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THE SOCIAL COST OF CAPITAL: RECENT ESTIMATES FOR THE EU COUNTRIES

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THE SOCIAL COST OF CAPITAL: RECENT ESTIMATES FOR THE EU COUNTRIES[1]

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Abstract

Discounting enables to express future monetary or socio-economic effects in terms of present values when inter-temporal decisions are to be taken. In the context of the cost-benefit analysis, this allows for directly comparing net benefits expressed in terms of their net present values, and, subsequently, for aggregating them to obtain a single measure of the project value (the net present value). This paper deals with the social discount rate used to discount economic flows and estimate the investment's economic profitability indicators. It discusses the two most popular approaches for estimating the social discount rate, namely the social rate of return on private investment and the social rate of time preference, as well as the important implications on present and future generations deriving from using one discount rate instead of another. An overview of the social discount rates applied in several countries worldwide is provided and country-specific social discount rates for some EU Member States are empirically estimated using the social rate of time preference approach.

JEL codes: D61, D63, D91, H43

Keywords: Social discount rate, cost-benefit analysis, project evaluation

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[1] A more advanced version of this working paper will be published in Florio (2014) "Applied Welfare Economics – Cost-Benefit Analysis of Projects and Policies", London: Routledge, forthcoming (http://www.routledge.com/books/details/9780415858311/).

1. Introduction

In the framework of cost-benefit analysis, positive financial and economic flows are compared against the negative ones in order to assess the investment's net impact on social welfare. The fact that flows take place in different periods of time determines an aggregation issue: can the net cash flow at time *t* be summed to the net cash flow at time *t+1*? Even when constant prices are used, so as to exclude an inflationary effect, the utility of spending or obtaining one euro today is higher than one euro tomorrow, as pointed out in the literature[2] and derived from empirical observations.

The first reason why future flows need to be discounted is that the employment of resources has an opportunity cost, meaning that resources committed to a project could be employed in another return-generating investment. Thus, to induce investment, the expected return from the investment should be at least as high as the opportunity cost of funding. The second reason for discounting future costs and benefits is that consumers generally prefer to receive the same amount of goods and services sooner rather than later. This happens both because individuals expect an increasing level of consumption over time, thus, in the future, marginal utility of consumption decreases, and because individuals have a pure time preference, due to impatience, myopia and the risk of not being alive in the future. Available experimental evidence from both economics and psychology supports this view.[3]

Among the first formalizations of discounting in economics, Samuelson (1937) suggested a discounted utility function based on the idea that, during any period of time, an individual maximises the sum of his/her future utilities and, therefore, has to discount future utilities in order to reduce them to comparable magnitudes to today's. The individual discount rate, in this context, coincides with the concept of a pure rate of time preference, which is generally positive, due, as mentioned, to the impatience of individuals and the preference of immediate over future consumption. When the perspective moves from individuals to policy makers, a discount rate other than the individuals' pure rate of time preference should be used. Caplin and Leahy (2001) state that the social discount rate should be lower than the private one, although still positive, given that benevolent policy makers should be more patient than private agents and should attach greater value to the utility of future generations.

This paper deals with the social discount rate (SDR), i.e. the rate applying to future economic inflows and outflows in order to decrease (or discount) their value over time and, in this way, directly comparing net benefits expressed in terms of their net present values, and, subsequently, for aggregating them to obtain a dingle measure of the project value (the net present value). The paper's objective is to show how the rate might differ across countries when different theoretical foundations for SDR estimation are adopted and country-specific socio-economic features are taken into account.

The paper is structured as follows. After this introduction, section 2 describes the two main approaches used in the theoretical and empirical literature when estimating the SDR, namely the social rate of return on investment approach, and the social rate of time preference approach; section 3 then shows existing empirical estimates of the SDR in different countries, while recent estimates of the SDR for a number of European countries are computed in section 4, by adopting the social rate of time preference approach. Finally, section 5 concludes with some implications on present and future generations deriving from using one discount rate instead of another.

[2] See, among others, Arrow and Lind (1970), Arrow et al (1996) and Frederick et al (2002).

[3] The philosopher Derek Parfit provided an argument for such consumption impatience, by stating that an individual is aware that its own identity changes over time. Consequently, the individual would perceive its future identities, which are different from the current one, as district persons from himself. This logic would justify the fact of giving less weights to utilities of these other selves (Parfit 1971).

2. Main approaches to estimate the social discount rate

Discounting can be defined as the process that enables to express future monetary or socio-economic effects in terms of present values when inter-temporal decisions are to be taken. It is both deliberately used by policy-makers, economists or financial analysts and unconsciously by every individual whenever the time-horizon of an investment decision exceeds a single period. The social discount rate (SDR) to be used in the economic analysis is the opportunity cost of capital for the whole society. Drèze and Stern (1987) define it as the rate of fall in the marginal social value of the numéraire against which goods are valued and it is used to convert shadow values in different years into common units this year or present values.

