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ad hoc del proceso de descuento en Costa Rica pueda llevar a error en el análisis económico, este documento revisa aspectos teóricos y metodológicos sobre el descuento, para luego proceder a la estimación de tasas de descuento financieras y privadas. Los resultados sugieren que el mejor estimado del costo de oportunidad privado del capital, la tasa de interés del consumo (CRI) y la tasa social de descuento se encuentran en un rango del 9-10%. Dada la poca diferencia significativa entre el costo del capital y la CRI no hay necesidad inmediata de distinguir entre el descuento de flujos de consumo y de inversión. El rango de variación observado en CRI sugiere que los análisis de sensibilidad de la tasa de descuento deberían probablemente utilizar un rango del 7% al 10%. En otras palabras, dada esta revisión preliminaria , la práctica actual puede no ser tan terriblemente inapropiada. Es necesario sin embargo que más esfuerzos sean dirigidos hacia la estimación de parámetros claves relacionados con los modelos utilizados en este documento.

Abrégé

La mise en application des méthodologies économiques d'évaluation et d'estimation est fortement dépendante de la pondération intertemporelle des flux monétaires. Ceci prend toute son importance dans le cas de l'évaluation environnementale, où les effets à long terme sur l'environnement sont compensés par les avantages productifs à court terme. Le passage en revue des taux d'actualisation appliqués dans la documentation économique et par les agences de financement au Costa Rica amène à penser que les méthodes et taux employés ne sont guère fondés ni en théorie, ni par l'analyse empirique. Réfléchissant au risque que la nature *ad hoc* de l'actualisation pratiquée au Costa Rica amène une erreur d'analyse économique, ce texte revisite les questions théoriques et méthodologiques relatives à l'actualisation, avant de passer au calcul des taux d'actualisation financiers et sociaux. D'après les résultats obtenus, il

consumption rate of interest - CRI) et le taux d'actualisation sociale se situent tous trois dans la fourchette des 9-10 %. Étant donné qu'il n'y a pas de différence significative entre le coût du capital et le *CRI*, il n'est pas immédiatement nécessaire de faire une distinction d'actualisation entre les flux de consommation et les flux d'investissement. La marge de variation enregistrée pour le *CRI* suggère que l'analyse de la sensibilité des taux d'actualisation devrait probablement faire appel à une marge de 7 à 10 %. En d'autres termes, il se pourrait bien que compte tenu de cet examen préliminaire, la pratique actuelle ne soit pas excessivement inadéquate. Il faudra cependant faire un effort supplémentaire afin d'estimer les paramètres-clés impliqués dans les modèles auxquels on a fait appel pour ce texte

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Introduction[1]

In the economic analysis of long-term projects or changes in policy and land use with long term impacts, the cost and benefit flows typically occur in different periods. The process of discounting these flows enables them to be added together and compared with the net present value of alternative courses of action. Discounting is therefore central to intertemporal economic analysis. In the case of the analysis of environmental issues, discounting assumes particular importance, given that economic benefits produced by ecosystems (or damages incurred by their degradation) either (1) occur only in the future (2) increase into the future or (3) subsist at a low level indefinitely. In such cases the difference between a 5 and a 15% discount rate can easily outweigh other considerations in the decision-making process.

In a recent analysis of economic incentives for watershed protection in Costa Rica, efforts to value forest productivity and long-term hydrological externalities confronted similar problems. Consultation with local financing agencies, researchers and the literature to determine the source of the discount rate methods and figures employed in practice yielded no satisfactory indication of how rates were developed. Given the paucity of informed expectation regarding such a key variable this paper presents the results of the subsequent effort to develop an informed and defensible position regarding discount rate issues in Costa Rica.

The general objectives of the paper are to develop discount rates that can be used in financial and economic analysis within the Costa Rican context. Specifically, the following discount measures were identified (expected use is indicated in parenthesis):

- real after-tax private opportunity cost of capital (for discounting all flows in financial analysis)

- a consumption rate of interest (CRI), or social rate of time preference (for discounting consumption flows in economic analysis)

- development of a shadow cost of capital (for use with the CRI in discounting investment flows in economic analysis)

In the process of meeting these objectives, information is also required on imperfections and applicable policy distortions in Costa Rican capital markets and local real riskless interest rates. The final product of the analysis is the calculation of a social discount rate for Costa Rica. Following a presentation of the theory and methods employed, the data and results for Costa Rica are presented.

[1] The auhors would like to thank David Pearce, Colin Price and Douglas Southgate for commenting on an earlier version of this paper. The authors accept full responsibility for any errors or omissions.

Theory and Methods

Discounting of cost and benefit flows associated with a particular decision-making task (eg, project, land use, policy) allows the decision-maker to effectively compare monetary flows that occur in different periods. In discussing the different types of discount rates that are available, Gittinger (1982) distinguishes between discount rates for use in financial or economic appraisal. Financial measures reflect the marginal opportunity costs of funds as perceived by different individuals and groups in society (ie, individuals, households or firms). An economic measure of discount entails a discussion of what would be an appropriate discount rate from the perspective of the economy as a whole, in the absence of market and policy imperfections. As employed within the context of economic analysis, such a rate must be consistent with other economic (or shadow) prices that are used to infer the worth of a particular undertaking from the perspective of national income.

Private Discount Rates

Relatively little variation of opinion exists regarding the theoretical basis for the development of financial discount rates. As stated by Freeman (1993), in the absence of taxes and other capital market imperfections, utility maximising individuals borrow or lend so as to equate their marginal rates of substitution between present and future consumption with the market rate of interest. As a practical implication of the former, Gittinger (1982) suggests that the private marginal opportunity cost of capital will be the interest rate at which the respective entity can borrow funds. If the entity is a firm that also relies on equity capital then a weighted opportunity cost of capital may be required that accounts for both borrowing rates and the need to attract equity capital (Gittinger 1982; Brealey and Myers 1988).

