of public nature and whose benefits come even beyond the life of current generation. The other reason for not using the market rate of interest for such projects is that it is alterable, being a macroeconomic policy instrument, due to cyclical changes in the economy. Hence for public policy decisions a different rate of discount called the social discount rate is required.

Although knowledge of social discount rate is very essential for both developed and developing countries, it is extremely useful for developing countries as governments in these countries have the major responsibility of incurring public investment and programs towards supplying drinking water, irrigation, electricity, energy exploration, transport and communication, population control, and so on. Also, the public investment in the developing countries constitutes a large proportion of the gross investment in the economy and is raised thru taxation and international grants/or loans. Thus, knowledge of social discount rate becomes exceedingly significant information towards making public investment in choosing appropriate mix of public and private projects for maximizing social welfare. This information can also be useful for international developmental-loan granting agencies at both micro and macro levels, and for assessing the prospects for adoption of

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new technologies in general (Pender and Walker, 1990).

THEORETICAL MODEL

Theoretically the social discount rate in a two period (1, 2) model is determined at point E in Figure 1 by the tangency of social indifference curve I_1I_2 and the production possibility schedule T_1T_2. Thus, at the tangency point E the marginal rate of substitution in consumption (MRS_{12}) equals to the marginal rate of transformation in production (MRT_{12}), and both of these equal to slope of tangent line A_1A_2 which is equal to $(1 + w_{12})$; the w_{12} being the social discount rate. That is, at point E the slopes of social indifference curve (I_1I_2), production possibility schedule (T_1T_2), and the tangent line (A_1A_2) are one and the same. The social discount rate w hence equals to the social time preference rate (s) derivable from the social welfare function I_1I_2, and also equals to the social opportunity cost of capital (r), derivable from the production possibility frontier T_1T_2. In the equilibrium, $s = r = w$. Since in the equilibrium $MRS_{12} = (1+s)$, then $s = MRS_{12} - 1$; for details, see Pearce and Nash (1981, pp. 145-48).

(Insert Figure 1 around here)

In the empirical literature, attempts have been made to estimate the social discount rate thru estimation of s or r, or a combination of both. Various methods used so far can be classified under four categories. The first approach is to estimate the social time preference rate or consumption rate of interest using the diminishing marginal utility of consumption (DMUC) model. Kula (1984, 1985) used

this approach to estimate the Social Time Preference Rate (STPR) for United Kingdom, United States and Canada. The second approach calls for estimating the social opportunity cost of capital (SOC) which is also referred to as social internal rate of return or social marginal efficiency of capital. Flemming et al (1976) used this approach to the United Kingdom. However, in practice STPR and SOC can differ as shown by Baumol (1968). As a result, some alternative approaches have been also suggested. For example, a third approach is suggested by Scott (1977) who argues to derive the social discount rate by looking at the nsumption and investment in the public sector only. This requires the cept of "base level income". The fourth approach is to derive the nthetic" discount rates as suggested by Marglin (1967) and Feldstein 972). The synthetic approaches, in fact, use an average of SOC and STPR and discriminate sources of finance for a project. However, the synthetic discuount rates are considered to be the second best choice given that the STPR and SOC are more than likely to diverge for various reasons.

In this paper an attempt is made to quantify the social time preference rate for a developing economy of India, using the DMUC model which of course has its own limitations (Pearce and Nash, 1981). The material of this paper is arranged as follows: the analytical framework is discussed in the second section, followed by the estimation of parameters and data, results and discussions in the subsequent sections.

ANALYTICAL FRAMEWORK

To begin with, it is assumed that STPR case is derived from an individual's utility function which is the miniaturized version of social indifference curve; that is why STPR is also called the consumption rate of interest (CRI). The individual here is a Mr. Average Indian having a two period dynamic utility function which is smooth, twice differentiable, quasi-concave, and additive and which has the constant elasticity of marginal utility of consumption e and has constant STPR as well:

$$U(C) = \frac{A\ C^{1-e}}{1-e} \qquad (1)$$

or absolute value of e being greater than zero.