Like for the other shadow prices, the value of the SDR in principle depends upon the source of adjustments elsewhere in the economy needed to allow the investment. These adjustments may be decreased investments in other sectors and/or increased savings (hence less consumption). The relevant opportunity cost of capital in the former case is the rate of return of an alternative private investment.[4] In the latter case – i.e. when the adjustment in the economy determined by the allocation of public capital is in terms of increased saving – the opportunity cost of capital is the consumption rate of interest, measuring the subjective value of present versus future consumption to the individual.

However, other methods exist and could be used for inter-temporal discounting, although they are more rarely applied in the practice. Among these, the weighted average method and the shadow price of capital approach can be mentioned. The former consists of a weighted average of the investment rate of return and the net return to savers, to keep into account that public spending may have both a crowding out effect on private investment and a displacement effect of private consumption. The latter implies to convert investment flows into 'consumption equivalent's using the shadow price of capital and discount them at the social rate of time preference. This is intended to correct for the distortions in private investment returns which are referred to the fact that while consumption provides an immediate benefit, investment generates a stream of benefits that occur in future periods.[5]

In a perfectly competitive economy and under equilibrium these rates coincide between them and with the financial market interest rate. However, this does not apply in the practice, since capital markets are in fact distorted by taxation, capital rationing, information asymmetries and other market failures. In what follows, the two most popular approaches proposed in the literature and used to estimate the SDR are presented more in detail: these are the social rate of return on private investment and the social rate of time preference.

2.1 The social rate of return on private investments

A traditional approach suggests that public investment displaces private investment and, for this reason, the SDR should reflect the marginal social opportunity cost of the latter. The rationale is simply that private investment generates future income, and then valuable consumption in the future. This leads to a SDR equal to the marginal social opportunity cost of funds in the private sector. In other terms, according to this approach, the returns from the public investment should be at least as big as the one which could be obtained from a private investment. If this was not the case, there would be an inefficient allocation of resources and welfare could be increased by reallocation of funds, away from public to private investments.

Boardman et al (2006) argue that probably the best proxy for the marginal rate of return on private investment is the real before-tax rate of return on corporate bonds. The reason why one should look at the marginal, not the average return on private investment is because of diminishing returns of scale of project portfolios, which imply that rational investors conclude the most profitable deals first, so that returns are decreasing in the number of projects.

As mentioned by many economists (Boardman et al 2006, Barrett et al 1999, Arrow and Lind 1997), the SRRI approach tends to be biased toward high estimates of the SDR. First of all, externalities, monopoly, rationing, incomplete information and other market failures distort private investment returns and may generate private investment returns higher than the social ones. Second, the observed private return on investments usually includes a risk premium. This is however not to be included in the SDR because the

[4] This perspective is also adopted to estimate the financial discount rate.

[5] A more in-depth discussion on the weighted average approach and the shadow price of capital method is in Florio (2014).

society as a whole, or the government, has a much larger portfolio than any private investor has and consequently is able to exploit risk pooling.

By being typically based on observed returns in the private financial markets, one additional concern about the empirical estimation of the SRRI is market volatility and the role of persisting asset bubbles (the recent global crisis started around 2008 is a clear reminder of this recurrent fact). Average of long time series stock exchange returns may correct this bias, but overall the results will be higher than the returns to consumers under the social time preference approach.

As noted by Dasgupta, Marglin and Sen (1972), the marginal opportunity cost of capital could be used to estimate the SDR only when the total amount of capital available for investment in the economy is fixed. Such a context would justify the assumption that one euro of public investment displaces one euro of private investment. Yet, when the amount of capital is not fixed and agents satisfy, at least partially, the capital needed for financing public projects by postponing their current consumption, then the return required by consumers is less than the marginal rate of return on private investment. This would lead to a social discount rate that is lower than the marginal opportunity cost of capital for the economy. When consumption is postponed, a better estimate for the SDR is provided by the social rate of time preference approach.

2.2 The social rate of time preference

The social rate of time preference is the rate at which the society is willing to postpone a unit of current consumption in exchange of more future consumption. The logic of this approach is that the government should consider the welfare of both current and future generations and solve an optimal planning program based on individual preferences for consumption, and additional parameters.

In practice, the best return that people can earn in exchange of postponing consumption is the real after-tax return on saving, which provides a potential way to estimate the SRTP (Boardman et al 2006). In this case, a possible candidate for estimating the social marginal rate of time preference is to look at the return to holding government bonds, or other low-risk marketable securities. Yet, different criticisms can be raised concerning this method. The most important one is that it is not obvious how to aggregate different individual marginal rates of time preferences into a single social marginal rate of time preference. Actually, individuals have different saving and borrowing preferences, to which different return rates are attached: because consumer borrowing rates exceed saving rates and because reducing the debt is a not taxed operations, the result is that consumers who save by reducing their debt earn a higher real after tax return than other savers.