Actual derivation of real private rates of discount rates are complicated by the existence of inflation, risk, taxes and the variety of market interest rates, including different rates for different borrowers and lenders and different rates for borrowing and lending. Nevertheless, assuming for the moment that a nominal market rate can be observed, it is possible to identify the effective private opportunity costs of capital for different actors.

In the presence of taxes or other policy distortions, an adjustment to observed market rates may be required in order to derive the effective rates faced by borrowers or lenders. In the case of individuals supplying capital to the market, taxes applicable to earned interest and the deduction of interest expense from personal income taxes may be used to arrive at effective after-tax rates. The personal after-tax lending rate, l_P, in the presence of a tax on personal income (including interest), t_p, and nominal market interest rate i, is as follows (Jenkins and Harberger 1986; Freeman 1993):

$$l_P = i(1 - t_P) \qquad \text{Eq. 1}$$

If interest income is also taxed at source at a rate of t_i, prior to applying the income tax to net interest (net of t_i), then the after-tax lending rate becomes:

$$l_P = i(1 - t_i)(1 - t_P) \qquad \text{Eq. 2}$$

Jenkins and Harberger (1986) suggest that institutional lenders will require a margin, *M*, to lend to individuals who borrow to finance current consumption. The nominal rate faced by borrowers can thus be described as:

$$b_P = i + M \qquad \text{Eq. 3}$$

In the presence of an interest expense deduction on personal income taxes, t_D, the rate actually faced by borrowers would be altered to reflect the personal after-tax borrowing rate for individuals (Freeman 1993):

$$b_P = (i + M)(1 - t_D) \qquad \text{Eq. 4}$$

In this case, the market borrowing rate ($i + M$) is likely to be observable. Also, note that the effect of these distortions is to result in effective lending and borrowing rates that are lower than observed market rates.

The effect is the reverse for corporations subject to a corporate income tax, t_C. In this case, the corporation will have to equilibrate their net of tax rate of return with the market interest rate. This implies that the corporation's pre-tax or gross rate of return will need to be proportionately higher (depending on the rate of tax) than the market rate in order to justify borrowing. Implicitly, then the cost of borrowing to the corporation, b_C, will be the market rate adjusted for the effect of taxes as follows (Harberger and Jenkins 1986):

$$b_C = i / (1 - t_C) \qquad \text{Eq. 5}$$

The net effect of taxes and margins may lead to a rather large wedge between the marginal productivity of investment and the rate of time preference of savers (Jenkins and Harberger 1986). In addition, market imperfections and transactions costs may add to the difference between effective interest rates faced by different sectors and individuals (Freeman 1993). If, however, corporations are allowed to deduct interest expense in arriving at pre-tax profits, taxes have no effect on capital costs as the ($1 - t_c$) factor is then effectively included in the numerator thereby canceling out the effect of taxes on the effective borrowing rate.

The effect of inflation on nominal interest rates is typically deducted in arriving at real rates of interest. This is based on the assumption that all actors will perfectly anticipate inflation and adjust their behaviour based on the real, not nominal, rate of interest. Freeman (1993) specifies the relationship between the nominal rate of interest, *i*, the real rate of interest, *r*, and inflation, π, by equilibrating expected returns after one period:

$$\frac{(1 + i)}{(1 + \pi)} = 1 + r \qquad \text{Eq. 6}$$

or:

$$i = r + \pi + r\pi \qquad \text{Eq. 7}$$

Given low real interest rates and low inflation the third term in the latter equation reduces to approximately zero, leading to the conventional means of obtaining real rates by simply subtracting the inflation rate from the nominal interest rate. However, in cases where inflation is not trivial the term is left in the equation in order to solve for the real rate of interest:

$$r = (i - \pi) / (1 + \pi) \quad \text{Eq. 8}$$

Each of the tax-adjusted rates developed above can in turn be substituted for *i* in Equation 8 in order to derive the real private discount rates from different perspectives. For example, the real effective borrowing rate for an individual in the presence of a tax deduction on interest payments will be:

$$r_P = ((i + M)(1 - t_P) - \pi) / (1 + \pi) \quad \text{Eq. 9}$$

The issue of just which market rate should be used in such calculations is often a matter of judgment. To the extent possible, effort should be made to isolate the observable rate most relevant to the case under consideration and adjust for any distortions and inflation present. This applies equally to the case(s) where different rates are observable for different borrowers (or lenders) as to the issue of whether to use a consumption or investment rate. In the latter case, Freeman (1993) suggests that individuals face a kinked budget line. In a given period, they will be borrowing at a given rate and in the next they may be lending at another rate. Thus, those individuals that lend, face a lending rate of interest, and those that borrow, face a borrowing rate of interest. This issue is particularly relevant in developing countries where relatively, inefficient state run banks often dominate local capital markets. Typically, the observed interest rate used is a short-term riskless rate of interest. In such cases the observed margin, or spread, between such a riskless lending rate and the generally available borrowing rate is considerable. As indicated above, this margin can be considered to reflect a margin that incorporates the net transaction costs incurred in capital market operations plus a risk premium.

Social Discount Rates

Unlike the case with private discount rates, there exists a variety of opinions on what type of rate society should use in discounting future income and expenditure streams to best societal welfare, regardless of actual market rates. This question is often construed in the context of the appropriate rate to use for the appraisal of projects (and policies) involving the use of public funds (ie, societal funds) and in the context of finding a rate with which to discount long-term environmental costs and benefits. Typically, a single rate based on the opportunity cost of capital in the private sector is applied to all three types of cash flows: (1) displaced investment flows (ie, the capital share of a project's cash flow), (2) reduced consumption flows (ie, the share of costs devoted to recurrent expenditure) and (3) income streams which may have both capital and consumption components (see Cline 1992: 247).

As noted by many authors, the need to arrive at a social rate is primarily a product of the disparity between observed rates of discount for consumption (or the social rate of time preference) and the rate of return on investment (or the opportunity cost of capital). In a perfectly competitive capital market with no distortions (or transaction costs) it is generally assumed that the social time preference rate should equal the social opportunity cost of capital. The observed disparity between the two rates is primarily a product of the existence of distortions in capital markets, project risk and taxation of income (Cline 1992; Freeman 1993; Pearce and Ulph 1995). Typically then, the debate over social rates for discounting comes down to whether it is preferable to use a rate solely based on the private rate of return on investment or on a rate that incorporates both the opportunity cost of capital and the social rate of time preference.