Here the elasticity of marginal utility of consumption is given by -e, and elasticity of substitution between consumption at any two points of time period is constant and is equal to 1/e. Also, e has an alternative interpretation as the coefficient of constant relative risk aversion which is a better and realistic representation than the constant absolute risk aversion. However,the additivity and separability is assumed for sheer analytical convenience, although marginal utility of consumption e may be affected by the past consumption thru habit or boredom effects or may well have time preference rate that changes thru life (Blanchard and Fischer, 1989). Given these characteristics of utility fuction, the present value of Mr. Average Indian's consumption stream can be written as:

$$U = \frac{A\ C_1^{1-\theta}}{1-\theta} + \frac{\pi\ A\ C_2^{1-\theta}}{1-\theta} \qquad (2)$$

where C_1 and C_2 are real consumption in period 1 and 2; A is constant; π is the probability of survival from period 1 to 2 with which the future utility is discounted and the rest notations have usual meaning. From the above, the marginal rate of substitution between to periods can be obtained as follows:

$$MRS_{12} = \frac{dU/dC_1}{dU/dC_2} = \left[\frac{C_2}{C_1}\right]^{\theta} \frac{1}{\pi} \qquad (3)$$

But social time preference rate s is given by

$$s = MRS_{1,2} - 1 \qquad (4)$$

Substituting (3) into (4), we get:

$$= \left[\frac{C_2}{C_1}\right]^{\theta} \frac{1}{\pi} - 1$$

$$= (1 + g)^{\theta} \frac{1}{\pi} - 1 \qquad (5)$$

where g is the growth rate in real consumption.

Estimation of STPR thus requires the following parameters to be estimated: (i) real consumption growth rate (g); (ii) probability of survival from one year to next (π); and, (iii) the elasticity of

marginal utility of consumption (e). In the section that follows we discuss the estimation of above parameters and data needs.

ESTIMATION OF PARAMETERS AND DATANEEDS

The parameters required for the estimation of STPR were estimated as follows. The real growth rate in consumption is obtained by fitting the semilog trend equation,

$$\ln C = A + g\ (t) \qquad (6)$$

the data series given in the Appendix. Here C is the per adult equivalent consumption expenditure in 1970-71 prices and t is a time trend (1960/61 = 1 .... 1984/85 = 25). The estimated equation is given below and which is highly significant.

$$\ln C = \underset{(505.1)}{6.46} + \underset{(12.5)}{0.01076}\ (t) \qquad (7)$$

$$R^2 = 0.87 \quad D.W. = 1.5960, \quad F = 156.6,$$

The t-values are given in the parentheses below the estimated parameters. The equation (7) suggests a growth rate of g = 1.076%.

The next thing is to get an estimate of the elasticity of marginal utility of consumption, e. Following the earlier ideas of Fisher (1927) and Frisch (1932), Fellner (1967, pp.45-67) has suggested a model for

estimating e which is based upon an additively separate utility function with respect to food and non-food commodities in the consumers basket; that is, in the Fellner's model the e is measured by the ratio of income elasticity (e_2) to the compensated price-elasticity ($\hat{e}_1$) of food demand or

$$e = \frac{e_2}{\hat{e}_1}$$

The compensated price elasticity is obtained from uncompensated ce elasticity e_1 by eliminating the income effect. For estimation of nd e_2 a food demand function was specified and estimated with data n in the Appendix. The estimated model is as follows:

$$\ln Q = 4.74 - 0.0724 \ln (P_1/P_2) + 0.2044 \ln (Y) - 0.0902 \text{ DUM1} \qquad (7)$$

(18.3) (1.66) (5.31) (5.99)

$R^{-2} = 0.72$ D.W = 1.6609 F = 21.6

where Q is the per adult equivalent real food expenditure in 1970-71 prices; P_1 and P_2 are aggregate price indices constructed for food and non-food products in the consumers' basket (1970-71= 100); Y is the per adult equivalent real disposable income in 1970-71 prices; DUM1 is a dummy variable which takes a value of 1 in the years when foodgrain production dipped suddenly from the previous level due to drought (1965/66, 66/67, 76/77, 79/80) and otherwise takes zero values for normal years.

The estimated model, more or less, provides a reasonbale fit to data and there is no autocorrelation. The estimated regression coefficient on P_1/P_2 and Y are direct estimates of e_1 and e_2 since the function is of double-log form. The regression coefficient on Y is significant at 5% level of significance, while regression coefficient on price ratio is significant at 10% level of significance. From the above function we get:

$$e_1 = 0.0724$$

$$e_2 = 0.2044$$

The compensated price elasticity e_1 is obtained from the following standard slutsky condition:

$$\hat{e}_1 = e_1 - \alpha (e_2)$$

where α is the proportion of food expenditure in the total consumption expenditures. Based on data from 1960-61 to 84-85, an averge value of α is equal to 0.611. Now substituting the values of e_1 and e_2 in the above we get