Another way to estimate the SRTP is based on a formula obtained from the Ramsey growth model (1928). It is the following:

$$SRTP = p + e \cdot g$$

where p is the pure time preference, e is the elasticity of marginal utility of consumption, i.e. the percentage change in individuals' marginal utility corresponding to each percentage change in consumption; g is the expected growth rate of per capita consumption or other welfare-related variable (e.g. income).[6] As highlighted by Potts (2002), the two components of this formula – the one related to time preference and the other related to consumption growth – reflect the two possible reasons why future consumption may have a lower value than in the present. First, because of uncertainty about the future which leads to preferring present income; second, because of the probability of people to become richer in the future: if per capita consumption is growing, then the value of additional consumption in each year in the future is declining at a rate related to the rate of growth of per capita consumption and the elasticity of diminishing marginal utility of consumption.

Each term of the formula is discussed more in detail here below.

The pure time preference term, in turn, can be decomposed into two terms, one related to individuals' impatience and myopia and the other one related to the risk of death or human race extinction. As already mentioned with reference to the private discount rate, impatience refers to the observation that individuals favour present over future consumption and it is reflected in a positive value of *p*.

The other component of the rate of pure time preference, the risk of death, is often simply taken as the ratio of total deaths to total population (Pearce and Ulph, 1995). It is important to stress that the risk of death from a societal perspective is, however, not the same as the risk of death of an individual. Actually, the latter can be expected to be much higher than the one for a generation as a whole. This is due to the fact that it would take a global catastrophe to extinguish all human life, whose probability to occur is obviously much less than the probability of dying of a single human person.

[6] As stressed by Spackman (2007) and Kula (2012). See in Feldstein (1965) more details on the algebra of this equation.

The elasticity of the marginal utility with respect to consumption captures dynamics of consumption over time. Suppose that the economy is growing, outside the steady state; then per-capita consumption grows. In the future, the representative consumer is richer. How does this income effect enter in social preferences for time? The elasticity parameter captures the fact that if tomorrow the representative consumer is a bit richer, marginal utility of consumption is decreasing over time. The impact of future consumption should be translated in that by its marginal effect. One is the neutral value of the parameter: for this society a future increase in consumption by one euro adds exactly one euro to social welfare. If instead $e < 1$, consumers attach a lower utility to marginal increase of consumption, while if $e > 1$, when consumption increases by one unity, social welfare increases more than one. And, as already mentioned, the poorer consumers are now, the more interested they are in present consumption growth: thus, for relatively less developed countries, the elasticity parameter will tend to be larger than one.

This parameter can be viewed either from an individual's or social perspective. While, from the former one, the elasticity indicates how an individual would like to allocate consumption over time, from the latter, it reflects how consumption should be transferred across different generations. Here, e can be seen as a planning parameter for the social planner in that it reveals his preference for income inequality aversion.

The last component of the Ramsey equation is the expected rate of growth in real per-capita consumption. Pearce and Ulph (1995) propose to use very long-run growth rates of real per capita consumption to estimate future growth. This method allows to solve two problems that may occur if g is assessed based on actual growth data of the very recent past. First, if individuals were to substitute leisure for consumption, recent data may lead to an understatement of g. Second, if real per capita consumption failed to reflect eventual rising social costs arising from consumption, g might be overestimated.

As to the point of view of inter-generational equity, this means that if future generations are expected to be wealthier that the ones of today, and thus if consumption rises over time, this would result in an increase of the discount rate in order to shift the priority to the poorer current generation.

To conclude this analysis, the SRTP allows the government to consider the welfare of future and current generations simultaneously and to determine the optimal planning program, based on individual preferences for consumption and additional parameters. The problem with this approach, which makes empirical estimation of the SDR difficult, is that e and p are essentially value judgments.

It is important to mention that some authors regard zero as the only ethically defensible value for the social rate of time preference (e.g. Ramsey 1928, Pigou 1932 and Broome 1992), stating that, from a utilitarian and impartial point view, good at one time cannot be different from a good at another. A positive value would signify that future generations are made worse off only due to the fact they are born at a later point in time, which would be unacceptable from the point of view of society as a whole.

However, most welfare economics literature based on empirical evidence agrees that a modest rate of time preference is justified and more realistic. Moreover, a practical implications of using a zero discount rate, as highlighted by Pearce et al (2003), would be that in the presence of positive interest rates the current generation would have greater incentive to save and invest, given that the value of future consumption will be higher. These future benefits would then always outweigh the current costs of foregone consumption and would consequently result in the impoverishment of the current generation. This would be true for every generation still to come, which would sacrifice its own consumption for the benefit of the next one. This argument gives an ethical reason for the adoption of a positive rate of pure time preference.