In choosing the appropriate discount rate for evaluation of public sector investments, advocates of the opportunity cost approach recommend using one of three measures: the marginal opportunity cost of capital for the private sector, the same cost for the public sector, or for the economy as a whole (Gittinger 1982; Jenkins and Harberger 1986). Gittinger (1982) suggests that the latter rate in most developing countries would lie between 8 and 15%. Birdsall and Steer (1993) confirm that the World Bank, in assessing the opportunity cost of capital in borrowing countries, regularly uses rates in the order of 8 to 10%. Jenkins and Harberger (1986) critique these approaches as failing to account for the ability of capital markets to adjust the allocation of funds between consumption and investment. In other words, a more theoretically correct approach to the allocation of social investment takes into account not just opportunity costs related to foregone investment, but also those of postponed current consumption.

Two principal methods exist for undertaking such a comprehensive approach to estimating social rates. The first, the social opportunity cost of public funds (SOC) method, developed by Harberger (see Jenkins and Harberger 1986), is calculated by deriving a weighted average of the marginal productivity of capital in the private sector and the rate of time preference for consumption. This method relies on information regarding the elasticity of supply and demand for savings and investment, respectively, across different types of savers and investors.

The second approach is called alternatively the consumption-equivalent method (Cline 1992), the consumption rate of interest plus shadow price of capital method (Pearce and Ulph 1995) or the shadow cost of capital method (Freeman 1993). According to Cline (1992), Arrow, Feldstein, Kurz and Bradford developed this method during the late 1960s and early 1970s. The consumption-equivalent method (CE) consists of three steps: (1) all monetary flows are divided into consumption or investment flows; (2) investment flows are converted into consumption equivalents using the shadow cost of capital; and (3) all flows are discounted by the consumption rate of interest (CRI), or social rate of time preference.

A few points regarding the CE method are worth noting before turning to the formulae used in the derivation of the CRI and the shadow price of capital. First of all, the method does not explicitly employ a single social discount rate that would be comparable to the SOC rate (in that it incorporates both the demand and supply conditions in capital markets). Instead, the CE method employs the marginal productivity of capital to derive the shadow price of capital that is subsequently used to convert investment flows to consumption equivalents. Nonetheless, Cline (1993:4) demonstrates that if relative shares of consumption and investment in the general economy are known, an economy-wide social discount rate that is comparable to the SOC can be derived. This is accomplished by taking a weighted average (by shares) of the CRI and the shadow-priced CRI (CRI multiplied by the shadow cost of capital). Thus, although the CE method uses different techniques than the SOC method, the two methods are conceptually similar (Jenkins and Harberger 1986).

The SOC method is described in detail in Jenkins and Harberger (1986). It is not repeated here as the information required for the estimation of such a weighted average for Costa Rica is not available. Indeed, practical applications of both the SOC and CE methods are not easy to find. Despite the assertion that the CE method is generally accepted by economists and is the "state of the art" (Cline 1993:4) neither it, nor the SOC method, are often seen in applied cost-benefit analyses, particularly in developing countries. One explanation of the relative scarcity of applications of these approaches may be a resistance to the notion of abandoning the opportunity cost of capital approach for the (perceived) lower consumption rate of interest. Another reason is likely to be the paucity of methods for actually calculating the consumption rate of interest, and the considerable disagreement (both economic and ethical) over the magnitude of its components. A final complication for the analyst is the need to distinguish between investment and consumption flows.

In developing a social rate for application to the problem of global warming, Cline (1992) discusses the CRI in relation to growth and utility theory, however, his methods are more discursive than formal. In the end he relies on rough historical observations of lending rates and the growth of consumption to arrive at a CRI of 1.5% (Cline 1992 and 1993). Pearce and Ulph (1995), on the other hand, present a formal method for calculating the CRI and an application using figures for the United Kingdom. Given its nature the Pearce and Ulph (1995) approach lends itself to adaptation to other countries and, so, it is reviewed below in detail.

The Consumption Rate of Interest

The consumption rate of interest is composed of two factors. The first factor accounts for the extent to which consumers have an inherent preference (ignoring conditions) to consume now as opposed to later.[2] The second factor relates to the actual utility of additional units of consumption. As basic consumer needs are satiated it is assumed that the value of additional units of consumption falls. Thus, the more consumers are inherently in a hurry to consume the higher the CRI. Conversely, the lower the increase in value derived from each additional unit of consumption the lower will be the CRI. A common mathematical formulation of these concepts is that the consumption rate of interest, s, is determined by the rate of time preference, δ, plus the product of the elasticity of the marginal utility of consumption, μ and the expected rate of growth in average per capita consumption, g (Cline 1992; Pearce and Ulph 1995):

$$s = \delta + \mu * g \qquad \text{Eq. 10}$$

[2] For a different view see Price (1993, Chapter 7) in which time preference is presented as a preference for now-rather-than-any-other-time not for now-rather-than-later.

Pearce and Ulph (1995) suggest that the rate of time preference is affected by two factors: the pure rate of time preference, ρ, and changes in the risk to life (mortality), L. The latter factor negatively affects time preference as follows:[3]

$$\delta = \rho - L \quad \text{Eq. 11}$$

The pure rate of time preferences is that preference for consumption today as opposed to the future that arises simply because of the difference in the timing of such consumption and not due to the circumstances surrounding it (Pearce and Ulph 1995 and Price 1993). Much controversy surrounds the value of ρ. Some economists suggest it should be zero on ethical concerns regarding intergenerational equity (see the section on "Discount Rates over time" below). Pearce and Ulph (1995), disagree with the view that impartiality between generations (ie, a rate of zero) must be the outcome of a utilitarian approach that underlies cost-benefit analysis. Instead, they suggest that since future generations may in fact be likely to be better off than the current generation it is possible to support a positive pure rate of time preference on egalitarian grounds. In a review of the literature on the United Kingdom, Pearce and Ulph (1995) find only a single estimate of ρ equal to 0.5% and conclude that based on a second study by the same author a central estimate would be 0.3%.