$$e_1 = 0.0725 - 0.611\ (0.2044) = 0.0524$$

$$\text{Thus } e = e_2 / \hat{e}_1 = 0.2044/0.0524 = 3.9.$$

That is, the elasticity of marginal utility of consumption is -3.9. A comparision of some estimates of e across different counties is done in Table 1. The estimate of e across developed countries range in

between -0.71 for UK and -4.3 for Australia; a figure of -2 seems to be the average. For the developing country Chile, Betancourt (1968) provides an estimate in between -1.76 and -13.8--a very wide range; Martin and Marcelo (1988) have assumed e is equal to -1 for Brazil but this is not based on estimation. In the light of the above, our estimate for India seems plausible.

(insert Table 1 around here)

The next parameter that needs to be estimated is the probability of survival (π). The survival probability is calculated with the assumption that the discounting of future utility by the Mr. Average Indian depends upon his probability of being alive at that particular date (Kula 1984). That is

$$\pi = 1 - \frac{n_t}{p_t} \qquad (8)$$

where n_t and p_t are respectively the total numbers of death and total stock of population in year t. For example, during the 1981 census only 987.5 persons survived out of 1000 individuals, that is, the probability of survival being 0.9875. The computed survival probabilities for 1951, 1961, 1971 and 1981 census years were respectively 0.9726, 0.9772, 0.9802, and 0.9875; an average of these, which happens to be 0.9795, is taken for computation of STPR.

One may ask at this juncture whether computing of survival

probabilty in the above manner would capture the entire concept of pure time discounting or not. Some economists like Fisher (1930), Eckstein (1961), Henderson (1965), Dasgupta and Pearce (1972), Lindstone (1973), and Webb (1973) argue that the sheer fact of mortality is a rational enough reason for defence of pure discounting, that is, individuals prefer a given amount of present consumption to the same amount at a future date.

However, other economists such as Jevons (1871), Bohm Bawrek (1884), Pigou (1929), and Strotz (1955) argue pure time discounting is unreasonable and is entirely due to irrationality, myopia, and backwardness. The survival probability as computed in this paper does not take care of pure time discounting due to such factors as irrationality or pure myopia. Also inclusion of irrationality in STPR is suggested not to be a justifiable argument as well as not a empirically tractable idea (Kula 1984,p.879).

Economists like Eckstein (1961), Rae (1905), Fisher (1930) suggest an upward adjustment on the pure time discount factor derived on the basis of individuals' survival probabilities. While others such as Scott (1977) argue for a downward adjustment of π because of increased self-inflicted possibility of destruction on the earth due to nuclear war, etc. Scott has suggested an addition of 1% to the pure time discounting rate as an arbitrary figure. However, in recent years the improved atmosphere between two super powers may have reduced self-inflicted extinction probability. In this paper, we have not made

any type of arbitrary adjustment, neither upward nor downward, in π.

Data Needs and Sources

A digression is sought here to describe the data needs for the estimation of above relationships. Note that in the above estimated food demand function we have computed real food expenditure and disposable income on per adult equivalent basis which requires convertno the ordinary population data into adult-equivalents. There are many possible adult-equivalent scales developed for expenditure, national income, welfare, etc. (Buse and Salathe 1978, Price 1970). Generally the conversion of ordinary population data into the adult equalents is done through the "Reduced Amsterdan Scale" (RAS) which gives lower weights to children and women compared with adult males with the implied assumption that adult males consume more food than others (Dutch Labor Statistics 1937). However, in this study, adult equivalent population was computed using the weights suggested by Rao (1982) based on calorie coefficients as follows:

Type of population	Weight
Males of 15 years and over	1.0
Females of 15 years and over	0.8
Children aged 10-14 years	0.8
Children aged 5-9 years	0.5
Children aged 0-4 years	0.3

The primary reason to choose the latter weights was simply that the Indian data was not available in the format required by the RAS for all

the census years except that for 1981. A comparison of adult equivalents for 1981 census computed using RAS and the one suggested above based on calorie coefficient showed no significant difference. For example, adult equivalent population by Dutch and Calorie Coefficient Scales were 77.8 and 75.6% of the actual population in 1981.

The time series data on food and consumption expenditures were obtained from various issues of **National Accounts Statistics** published by the **Central Statistical Organization (CSO)**. Food includes expenditures on cereals and cereal substitutes; milk and milk products; edible oils; meat, egg and fish; sugar, salt, and other food items including nonalcoholic beverages. Nonfood items include clothing and footwear, rent, taxes, fuel and power, furniture and household equipments, medicare and helth expenses, transport and communication, recreation, entertainment, education, and other miscellaneous items.