3. Empirical estimates of the social discount rate

Significant variations in social discount rates adopted by governments exist across the world, with developing countries generally applying higher rates (around 8-15 per cent) than developed countries (3-7 per cent). The actual value of the SDR adopted by different countries or institutions depends, first of all, on the estimation method used and, secondarily, on the specific underlying parameters, reflecting different perceptions of the social opportunity cost of public funds and different intergenerational ethical values.

In this section, a number of real-world examples of estimation of the social discount rate are provided. Table 1 synthetically presents the social discount rates currently used in selected countries worldwide, computed either as SRRI or SRTP. This gives an overview of the variance of SDR.

Table 1: Social discount rates adopted in selected countries

Theoretical foundation	Country	Social discount rate (real)	Source
SRRI	Australia	8%, with sensitivity test over the range 3-10%	Harrison 2010
	Canada	8%, with sensitivity test over the range 3-10%	Guidelines of the Treasury Board Secretary (2007) cited by Boardman et al (2010)
	India	12%	Zhuang et al (2007)
	Ireland	5%	Florio (2006)
	Netherland	4%	Florio (2006)
	Pakistan	12%	Zhuang et al (2007)
	Philippines	15%	Zhuang et al (2007)
	USA (Office Management and Budget)	7%	Zhuang et al (2007)
SRTP	France	4% (declining after 30 years)	Quinet (2007).
	Germany	3%	Florio (2006)
	Italy	5%	Florio (2006)
	Malta	5.5%	Planning and Priorities Co-ordination Division (2013), following the European Commission DG Regio Guide (2008)
	New Zealand	10%	Zhuang et al (2007)
	Portugal	4%	Florio (2006)
	Slovak Republic	5%	Hepburn (2007)
	Spain	For transport: 6% For water: 4%	Florio (2006)
	United Kingdom	3.5% (declining after 30 years)	HM Treasury (2003)
	USA (Environmental protection Agency)	Intra-generational discounting: 2-3% with sensitivity test over the range 2-3%. Inter-generational discounting: undiscounted cost and benefit streams, with sensitivity test over the range of 0.5-3%.	Zhuang et al (2007)

Source: Adapted from different sources

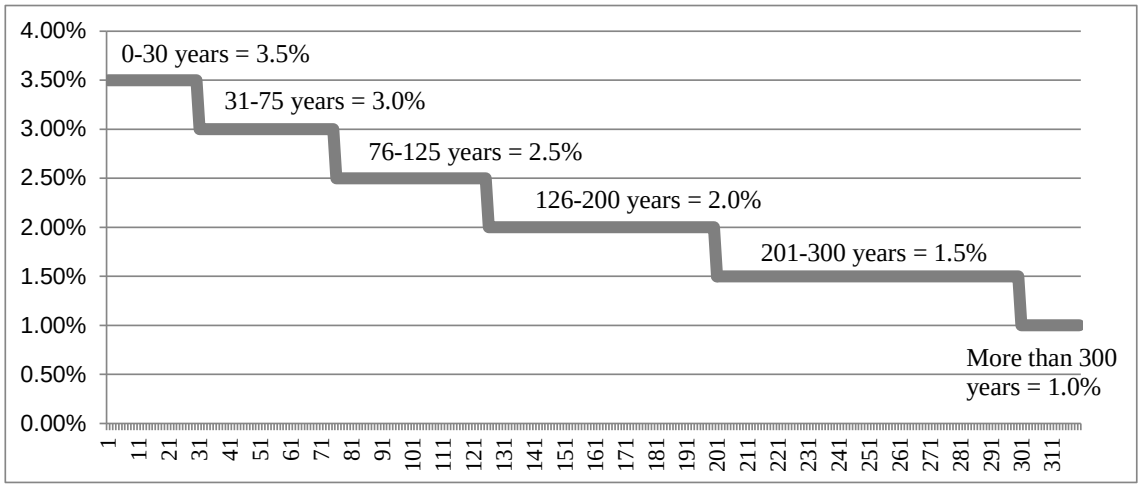
In the 1970s and 1980s the prescribed rates in the USA for most governmental agencies was 10 per cent. This rate was intended to approximate the opportunity cost of capital, measured as the real, marginal, before-tax rate of return on private investment. In 1996, the Office of Management and Budget has revised this rate downward to 7 per cent, still considering the marginal rate of return on private investment as a proxy of social discount rate. However, in the case of environmental projects, a lower SDR applies: this rate,

amounting to approximately 2-3 per cent, is recommended by the USA Environmental Protection Agency, and its estimation has been based on the SRTP approach.[7]