The inclusion of changes in life opportunities in the derivation of rates of time preference is based on the common sense reasoning that one argument for consumption now as opposed to the future is the risk that in the future the consumer may be dead. Pearce and Ulph (1995) adopt the following method of quantifying this element as the total number of deaths (the crude mortality rate) divided by the total population and derive a value of 1.1% for the UK in 1991:

$$L = \text{Total deaths / Population} \quad \text{Eq. 12}$$

With respect to the estimation of the elasticity of the marginal utility of consumption, Pearce and Ulph (1995) first acknowledge that a number of economist regard μ as beyond measurement and then survey potential methods and a variety of results for the UK. They conclude that, although it is impossible to estimate μ from observed consumption behaviour, it is possible to estimate this elasticity through the observation of savings behaviour. The authors cite Stern (1977) and Hicks (1965) in developing a lifetime utility function constrained by savings behaviour. Assuming that incomes are expected to grow over time, the maximised utility function leads to the following definition of the elasticity of the marginal utility of consumption (Scott 1989, in Pearce and Ulph 1995):

$$\mu = \frac{r - \rho}{\frac{S}{Y}(r - y) + y} \quad \text{Eq. 13}$$

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[3] $\dot{L}$ is negative reflecting that life chances decrease over time. However, given that a decrease in life chances will raise the rate of time preference, life chances are subtracted from the pure rate of time preference, effectively yielding a double negative

where ρ is the pure rate of time preference (or "utility discount rate"), r is the rate of return on investment, y represents the growth rate of incomes from work, S is saving, and Y is income. Using values of r = 5%, S/Y = 10%, y = 2.5% and ρ = 2.5% for the United Kingdom, Pearce and Ulph (1995) suggest that μ will fall between 1.0 to 1.3% (actually it is correctly calculated as 0.91%). If a value for the pure rate of time preference of zero is used the value of μ changes to 1.82% (Pearce and Ulph 1995). Based on even more recent work Pearce and Ulph (1995) conclude that a central values for μ is 0.8% with a range from 0.7 to 1.5%. The authors note that a μ of 1.5% is equivalent to saying that the value of an extra £1 to a household with consumption twice that of a second household is the valued by the first household at only 35% of what it is valued by the second household. Pearce and Ulph (1995) suggest that using a μ above 1.5 is implausible. However, the authors offer no specific rationale for this view, nor is it clear why there would not be room for considerable movement in the elasticity of the marginal utility of income across different income groups.

Finally, Pearce and Ulph (1995) suggest that the best way to derive estimates of the expected growth rate of per capita consumption is to use available time series data. For the UK, the authors obtain values of 1.3% for the period 1885-1992 and 2.2% for 1951-1992. Aggregating low, high and central estimates of the various variables, Pearce and Ulph (1995) estimate a range of from 0.9 to 5.0% and a central estimate of 2.4% for the CRI in the UK.

The Shadow Price of Capital

Cline (1992) reviews previous methods for calculating the shadow price of capital, highlights their weaknesses and provides the following intuition for an improved method.[4] First, Cline (1992) portrays the shadow cost of capital as the difference between the choice of a loaf of bread this year and a machine that generates q loaves of bread annually ($0<q<1$) and then breaks down completely at year N. With an internal rate of return for the bread machines of r, the real annuity, $A_{r,N}$, derived from the machine is equivalent to q. The value of the bread machine, with bread-loaf units being the numeraire, is the stream of q over N years discounted at the consumption rate of interest, s (as q is a consumption flow). The shadow price of the machine, v_C, will, therefore, be this present value divided by the consumption value of a loaf of bread today. The latter being equal to unity, Cline (1992) concludes that the shadow price of capital is as follows:

$$v_C = \sum_{t=1}^{N} A_{r,N} (1+s)^{-t} \qquad \text{Eq. 14}$$

[4] This paper follows Cline (1992) in excluding the issue of the reinvestment of investment income (i.e. future project benefit flows) from the calculation of a shadow price of capital. Instead the analyst is left to decide to what degree future benefits flows (e.g. of a project) are destined for investment or consumption. For differing views on this issue see Price (1996: 161) and Cline (1992: 270-274).

As the equation for calculating v_C is nothing more than the present value of an annuity, the standard formula for calculating the present value of an annuity of length N can be used as follows (Brealey and Myers 1988):

$$v_C = \frac{A}{s} - \frac{A(1+i)^N}{s} \qquad \text{Eq. 15}$$

As the bread making machine must have an internal rate of return equal to the rate of return on capital, *r*, Pearce and Ulph (1995) add that the following equation must be satisfied:

$$-1 + \sum_{t=1}^{N} A(1+r)^{-t} = 0 \qquad \text{Eq. 16}$$

By solving the above equation for the annuity payment, *A*, we can then substitute *A* into the formula for calculating the shadow price of capital (Pearce and Ulph 1995):

$$v_C = \frac{r}{1-(1+r)^{-N}} \frac{1-(1+s)^{-N}}{s} \qquad \text{Eq. 17}$$

This reduces the shadow price of capital to a function of the opportunity cost of capital, the consumption rate of interest and the average lifetime of capital in the economy (Pearce and Ulph 1995). Cline (1992) points out that when *N* is one the shadow price of capital approximates $(1+r)/(1+i)$ and as *N* extends to infinity the shadow price of capital approaches r/i, both intuitive results. The method generates explosive results (ie, goes to infinity) only when *i* goes to zero and *N* approaches infinity. In such a case, Cline (1992) concludes that any project with the slightest return will be heavily favoured, again consistent with intuitive reasoning. Finally, Cline (1992 and 1993:4) concludes that the method will typically yield results in the range of 1.5 to 2.0 (eg, 1.56 in the case where $r = 8\%$, $s = 15\%$ and $N = 15$).

