DISCOUNT RATE

ANNEX 6

INTRODUCTION

1 This Annex shows how the discount rate of 3.5 per cent real is derived and the circumstances in which it should be applied.

SOCIAL TIME PREFERENCE RATE

2 Social Time Preference is defined as the value society attaches to present, as opposed to future, consumption. The Social Time Preference Rate (STPR) is a rate used for discounting future benefits and costs, and is based on comparisons of utility across different points in time or different generations. This guidance recommends that the STPR be used as the standard real discount rate.

3 The STPR has two components:

- The rate at which individuals discount future consumption over present consumption, on the assumption that no change in per capita consumption is expected, represented by ρ; and,
- An additional element, if per capita consumption is expected to grow over time, reflecting the fact that these circumstances imply future consumption will be plentiful relative to the current position and thus have lower marginal utility. This effect is represented by the product of the annual growthin per capita consumption (g) and the elasticity of marginal utility of consumption (μ) with respect to utility.

The STPR, represented by r, is the sum of these two components, i.e.

$$r = \rho + \mu.g \qquad (1)$$

Each element of STPR is examined in turn below.

Estimates of ρ

4 This comprises two elements:

- Catastrophe risk (L); and
- Pure time preference (δ)

5 The first component, catastrophe risk, is the likelihood that there will be some event so devastating that all returns from policies, programmes or projects are eliminated, or at least radically and unpredictably altered. Examples are technological advancements that lead to premature obsolescence, or natural disasters, major wars etc. The scale of this risk is, by its nature, hard to quantify.[1]

6 The second component, pure time preference, reflects individuals' preference for consumption now, rather than later, with an unchanging level of consumption per capita over time.[2]

7 The evidence suggests that these two components indicate a value for ρ of around 1.5 per cent a year for the near future.[3]

Estimates of μ

8 The available evidence suggests the elasticity of the marginal utility of consumption (μ) is around 1.[4] This implies that a marginal increment in consumption to a generation that has twice the consumption of the current generation will reduce the utility by half.

Estimates of g

9 Maddison (2001) shows growth per capita in the UK to be 2.1 per cent over the period 1950 to 1998. Surveying the evidence, the Treasury paper *Trend Growth: Recent Developments and Prospects* suggests a figure of 2.1 per cent for output growth to be reasonable. The annual rate of g is therefore put at 2 per cent per year.[5]

The calculated STPR

So with g = 2 per cent, ρ = 1.5 per cent, μ = 1.0, then from equation (1) the STPR to be used as the real discount rate is

0.015 +1.0*0.02 = **3.5 per cent**

LONG-TERM DISCOUNT RATES

10 Where the appraisal of a proposal depends materially upon the discounting of effects in the very long term, the received view is that a lower discount rate for the longer term (beyond 30 years) should be used.[6]

11 The main rationale for declining long-term discount rates results from uncertainty about the future. This uncertainty can be shown to cause declining discount rates over time.[7]

12 In light of this evidence, it is recommended that for costs and benefits accruing more than 30 years into the future, appraisers use the schedule of discount rates provided in Table 6.1 below.

TABLE 6.1:THE DECLINING LONG TERM DISCOUNT RATE

Period of years	0–30	31–75	76–125	126–200	201–300	301+
Discount rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

EXCEPTIONS TO THE DISCOUNT RATE SCHEDULE

13 The standard schedule of discount rates may not be appropriate in the following circumstances.

- For international development assistance projects, a discount rate derived from estimates of the social time preference rate appropriate to the recipient economy should be used.
- When undertaking sensitivity analysis, the impact of changing the precise value of the discount rate can be analysed in the same way as for other parameters in the appraisal. The rationale for undertaking sensitivity analysis on the discount rate should be clearly explained.