In the United Kingdom, the guidelines for investment appraisal by departments and executive agencies are given in the Green Book, published by the HM Treasury in 2003. Until the early 1980s the Ministry of Finance used the SRRI approach resulting in a value of 10 per cent real in 1969, which subsequently declined to around 5 per cent real in 1978. In 1989 both the time preference and the cost of capital were derived with the outcome of a range of 4 per cent-6 per cent. A social discount rate of 6 per cent was chosen. Following the decision in 2003 of adopting the social rate of time preference approach (SRTP), the social discount rate has been revised and reduced to 3.5 per cent for projects with a time horizon of less than 30 years. In particular, with reference to the Ramsey formula for the SRTP, the HM Treasury indicates that the pure time preference and the catastrophe risk give a value of around 1.5 per cent per year. The growth per capita in the UK over the period 1950-1998 is on average 2.1 per cent. The annual rate (g) is therefore set on 2 per cent per year. The two rates are applied to the social rate of time preference formula, with en elasticity value of 1, which gives a real discount rate of 3.5 per cent.

The Green Book suggests that for projects with very long impacts, i.e. beyond 30 years, a declining schedule of discount rates should be used rather than the standard discount rate (see Figure 1). The main rationale for declining long-term discount rates results from increasing uncertainty about the future. Actually, there is some theoretical and empirical support[8] to the view that, in facing the decision between a small reward soon or larger reward later, individuals would apply a lower discount rate in the long run. This could be because of uncertain future interest rates and inability of current market rates of interest or marginal rates of time preferences to reflect the preference of future generations.[9]

Figure 1: Declining long term discount rate in the UK



Source: Authors based on HM Treasury (2003)

In Germany the Federal Finance Ministry offers guidance on appraisal and evaluation of public investment projects. An inter-temporal model has been constructed at the end of the 1980s to compute the social discount rate. The foundation of this model is a utilitarian welfare function, where the welfare is the sum of the utility over time, discounted with the pure time preference. The empirical quantification of the parameters of this model had an outcome of a social discount rate of 4 per cent real (the average interest rate on public bond over the last 40 years is slightly higher than 3 per cent). The German government lowered its SDR from 4 per cent real in 1999 to 3 per cent real in 2004.

In France a real discount rate has been set up by committees of experts, generally under guidance of the *Commissariat Général du Plan*, since 1960. The social discount rate was determined by the analysis of the marginal return of industrial capital and amounted

[7] Zerbe Jr. et al (2002) examine various discount rates used by the USA governmental agencies and point out how little federal government agencies are consistent among themselves.

[8] Ainsle and Handel 1983, Laibson 1997, Newell and Pizer 2004, Weitzman 2001 and Gollier 2002a and 2002b

[9] Declining social discount rates are particularly important for intergenerational discounting, for example when assessing certain environmental projects whose benefits occur in the very long term (reforestation, measures to mitigate global warning, actions to preserve biodiversity, etc.).

to 9 per cent in the seventh Plan, then reduced to 8 per cent real in 1985 (ninth Plan). More recently (2005) the *Commissariat Général du Plan*, on request of the government, has re-evaluated the social discount rate, and adopted the SRTP, with a result of 4 per cent real.

The differences existing between the social discount rates in European countries would produce varying estimates of the net present value of a given project. For this reason, the European Commission, in its 'Guide to Cost Benefit Analysis of Investment Projects' (2008) provides a reference social discount rate for investment projects receiving EU capital funds.[10] Based on long-term economic growth and pure time-preference rates, the Commission proposes the following indicative benchmarks for the social discount rate: 5.5 per cent for the Cohesion countries eligible to Cohesion Fund and 3.5 per cent for the others. Florio (2006) explains that, while in principle the SDR may be region/country-specific, only two macro regions should be considered for the determination of the SDR of projects eligible under the EU Cohesion Fund and the European Regional Development Fund, i.e. the Competitiveness and Convergence objective regions. The rationale for using different discount rates lies in the different growth rate of EU members, with average growth rates of Cohesion countries being twice as great as in the rest of the European Union during the 2000-2005 period.

[10] A revised Guide is currently under preparation and is expected to be issued in 2014.

4. An example of SRTP estimation

In this section a coherent methodology to estimate the SDR of a sample of European countries is provided. The SRTP approach, in particular, has been applied. The reasons why the SRTP has been selected, instead of the SRRI, are manifold and they mostly refer to the weaknesses of the SRRI approach mentioned above (see section 2.1). Additionally, the SRTP is the most widely used in developed countries, especially in the European Union, as shown in Table 1. It is also the reference approach considered by the European Commission-DG REGIO in its Guide to CBA of investment projects and used by all EU Member States when applying for Structural Funds' co-financing. Finally, in line with Lind (1990) who stresses that the growth of international financial markets and capital mobility makes in fact the impact of public investment on private investment minimal, we consider the social time preference approach more appropriate for comparing public expenditure over time.