As indicated earlier, the consumption-equivalent method should in theory produce the same result as the social opportunity cost method. However, the latter method simply produces a single, weighted average rate. In order to arrive at the economy-wide social discount rate by means of the consumption-equivalent method one additional step is necessary. First, the CRI is multiplied by the best estimate of the shadow price of capital and the result adjusted for the share of investment in the economy. Second, the CRI as weighted by the share of consumption in the economy. Combining the two figures leads, then, to an overall rate for the economy. Following the example from the previous paragraph, if the share of investment in the economy was 20% (and consumption 80%), then the social discount rate would be 1.67% (0.015*1.5*0.20+0.015*0.8).

Discount Rates over Time

The time profile of discount rates is an additional complicating factor (in the case of both private and social rates). Typically, cost-benefit analysis is carried out with a single rate applied over the length of the planning horizon in a negative exponential fashion. Although there is little agreement on this topic, there does seem to be a growing suspicion (more so than a formal proof) on the part of economists that over longer periods such an approach is untenable. Heal (1996) suggests that our evident concern about the future and the environment is not captured by utilitarian discounting, a practice that equates present world GNP two hundred years in the future, as discounted at a constant exponential rate of 10%, to the value of a used car today. Others (eg, Price 1993) have simply taken examples of the latter type to suggest that discounting, taken as a whole, is not useful.

Many economists have pointed to the difficulty of discounting over more than one generation.[5] As the intertemporal preferences of future generations are unknown, Hanley and Spash (1993) claim that discounting over generations involves an ethical (not economic) view about the claims of future generations. Implicitly, then, practitioners that use current discount rates far into the future are assuming that the preferences of future generations will be the same as that of present generations. Essentially, this is taken as an arbitrary decision and has led to calls (by economists and non-economists) for the use of lower, or zero, discount rates for the evaluation of long term projects and policies in order to minimise the potential for future regret.

However, Dasgupta and Maler (1994) qualify this conclusion by showing that even when intergenerational equity is valued as an ethical goal, discount rates for use in cost-benefit analysis must be greater than zero, provided that consumption is growing over time. Nevertheless, as Heal (1996: 5) notes, "It may be fair to say that discounted utilitarianism dominates our approach more for lack of convincing alternatives than because of the conviction that it inspires."

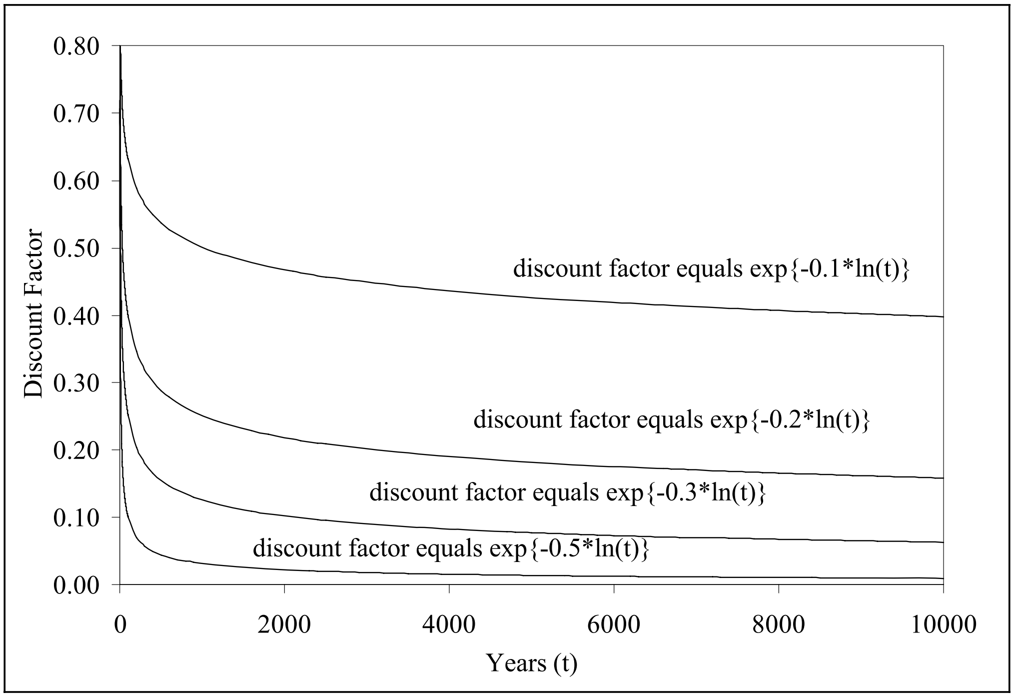
The intergenerational critique can be taken one step further by asserting that it is also indefensible to maintain a given discount rate over a single generation. This problem arises as it may be difficult to establish even the intertemporal preferences of a single individual over time. Price (1993) illustrates this problem by summarising existing experimental (and anecdotal) evidence that demonstrates that intertemporal choices are not only ill-informed but biased, leading to inconsistency in pure time preference. A number of economists report on studies that suggest that while people seem inclined to have high short term rates of time preference, that over time these rates diminish (Cline 1992; Freeman 1993; Price 1993; Heal 1996). For example, Cropper, Aydede and Portney (1992) surveyed public preferences for life saving and found that respondents did not discount future lives at a constant exponential rate. Median discount rates for the authors' sample dropped from 17% for a five-year horizon to 3.7% for a one hundred-year time horizon.

Thus, a mounting body of evidence and critique of standard practice leads to the suggestion that it may be defensible to use declining discount rates over longer periods of time. In a recent paper, Heal (1996) suggests that discount rates may not be constant over time, but instead a function of time and go asymptotically to zero. Assuming that rates vary with the logarithm of time, Heal (1996) proposes a formulation, then, in which the discount factor would be equal to $e^{-\delta \ln(t)}$ instead of the usual $e^{-\delta t}$. In this case the δ, is not so much the "discount rate", given that the rate will change over time, but more a constant that defines the intertemporal path of the discount factor itself. In the absence of any empirical testing of the equation it is difficult to say what value the constant should take. In the figure below the path

[5] See Hanley and Spash 1993 for a review of such critiques in the context of cost-benefit analysis.

of the discount factor is shown for a range of constants.