DISCOUNT FACTORS

Discount Rates										
Year	1.0%	2.0%	3.0%	3.5%	4.0%	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	0.9901	0.9804	0.9709	0.9662	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091
2	0.9803	0.9612	0.9426	0.9335	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264
3	0.9706	0.9423	0.9151	0.9019	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513
4	0.9610	0.9238	0.8885	0.8714	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830
5	0.9515	0.9057	0.8626	0.8420	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209
6	0.9420	0.8880	0.8375	0.8135	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645
7	0.9327	0.8706	0.8131	0.7860	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132
8	0.9235	0.8535	0.7894	0.7594	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665
9	0.9143	0.8368	0.7664	0.7337	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241
10	0.9053	0.8203	0.7441	0.7089	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855
11	0.8963	0.8043	0.7224	0.6849	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505
12	0.8874	0.7885	0.7014	0.6618	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186
13	0.8787	0.7730	0.6810	0.6394	0.6006	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897
14	0.8700	0.7579	0.6611	0.6178	0.5775	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633
15	0.8613	0.7430	0.6419	0.5969	0.5553	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394
16	0.8528	0.7284	0.6232	0.5767	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176
17	0.8444	0.7142	0.6050	0.5572	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978
18	0.8360	0.7002	0.5874	0.5384	0.4936	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799
19	0.8277	0.6864	0.5703	0.5202	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635
20	0.8195	0.6730	0.5537	0.5026	0.4564	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486
21	0.8114	0.6598	0.5375	0.4856	0.4388	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351
22	0.8034	0.6468	0.5219	0.4692	0.4220	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228
23	0.7954	0.6342	0.5067	0.4533	0.4057	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117
24	0.7876	0.6217	0.4919	0.4380	0.3901	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015
25	0.7798	0.6095	0.4776	0.4231	0.3751	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923
26	0.7720	0.5976	0.4637	0.4088	0.3607	0.2812	0.2198	0.1722	0.1352	0.1064	0.0839
27	0.7644	0.5859	0.4502	0.3950	0.3468	0.2678	0.2074	0.1609	0.1252	0.0976	0.0763
28	0.7568	0.5744	0.4371	0.3817	0.3335	0.2551	0.1956	0.1504	0.1159	0.0895	0.0693
29	0.7493	0.5631	0.4243	0.3687	0.3207	0.2429	0.1846	0.1406	0.1073	0.0822	0.0630
30	0.7419	0.5521	0.4120	0.3563	0.3083	0.2314	0.1741	0.1314	0.0994	0.0754	0.0573

LONG-TERM DISCOUNT FACTORS

Year	Long Term Discount Factor	Year	Long Term Discount Factor
0	1.0000	23	0.4533
1	0.9662	24	0.4380
2	0.9335	25	0.4231
3	0.9019	26	0.4088
4	0.8714	27	0.3950
5	0.8420	28	0.3817
6	0.8135	29	0.3687
7	0.7860	30	0.3563
8	0.7594	40	0.2651
9	0.7337	50	0.1973
10	0.7089	60	0.1468
11	0.6849	75	0.0942
12	0.6618	80	0.0833
13	0.6394	90	0.0651
14	0.6178	100	0.0508
15	0.5969	125	0.0274
16	0.5767	150	0.0167
17	0.5572	200	0.0062
18	0.5384	250	0.0029
19	0.5202	300	0.0014
20	0.5026	350	0.0009
21	0.4856	400	0.0005
22	0.4692	500	0.0002

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1 Newbery (1992) estimates L as 1.0, Kula (1987) as 1.2, Pearce and Ulph (1995) as 1.2, OXERA (2002) as 1.1 currently and 1 in the near future.

2 Scott (1977, 1989) estimates (δ) as 0.5. Other literature suggests it lies between 0.0 and 0.5. However, if zero, this implies pure time preference does not exist, which is not regarded as plausible.

3 Scott (1977) derives a central estimate value of 1.5 from past long-term returns received by savers in the UK. A later estimate in Scott (1989), updated this estimate to 1.3. However, this was based on United States, as well as UK, evidence. OXERA (2002) estimates ρ to lie between 1.0 and 1.6.

4 Pearce and Ulph (1995) estimate a range from 0.7 to 1.5 with 1.0 being considered defensible; Cowell and Gardiner (1999) estimate μ as being just below or just above one; OXERA (2002) estimate a range from 0.8 to 1.1.

5 This estimate removes the impact of net migration. The paper is available on the HM Treasury website

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6 OXERA (2002)

7 Weitzman (1998, 2001) and Gollier (2002)