The purpose of this exercise is to show a possible and practical way to estimate the SRTP using the Ramsey formula. A similar exercise has been made by Evans (2007). In his analysis, Evans focused on the 15 EU Member States belonging to the euro area at that time, with data over a period up to 2004. This section aims at updating Evan's estimates with more recent figures, which also take into account the recent economic crisis effects, as well as enlarging the sample of countries for which the SDR is computed. In what follows, an estimation of the different parameters entering the Ramsey formula is derived.

As to the rate of pure time preference, the economic literature generally estimates a value between 1 per cent (e.g. Newbery 1992, Arrow 1995 and Evans 2007) and 3 per cent (Nordhaus 1993). In the Stern Review (HM Treasury 2006) a much lower rate is considered (0.1 per cent), due to the assumptions about a nil impatience or myopia component, on the same ground as Ramsey (1928). Thus, the rate of pure time preference takes into account the sole probability of extinction of the human race, which corresponds to a probability of human extinction of 10 per cent in 100 years. More frequently, an approximate 1 per cent rate of time preferences is accepted for European countries (Evans and Sezer 2004), which also reflects the catastrophe risk.

A possible way to proxy this factor could be to set the impatience or myopia component equal to zero, in line with the above mentioned Ramsey's argument, and the life chance measure equal to the annual crude death rate of the population (number of death over population). The most up-to-date death rate figures at the moment of writing are provided by Eurostat for year 2011.[11] They are overall constant across time, with an average 2011 value for EU Member States (including Croatia) of 0.99, ranging from 0.63 in Ireland to 1.47 in Bulgaria.

Second, the SRTP approach needs an estimation of the elasticity of marginal utility of consumption. This could be assessed with a survey (such as Barsky et al 1995, and Amiel et al 1999)[12] or it can be inferred from observation on indirect individual behaviours. People's savings, for example, can reflect their views about how much consumption they wish to transfer over time. The literature offers a large number of empirical estimates derived from modelling lifetime consumption and demand. For instance, Evans found elasticity values of 1.6 and 1.33 for UK and France respectively (Evans 2004a and 2004b); for Italy, Percoco (2008) estimated elasticity at 1.28; Kula used 1.56 for Canada, 1.89 for the US and 1.64 for India (Kula 1984 and 2004).[13]

Another approach is to consider society's judgement about how consumption should be transferred across people at different times ('revealed social values' approach). In this case, the elasticity tells how much more worthwhile it is to carry out transfer of income from a rich person to a poor one, or, in other words, it reflects the social planner's aversion to income inequality. This value can be revealed by using two methods. The first one consists in considering national contribution of aid allocated to the developing countries. This approach leads to an elasticity value of around 1 per cent for developed countries.[14] The second method is based on the progressivity of national personal income tax rates, according to a model that rests on the following assumptions: income tax structure based on the principle of equal absolute sacrifice of satisfaction, and iso-elastic utility functions. The first assumption

[11] Source: Eurostat Demographic balance and crude rates, extracted on 08/05/2013.

[12] While Barsky et al (1995) obtained an elasticity of approximately 5, Amiel et al (1999) estimated values ranging between 0.2 and 0.8. Such a divergence is due to the different samples of population interviewed, which reflect different inequality aversion: US middle-aged people in the former case, US students in the latter.

[13] Other estimates of elasticity based in indirect behavioral evidence are proposed by Evans and Sezer (2002), Evans et al (2005), Blundell (1988, 1993 and 1994), and Banks et al (1997).

[14] OECD/DAC website.

suggests that the rich should pay more in tax, according to a progressive tax system, whereas the second implies that a social planner displays constant relative risk aversion independently of scale.

Stern (1977) proposed a formula for elasticity which is in line with the second mentioned method:[15]

$$e = \ln(1 - t') / \ln(1 - t)$$

where t' and t are respectively the marginal and average tax rates for an average taxpayer. The results obtained for e are sensitive to tax coverage and to the adopted definition for the average tax rate (for example whether employees' social contribution are included or not in the tax rates), but in general its value is above 1 per cent. Potts (2002) stresses that, in order to be consistent with other indicators of government attitudes to distributional issues, values of e should range between 0.5 and 2.

Following the tax-based model and, particularly, Evan's recent calculation (2006), the elasticity to be entered in the Ramsey formula has been estimated for the EU countries. Data are taken from the OECD Tax Database (Taxation of Wage Income, 2012)[16] and refer to personal income taxation. Tax rates include central and sub-central government taxation. Country elasticity has been calculated as the mean of elasticity at different income levels, included the social security contribution paid by the employee.[17] In 2011, for the 20 EU countries covered by the OECD Tax Database, the estimated elasticity values range between 1.09 per cent (Poland) and 2.31 per cent (Ireland), with an average of 1.50. The elasticity estimates under the fiscal model are probably exaggerated, because they consider income tax rates, while the social preference for equity should be assessed on the whole effective marginal tax rates. These are probably lower, because indirect taxation and capital taxation in most countries are not progressive.