Figure 1. Negative Exponential Discount Rates versus the Logarithm of Time



Although the logarithmic form will clearly give increased weight to costs and benefits occurring farther in the future (as opposed to the normal negative exponential method), the figure above poses a further question. Given the specification proposed, it is clear that the discount factor itself goes to zero only in the very long run. As shown the discount factor will drop only gradually, depending on the value of the constant employed. As a result flows far into the future will be weighted at some percentage of their nominal future value in the present value calculation. As time goes to infinity this characteristic implies that environmental benefits or damages that increase over time will always outweigh a constant (or decreasing) productive value. In other words the critical issue simply switches from being one of the choice of discount rate to one of the choice of time horizon. While this approach might have an intuitive appeal, it also implies a large degree of fatalism as, for example, with an appropriate time horizon (effectively infinity) almost any increasing environmental benefit that extends in perpetuity will outweigh its initial investment or opportunity cost. Although the ideas of declining discount rates as proposed by Heal (1996) and others is interesting its practical application remains unclear and is left for others to explore.

Data and Results

The Costa Rican financial system is composed of financial institutions, financial instruments developed by these institutions and the laws, regulations and norms that apply to the system. The next sub-section presents a brief summary of the Costa Rican financial system and its capital markets. This is followed by a discussion of policy distortions and market failures that affect Costa Rican capital markets. In subsequent sub-sections the calculation of the private cost of capital, the riskless rate of return on capital, the consumption rate of interest, the shadow price of capital and the social discount rate are presented.

The Costa Rican Financial System and Capital Markets

Financial intermediaries in Costa Rica can be classified into four groups: (1) banking institutions (including the Central Bank and the National Banking System), (2) non-banking public financial institutions, (3) non-banking private financial institutions and the (4) the stock and bond markets. As with many developing countries, the principal financial intermediaries are the banks. The state-owned commercial banks, the private commercial banks and the cooperative banks make up the national banking system (NBS).

Following the 1948 Civil War, the transition to a social welfare state included the nationalisation of existing banks and the creation of the state-owned commercial banks and Central Bank. Historically, the state-owned commercial banks (Banco Nacional, Banco de Costa Rica, Banco Anglo Costarricense, Banco Credíto Agricola and the Banco Popular) have, therefore, enjoyed a privileged oligopoly/oligopsony in local capital markets. Recent trends towards liberalisation of the welfare state have included a number of reforms of the banking sector, beginning with the legalisation of private banks in 1984 and culminating with the November 1995 banking reform law (Ley Orgánica del BCCR N° 7558). Deterioration of services, financial margins of over ten percentage points and the failure of the Banco Anglo Costarricense in 1994 all underscored the need for reform. Amongst the reforms, the Law eliminates the monopoly held by the state-owned banks on checking accounts and provides private banks with access to Central Bank bailout loans.

Historically, a limited number of savings instruments (checking and savings accounts, and short-term deposits), government bonds and other foreign liabilities underwritten by the Central Bank have been used by the non-Central banks in the mobilisation of funds for investment in Costa Rica (Zúñiga and Muñoz 1988). Foreign direct investment and the local stock and bond markets play only a minor role in savings mobilisation. Extension of credit to the private sector occurs through state and private banking institutions. The latter consist of private banks and cooperatives. As expected, the privileged position occupied by the state commercial banks has led them to play a dominant role in both savings mobilisation and extension of credit. In 1988 the state banks controlled 90% of term deposits and conceded 87% of loans (Zúñiga and Muñoz 1988). Initial evidence of the importance of banking reform can be seen by the rapid rise of the private sector's participation in credit extension to 13% by 1986 (Zúñiga and Muñoz 1988). A recent estimate suggests that private banks controlled 30% of the banking market (Harris 1996). Given the historical dominance of Costa Rican capital markets by state banking institutions the ensuing discussion relies primarily on data from these banks, incorporating data from the private sector where available.

Interest Rate and Loan Data

Loan rates as offered by both public and private banks are differentiated by sectors and subsectors (e.g. agricultural marketing, agricultural investment, agricultural operations, etc.). For this study, month by month statistics on interest rates across sectors where obtained from the Central Bank for the period 1986-1995. The data are disaggregated across the four commercial banks and the private sector (a low and high rate for each month). In order to calculate a yearly average by sector, a private sector rate (the midpoint between low and high rates) was first obtained. Simple monthly averages of the data over the four commercial banks and the private sector were then calculated and an average of these rates taken for the year (and sector). These annual averages by sector are presented in the table below.

Table 1. Nominal Borrowing Rates by Sector and Sub-Sector

	Agriculture				Livestock					Ag S	Ind	Others		
Year	Sum	MP	Inv	Op	Sum	Inv R	Inv O	D&F	Op O			Con	Hou	P
1986	-	26.2	24.3	22.8	-	22.4	23.2	23.7	-	11.8	26.3	26.3	24.5	30.0
1987	-	27.2	25.3	23.9	-	24.1	24.7	25.6	-	12.0	27.3	27.3	24.7	29.1
1988	-	-	27.8	27.1	-	27.9	26.5	29.2	-	12.0	30.6	30.6	26.9	32.0
1989	-	-	28.0	27.7	-	28.1	27.5	29.5	-	12.0	30.7	30.8	27.1	31.3
1990	-	33.0	31.0	31.2	-	31.5	30.9	32.5	39.3	12.0	33.8	34.2	30.9	35.2
1991	-	39.5	38.6	38.7	-	38.7	38.3	38.9	39.9	20.0	39.8	40.2	38.1	41.2
1992	-	28.7	28.7	27.9	-	28.2	27.9	28.3	28.4	23.4	28.5	28.3	27.0	29.7
1993	-	30.3	30.3	29.6	-	29.8	29.8	29.8	31.6	24.9	29.5	29.6	26.8	31.1
1994	33.2	33.7	-	-	33.2	-	-	-	-	31.2	33.3	33.2	29.8	34.9
1995	36.8	38.7	-	-	38.1	-	-	-	-	36.2	38.5	38.6	33.9	40.9

Notes: Figures in % per year. Sectors are as follows: Agriculture: (Sum) is an overall rate effective from 1995, (MP) is marketing, (Inv) is investment, (Op) is operations; Livestock: (Sum) is an overall rate effective from 1995, (Inv R) is investment in reproduction, (Inv O) is other investment, (D&F) is operations for development and fattening, (Op O) is other operations; (Ag S) is smallholder agriculture and livestock; (Ind) is industry; Others: (Con) is construction, (Hou) is Housing and (P) is other, primarily personal loans. (-) refers to data that is not available. Source: Central Bank of Costa Rica.