Theoretically speaking, retail price indexes should have been the best choice as they express prices paid by consumers. However, unavailbilty of such data at the national level forced us to resort upon wholesale prices indexes. In doing so it is implicitly assumed that marketing margins are fixed and would not bias the consumers' response. Since, ready-made aggregate price indexes for food and nonfood products in consumers' basket were not available, they were constructed by taking an weighted aggregate of price indexes of respective items in the food and non-food groups, the weights being those given in the **Wholesale Price Statistics of India.**

RESULTS AND DISCUSSION

Having estimated all the parameters, we now substitute them into the STPR equation (5) and obtain the following results:

$$(1 + 0.01076)^{3.9} \left[\frac{1}{0.9795} \right] - 1 = 0.0644$$

That is, the estimated social time preference rate for India is estimated to be 6.4%, which is slightly high, about 20-40% over and above those estimated for the developed countries as shown below:

Country	STPR Estimate	Source
USA	5.3%	Kula (1984)
Canada	5.2%	Kula (1984)
UK	4.5%	Scott (1977)
India	6.4%	Current study

The above result is however not too unexpected. In a developing country, where social securities are more or less absent, people must discount future heavily compared to their counterpart in the developed countries. Moreover, about 90% employment in the Indian economy is in the unorganized sector (Dandekar 1988); and about 67% is in agriculture alone, which is very much monsoon dependent, hence adding to uncertianty to the lives of people. Social security schemes such as provident fund, life insurance, and other ways to reduce risk are virtually not available to this unorganized sector. At the aggregate level, it is the

social time preference of these people which matters.

Since the elasticity of marginal utility of income depends upon the magnitudes of three parameters: (i) elasticity of food (e_1), (ii) income elasticity of food (e_2), (iii) proportion of food in the total consumption expenditure (α). Any change in one of them would affect the estimate of e. We have therefore done a sensitivity analysis with respect to changes in these three parameters and then accordingly substituted the value of e in the STPR equation (5). The variation in g and π is not much hence they are kept constant for conducting the sensitivity analysis.

Based on the past studies, estimates of income elasticities for food in India, more or less, have ranged within the magnitude of 0.4 to 0.6 (World Bank, Desai, Sandizzo and Bruce, Theil, NCAER, Verma); and estimates of price elasticity in between 0.3 to 0.8 (Swamy and Binswanger, NCAER, Radhakrishna). In the data period, food as proportion of the private final expenditure has varied from 56 to 66%. Taking these variations into consideration, the computed STPRs are given in Table 2.

[Insert Table 2 around here]

From Table 2, the minimum value of STPR comes around 3% while maximum can be as high as infinity although practically impossible; but most estimates vary within the range of 3 to 14%. The STPR of 6% thus

seems reasonable. We can compare it with the nominal and real long-term interest rates in the country. For example, the average long-term real interest rate, which is defined as long-run nominal interest rate minus the inflation rate ($r - \pi$), during the data period varies from -22% in 1974 to about 14% in 1976, with an average over the years equal to -1.6%. Since some economists also suggest long-term real interest rate as a proxy for STPR, judging from this criterion the two are different for India. This hoerbrt not true for developed countries like USA and Canada where capital markets are relatively perfect and long-term interest rates more or less, reflect the social time preference rate. In developing economies, because of absence of well-developed capital markets the link between STPR and interest rate is tenuous (Binswanger and Rozenzwig, 1986). Taking our estimate of STPR as right one since it is based on more accurate methodology and data, it can be argued that social rate of return on capital in India is artifically kept low for water purposes planners had in mind; this has perhaps encouraged larger investment by governments in infrastructural and social overheads than otherwise would have taken place if true social cost of capital would have been reflected in the market.

One major implication of the above results is that by keeping the low social rate of return on capital, government may have kept a low cut-off rate to undertake the social investments, which otherwise must yield a social rate of return equal to or more than the social cost of capital or social time preference rate. If this be true, there has been a gross misallocation of resources and hence Indian society's welfare is

not maximized. This becomes obvious if we briefly examine the public investment policy since independence. Following independence in 1947, India invented the concept of mixed economy in which both public and private enterprizes could co-exist and mutually contribute to each other. The public sector's main role was defined to provide the infrastructure and develop basic and heavy industries, which have significant backward and forward linkages. The first three Five Year Plans (FYPs) did meet the pre-assigned objecties of public sector investment but it got diluted thereafter. Public sector investment then became politicized; and less attention was given to efficiency and profitability. Indiscriminate expansion of public sector and nationalization of several sick units with a view to maintain short-run production and employment led to lower rates of return. For example, as of now, the aggregate investment in the public sector by both central and provincial governments is equal to the gross domestic product of the country, about Rs.3100 billions of which 75% is by the central government alone. The overall return on this is estimated to be less than 1.5% per annum (Naik, 1991).