In order to keep the method to estimate the parameter e consistent across the countries, no assumptions have been made on the elasticity values of non OECD European countries. Therefore, the SDR has been computed only for the 20 European countries for which data availability allowed to apply the Stern formula. The discount rates for the remaining countries could be computed by retrieving data from national statistical sources.

Empirical estimates for the rate of growth of per capita consumption are usually based on past performance. Pearce and Ulph (1995), in calculating the social discount rate for the United Kingdom, decided to take very long-run rates of growth in real per capita consumption in order to smooth out possible short-term distortions. Also Evans and Sezer (2005) used the average annual growth of per capita real consumption over the three past decades (1970-2001) to estimate the actual rate, which amounts approximately at 2.3 per cent for Spain, 2.5 per cent for Italy and Greece, 2.7 per cent for Portugal and 3 per cent for Ireland. A different method to estimate g is to consider another welfare correlated indicator as a proxy for consumption growth, such as real per capita GDP growth.

While most authors consider a simple average of past time series, as long as available, the disadvantage of such approach is that it is only backwards looking, while expected future growth in per capita consumption also matters. Rates of per capita consumption growth higher than 4 per cent are hardly sustainable in the long run, and so it might be assumed that long-run values for g would be in the range of 0-4 per cent for most developing countries, with most countries being at the lower end of the range (Potts, 2002). Moreover, when there have been major structural shocks in past times, as it happened in the European transition economies, past data may be misleading because such shocks are not going to be encountered again in the future. The best approach would be to estimate a long-term development path for each economy, based on an appropriate growth model. Yet, the economic collapse recorded between 2008 and 2012 and the still unstable macroeconomic situation make growth forecasts very uncertain.

For the purpose of this exercise, a different g for each country has been estimated, based on the per capita GDP real growth over the period 2000-2018. These data are provided by the International Monetary Fund (April 2013). They include a set of consolidated data and a set of forecasted values, which, at the moment of writing, are the only official projections going so distant in the future.[18] Hence, while annual data have been considered (referred to year 2011) for the elasticity and the pure time preference terms, g is computed as an average of values covering almost two decades, in order to account for different economic cycles.

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[15] This formula has also been applied by Cowell and Gardiner (1999) and Evans (2006).

[16] OECD, Part I, Table I.4 and I.5, extracted on 07/05/2013 http://www.oecd.org/tax/taxpolicyanalysis/oecdtaxdatabase.htm

[17] As highlighted by Evans (2006), average elasticity is very similar to elasticity calculated at the average production wage, i.e. the average annual gross wage earnings of an adult, full-time manual worker in the manufacturing sector.

[18] The IMF's country teams produce forecasts for individual countries. These are then aggregated, and through a series of iterations where there aggregates feed back into individual countries' forecasts, forecasts converge to the projection reported in the World Economic Outlook. Estimates of per capita real GDP start after 2012 for Austria, Belgium, Bulgaria, Estonia, Germany, Italy, Latvia, Poland, Portugal, Slovak Republic, Spain and Sweden; after 2011 for Denmark, Finland, France, Greece, Hungary, Ireland, Lithuania, Luxembourg, Netherland, Romania and Slovenia; after 2010 for Croatia, Czech Republic and the United Kingdom; after 2008 for Malta. No forecasts are provided for Cyprus, for which the latest available data is 2012 (source: IMF World Economic Outlook, April 2013).

The simple average of per capita GDP growth over the considered period (2000-2018) is expected to be 0.97 per cent for the group of the so-called Old Member States (Western Europe) and 3.01 per cent for the EU Member States accessed after 2004, including Croatia.

With these three elements – p, e and g – the SRTP can be estimated for the 20 EU-OECD countries, as shown in Table 2. The gap between the lowest social discount rate and the highest ones, which apply, respectively, to Italy and Estonia, is very large: 1.13 per cent in one case and 6.52 per cent in the other. It is worth noting that the simple average for EU Member States not eligible for Cohesion Fund results 2.41 per cent, which is below the benchmark of 3.5 per cent suggested by the CBA Guide in 2008, mainly because of lower estimates of per capita GDP growth. As far as the Member States eligible for Cohesion Fund are concerned, the European Commission's SDR of 5.5 per cent appears to be overestimated for countries such as Slovenia and Hungary, but underestimated for Estonia.