As a first step towards developing an average rate across sectors, the data in Table 1 were averaged to yield rates for four sectors: agriculture, livestock, industry and "other." In the case of the agriculture and livestock sectors the rather low rates offered to small producers are a complicating factor. In order to obtain averages for the two sectors smallholder loan rates were weighted proportionately to their share of total loans outstanding (SEPSA 1993). Figures for 1993 were used again for 1994 and 1995. For the "Other" category, rates from the housing, construction and personal sectors were combined using a simple arithmetic average. The rates for these four sectors are presented in Table 2.

Table 2. Nominal Sector Average Borrowing Costs and Overall Average Borrowing Costs

Year	Agriculture		Livestock		Industry		Others		AvBr	WAvBr
	Rate	Share	Rate	Share	Rate	Share	Rate	Share	Rate	Rate
1986	22.2	21	21.3	20	26.4	32	26.9	28	24.2	24.6
1987	24.0	19	22.7	17	26.3	31	27.0	33	25.3	25.8
1988	25.1	17	24.7	18	27.3	38	29.8	27	27.5	28.3
1989	26.2	19	24.8	14	30.6	34	29.7	32	27.8	28.7
1990	30.0	21	28.7	11	30.7	33	33.4	36	31.5	32.4
1991	37.7	20	34.2	9	33.8	33	39.8	38	37.9	38.9
1992	28.2	18	27.6	8	39.8	27	28.3	47	28.2	28.3
1993	29.9	18	29.3	8	28.5	27	29.2	47	29.5	29.4
1994	33.3	18	33.0	8	29.5	27	32.7	47	33.1	33.0
1995	37.7	18	37.9	8	33.3	27	37.7	47	37.9	37.9

Notes: AvBr is a simple arithmetic average of borrowing rates and WAvBr is the weighted average borrowing rate as discussed below based on the share for each sector. Source: Shares from Vargas and Sáenz (1993).

Ideally, new loan amounts in each sector would be used to weight the loan rates in each sector to obtain an annual weighted average loan rate. In the absence of reliable data of this type, two procedures were used and then compared. First, a simple arithmetic average of the agricultural, livestock, industry and other sectors was derived (AvBr in Table 2). Second, annual year-end data on outstanding loans from the Ministry for Development and Planning (MIDEPLAN) was used to derive a weighted average of the sectors for each year from 1985 to 1992 (WAvBr in Table 2). Figures for 1992 were used to weight subsequent years. The results indicate that the difference between the two methods leads to at most one percentage point difference between the simple and weighted average borrowing rates. Although the use of outstanding loan amounts (in place of loans issued annually) is not the best weighting factor it should give an indication of the relative weighting of the different rates and as such the weighted figure (WAvBr) is used in the subsequent analysis.

Table 3 provides initial calculations of real borrowing rates based on Equation 9 and using the consumer price index of inflation for Costa Rica as reported by the International Monetary Fund (IMF). Note that the ten-year average for the real weighted average and the agricultural sector borrowing rates are just under 10%, while the respective rate for personal loans is 13%. It is likely that the historic pattern of subsidising agricultural and livestock credit has lead to correspondingly higher rates for the (less strategic) personal loan category. Thus, the true marginal borrowing rate probably lies somewhere between the weighted average and the personal rate. For the purposes of the analysis that follows the average rate is used as a conservative estimate of economy-wide borrowing costs.

Table 3. Inflation, Real Borrowing Rates, Deposit Rates, and Intermediation Margins

	Inflation	Real Borrowing Rates			Deposit Rates		Margin	
Year	CPI	WAvBr	Agriculture	Personal	Nominal	Real	Nominal	Real
1986	11.84	11.80	9.30	16.26	16.67	4.32	8.36	7.48
1987	16.85	6.66	6.12	10.52	14.06	(2.39)	10.58	9.05
1988	20.83	4.14	3.54	9.28	15.18	(4.68)	10.66	8.82
1989	16.51	10.15	8.28	12.69	15.62	(0.77)	12.72	10.92
1990	19.04	8.09	9.22	13.59	21.16	1.77	7.52	6.32
1991	28.71	2.84	6.97	9.67	27.32	(1.08)	5.05	3.93
1992	21.79	14.03	5.26	6.46	15.80	(4.91)	23.08	18.95
1993	9.78	16.85	18.29	19.42	16.90	6.48	11.39	10.37
1994	13.53	13.97	17.43	18.86	17.72	3.69	11.67	10.28
1995	23.19	7.94	11.77	14.09	23.88	0.56	9.09	7.38
Average	18.21	9.65	9.62	13.08	18.43	0.30	11.01	9.35

Notes: All figures in percent per year. The nominal and real margins are the difference between the respective WAvBR and deposit rates. Sources: The real WAvBr, Agriculture and Personal rates are calculated based on nominal rates in Table 2, Table 2 and Table 1, respectively. Deposit rates and the consumer price index of inflation for Costa Rica come from IMF (1996).

As indicated above, savings mobilisation is accomplished primarily through a limited number of financial instruments. Checking accounts held by the state banks have traditionally been non-interest bearing. As a result, interest rates affecting savings mobilisation are limited to those offered on savings accounts and short-term certificates of deposits. Data on nominal interest rates paid on short-term deposits (thirty to ninety days) are taken from IMF statistics and converted to real terms. As shown in the table above the real deposit rate fluctuates around zero with an average for the ten-year period that is barely positive. It is not considered unusual for real interest rates to be negative or barely positive for riskless, short-term deposits. Using the same methods and IMF data on US short-term Treasury Bill rates yields a simple, non-compounded average annual return of 1.1% over the period 1949-1995.