SUMMARY AND CONCLUSIONS

This paper estimates the social time preference rate for India using the DMUC model. The findings of the study suggest that public investment in India has been grossly misallocated. The current problems of Indian economy cannot be dissociated with the deliberate misallocation of public resources in the past.

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Table 1: Some Estimates of Elasticity of Marginal Utility of Consumption, e, across Different Countries

Study	Country	Estimates (e)
Byron (1968)	Australia	-2.1
Hoa (1968)	Australia	-1.7 to -4.3
Kula (1984)	Canada	-1.56
Kula (1984)	US	-1.89
Kula (1985)	UK	-0.71
Betancourt (1968)	Chile	-1.76 to -13.8
Current study	India	-3.9

Table 2: Sensitivity of STPRs with respect to Elasticities of Marginal Utility of Income

Value of e_1	Value of e_2 Given:								
	α = 0.50			α = 0.55			α = 0.65		
	0.40	0.50	0.60	0.40	0.50	0.60	0.40	0.50	0.60
0.30	6.56	13.63	--	7.70	4.64	--	13.63	--	--
0.40	4.30	05.76	8.86	4.52	3.86	11.94	05.31	10.15	94.30
0.50	3.52	04.30	5.42	3.63	3.41	05.99	03.97	05.31	08.28
0.60	3.19	03.63	4.30	3.30	3.15	04.53	03.41	04.19	05.31
0.70	2.97	03.30	3.75	2.97	2.97	03.86	03.08	03.63	04.19
0.80	2.86	03.08	3.41	2.86	2.86	03.52	02.86	03.30	03.75

Table 3: Long-term Real Interest Rate in India, 1961-85

Year	Government Bond Yield (r)	CPI (1980 = 100)	Inflation (π)	Real Rate ($r - \pi$)
1961	4.11	26.1	1.6	2.51
1962	4.36	27.0	3.5	0.86
1963	4.68	27.8	2.96	1.72
1964	4.73	31.5	13.31	-8.58
1965	5.32	34.4	9.21	-3.89
1966	5.54	38.2	11.0	-5.46
1967	5.52	43.4	13.6	-8.08
1968	5.07	44.6	2.8	2.27
1969	5.00	45.4	1.8	3.20
1970	5.00	47.7	5.1	-0.10
1971	5.64	49.2	3.1	2.54
1972	5.65	51.8	5.3	0.35
1973	5.65	61.0	17.8	-12.15
1974	6.04	77.9	27.7	-21.66
1975	6.35	82.3	5.6	0.75
1976	6.29	75.9	-7.8	14.09
1977	6.32	82.3	8.4	-2.08
1978	6.37	84.4	2.6	3.77
1979	6.45	89.7	6.3	0.15
1980	6.71	100.0	11.5	-4.79
1981	7.15	113.0	13.0	-5.85
1982	7.59	121.9	7.9	-0.31
1983	7.99	136.3	11.8	-3.81
1984	8.65	147.7	8.4	0.25
1985	8.99	155.9	5.6	3.39
Average	6.05	71.82	7.69	-1.64

Source: Data obtained from International Monetary Fund (1986)