Table 2: Estimation of the SRTP for 20 EU countries

Parameter	***p* (%)**	***e***	***g* (%)**	**SRTP (%)**
Reference period for the estimation	*2011*	*2011*	*2000-2018*	
Italy	0.98	1.50	0.10	1.13
Portugal	0.97	1.86	0.38	1.67
France	0.84	1.27	0.71	1.74
Denmark	0.94	1.28	0.63	1.75
Belgium	0.96	1.53	0.71	2.05
Spain	0.84	1.45	0.86	2.09
Luxembourg	0.74	1.84	0.77	2.17
Netherlands	0.81	1.55	0.96	2.30
Greece	0.98	1.47	0.96	2.39
United Kingdom	0.88	1.53	1.13	2.61
Austria	0.91	1.45	1.20	2.65
Germany	1.04	1.33	1.36	2.84
Slovenia	0.91	1.38	1.69	3.25
Finland	0.94	1.70	1.46	3.42
Hungary	1.29	1.25	1.90	3.67
Sweden	0.95	1.65	1.73	3.80
Ireland	0.63	2.31	1.55	4.21
Poland	0.97	1.09	3.16	4.43
Czech Republic	1.02	1.44	2.58	4.75
Estonia	1.14	1.19	4.53	6.52
TOTAL AVERAGE	**0.94**	**1.50**	**1.42**	**2.97**
NON-CF COUNTRIES	**0.91**	**1.51**	**0.98**	**2.41**
CF COUNTRIES	**0.97**	**1.49**	**1.96**	**3.66**

Source: Authors' estimation based on Eurostat, OECD and IMF data

5. Concluding remarks

The two main approaches proposed by the theoretical and empirical literature to estimate the social discount rate, namely the social rate of return on investment and the social rate of time preference, have been discussed in this paper. According to the social rate of return on private investment (SRRI) approach, when public investment is considered to have a displacement effect on private investment, the social discount rate should reflect the marginal social opportunity cost of the displaced investment. A possible proxy for the marginal rate of return on private investment is the real before-tax rate of return on corporate bonds. However, this approach is generally considered biased towards high estimates of the SDR and might not be appropriate. When public investments determine a postponement in consumption, a better approach to estimate the SDR is based on the social rate of time preference (SRTP). In this framework, the SDR depends on the expected growth rate of per capita consumption, the elasticity of marginal utility of consumption and a pure time preference term.

Significant variations in social discount rates adopted by governments and evaluators exist across the world, depending on the country specificities, but also on the estimation method used and on the specific underlying parameters chosen. As far as the European Commission is concerned, it adopted the SRTP approach to estimate the social discount rates currently used by EU Member States. On the ground of different growth rates, the Commission required a 3.5 per cent SDR for the countries not eligible for the Cohesion Fund and a 5.5 per cent for the others.

In order to take account of the effects of the recent economic crisis, we have re-computed the European SDR based on more up-to-date growth expectations. The results of this empirical exercise, conducted at country level and considering the economic per capita growth trend over the 2000-2018 period for 20 EU-OECD countries, show wide country variations. The estimated average SDR in the twelve Member States not eligible to Cohesion Fund is 2.41 per cent, lower than the DG Regio 3.5 per cent benchmark. Among these, Italy has the lowest SDR, amounting to 1.13 per cent and Sweden the highest one, i.e. 3.80 per cent. The sample of countries for which the SDR has been estimated includes nine Member States eligible to Cohesion Fund. The average SDR for this group is 3.66 per cent, also below the DG Regio benchmark of 5.5 per cent, with Portugal having the lowest rate, 1.67 per cent, and Estonia the highest one, 6.52 per cent.

The different estimates of discount rates mainly rely on different present level of wealth and on different expectations about the future welfare. In calculating the net present value of investments, a poor person discounts future income more than a rich. If an individual is poor, the fact that in some distant future he will be richer is less important, as he has more urgency now and therefore puts more weight on today's consumption. In other terms, the opportunity cost of differing consumption is higher for a poor individual. The same argument holds for less or more economically developed countries. A relatively high social discount rate, deriving from a high consumption growth trend, high elasticity of marginal utility of consumption and/or high rate of pure time preference, reflects a higher preference for present consumption. Such a SDR gives a small weight to benefits or costs that occur further in the future, thus weakening projects with back-end loaded benefits and strengthening those with front-end loaded benefits. A positive but relatively low discount rate, on the other hand, applies to countries with lower economic growth rates. It indicates that the agent gives similar weights to the utilities occurring at any point in time, i.e. that today's and future consumption are almost indifferent from the utility point of view. A low discount rate reduces only to a limited extent the value of future flows, thus favouring projects whose benefits occur in the medium-long run.

The main contribution of this exercise is to highlight the importance of national heterogeneity and disparities in the estimation of the social discount rate, deriving from differences in terms of present and future welfare. A line for future work is to improve the estimation of the elasticity term and to compute it also for the remaining non-OECD EU Member States. To this purpose, data about marginal and average tax rates in non-OECD countries could be gathered from national statistics offices.

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