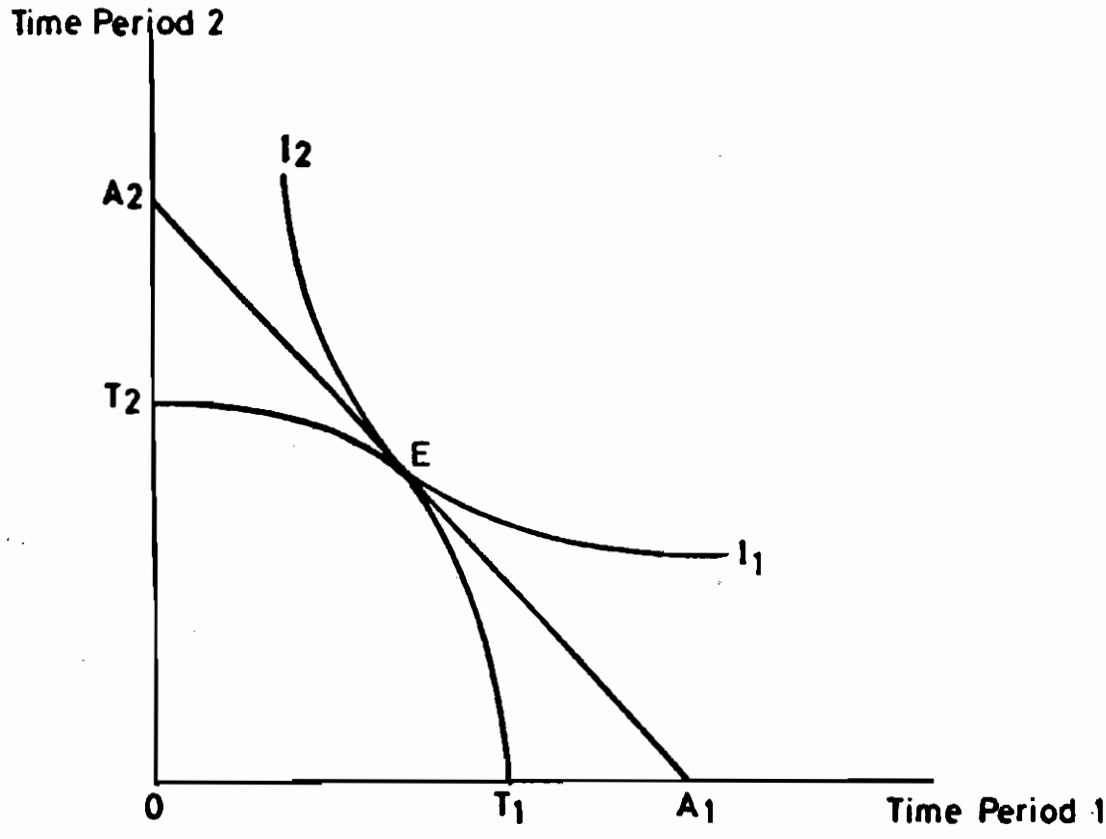

Figure 1: Theoretical Determination of Social Discount Rate

APPENDIX

Data Used for Estimation of STPR, India

Financial Year	Per Capita consumption in 1970-71 prices Rs/capita	Consumption per adult equivalent Rs/a.e. 1970-71 prices	Food expenditure per adult equivalent Rs/a.e. 1970-71 prices	Personal dispensable income Rs/a.e. 1970-71 prices	Price index for food 1970-71 = 100	Price index for non-food products 1970-71 = 100
1960-61	488.5	659.9	438.2	735.9	053.3	060.9
1961-62	486.4	657.0	432.2	744.9	050.8	062.2
1962-63	485.4	655.7	428.2	548.0	054.8	065.1
1963-64	487.2	657.9	423.0	593.0	060.7	069.2
1964-65	518.4	701.3	455.0	825.4	069.6	070.6
1965-66	491.5	663.8	414.2	764.9	073.2	073.8
1966-67	492.6	665.1	408.4	787.7	085.8	079.1
1967-68	519.2	701.3	449.0	803.7	109.7	083.9
1968-69	522.3	705.3	442.4	778.4	103.9	088.5
1969-70	530.9	717.1	457.4	824.0	097.3	093.1
1970-71	551.5	742.1	473.8	822.9	100.0	100.0
1971-72	554.2	746.1	461.9	830.7	110.1	107.2
1972-73	531.3	715.1	432.7	840.6	129.4	111.4
1973-74	533.3	718.1	432.3	892.5	150.7	128.5
1974-75	527.0	709.6	431.4	797.3	183.0	166.6
1975-76	552.3	784.9	461.3	779.2	175.8	172.3
1976-77	535.4	720.8	421.0	875.7	169.3	180.0
1977-78	580.6	781.7	469.0	905.8	175.9	188.0
1978-79	597.4	804.4	470.6	928.3	167.8	197.0
1979-80	555.7	748.1	418.2	935.0	198.2	223.0
1980-81	605.3	798.1	472.1	974.0	249.0	257.5
1981-82	611.7	807.7	467.6	956.4	255.0	286.4
1982-83	620.0	818.5	454.3	959.7	248.0	301.1
1983-84	655.8	866.4	496.4	1008.2	279.2	324.9
1984-85	654.5	863.8	483.1	1000.4	301.8	347.8