Comparison of equivalent annual rates of return in Costa Rica and the United States can be accomplished by comparing (1) the return earned on one-hundred colones that is exchanged for dollars at the beginning of the year, invested in T-Bills and then exchanged back into colones at year end at the new exchange rate and (2) the return earned on one-hundred colones at the deposit rate. Over the period 1986-1995 a simple average of the difference between the two rates of return (assuming comparable rates of tax) shows that a premium is earned by making annual investments in the US, but only by roughly 2 percentage points. During this period, then, Costa Ricans would have gained financially by maintaining short term deposits in Miami, for example. That funds were deposited locally suggests that the transaction costs of moving money offshore are greater than 2%. Costa Rican banks are apparently therefore able to pay interest at a discount to rates in Miami without greatly affecting savings mobilisation.

The results for the margin of intermediation suggest an average nominal margin of 11% and a real margin of just over 9%. While this is considerably higher than that expected in the US, for example, there are a number of reasons why banks in Costa Rica might be expected to be less cost-efficient than banks in the US. These are discussed further below.

Distortions Affecting Costa Rican Capital Markets

Distortions affecting Costa Rican capital markets, as discussed below, are divided into two categories: (1) policy distortions such as taxes and subsidies that drive a wedge between market interest rates, borrowing rates and after-tax returns; and (2) the inefficiency of the state commercial banks resulting from the oligopoly power granted to these institutions by the state that results in a larger than optimal rate of financial intermediation (margin). Another potential cause of distortion in capital markets is the role of state borrowing. Excessive intervention in local credit markets by the state may lead to higher interest rates and subsequent crowding out of private sector investment. Examining this issue in light of empirical evidence from the late 1980s, Naranjo and Zúñiga (1990) conclude that there is little evidence to sustain this theory in the case of Costa Rica. As a result the discussion of potential distortions affecting interest rates is limited to relevant taxes and subsidies and the level of financial intermediation costs.

Taxes and Subsidies on Interest Receipts and Payments. A number of implicit and explicit distortions exist in the Costa Rican banking system that affects interest and borrowing rates. Two implicit distortions are the minimum legal reserves that commercial banks are required to deposit with the central bank and the zero-interest checking accounts that the state commercial banks have operated for many years. In the case of the former, banks must deposit in the Central Bank between 10% and 31%, respectively of deposits with a term of more than six months and or deposits of less than one month. No interest is earned on these deposits and thus represents an implicit tax. The zero-interest checking accounts act in the opposite direction, providing an implicit subsidy to the banks. Unfortunately, the effect of both of these distortions on interests rates and the financial margin are difficult to determine.

The principal explicit taxes and subsidies that affect credit markets in Costa are:

1. a corporate income tax that varies from 10% to 30% depending on the gross income of the firm (the higher the gross income the higher the rate)

2. a deduction from income tax for interest payments on capital goods

3. a tax of 8% on earned interest (deducted at source)

4. a tax on personal income ranging from 10-25% depending on income level.

In Costa Rica the earned interest tax, but not the net interest earned, is deductible for the purpose of calculating taxable income. Interest expenses on capital expenditures are deductible for the purposes of calculating personal income and gross corporate income for taxation purposes. As derived earlier, these tax rates and deductions can be included in the derivation of the private cost of capital and the private opportunity cost of capital for savers. The result is that on the borrowing side, either personal or corporate, taxes do not affect borrowing rate, whilst in the case of lenders, both the interest tax and personal income tax serve to lower the effective rate of return on capital.

Oligopoly and the Financial Rate of Intermediation. The financial rate of intermediation, or margin between savings and borrowing rates, is non-trivial in the case of Costa Rica. Table 3 suggests that based on the difference between the weighted average borrowing rate and the short-term lending rate the average nominal margin for the period 1985-1992 was 11%. Based on a study of actual costs and revenues incurred by the banking sector Camacho and Mesalles (1993) report that between 1987 and 1992 the nominal margin for state-run commercial banks fluctuated between 14.5 and 23.4 percentages points, with an average of 18.4%. The difference between these two estimates probably reflects a difference in methods. The figures presented here are based on market rates actually paid and received, while the other is based not on rates but on bank revenues and costs. In addition, the time periods are different for the two analyses.

Regardless of these problems, the study by Camacho and Mesalles (1993) if of interest because it substantiates the idea that private and state banks have different margins. The nominal intermediation rate for the private banks averaged 9.5% during the period studied by Camacho and Mesalles (1993). These results confirm the impression that Costa Rican state-run banks are relatively inefficient when compared with what would be expected from a banking institution in a competitive market where profits and , hence, costs and margin are squeezed by competition. If this is true, then savers and borrowers who, respectively, receive lower interest rates and pay higher interest charges than would occur in an unfettered market are paying for the implicit cost of this inefficiency. The extent to which either savers or borrowers bear these costs is determined by the elasticity of supply and demand. If demand for capital is inelastic relative to supply it can be expected that borrower's will bear a relatively larger share of the burden. If demand for capital is elastic relative to supply, than the opposite effect can be expected.

Given the oligopolistic/oligopsonistic nature of the capital market in Costa Rica it is likely that the state banks can determine which side of the market should bear the burden. Camacho and Mesalles (1993) confirm that the state banks receive a large subsidy by virtue of their monopoly over checking accounts. Deposit rates, then, may be affected by the state banks ability to access such a large pool of low-cost resources. Thus, a change to a more competitive market (such as is already underway) would be likely lead to higher rates. Understanding the effect of deregulation on borrowing rates is more difficult. Camacho and Mesalles (1993) note that operational costs in the private sector are lower than those in the public sector, arguing for the conclusion that a reduction in borrowing rates would also occur in a competitive market. Nevertheless the difference in operational costs observed by these authors is small in relation to the difference noted in other components such as the costs of maintaining reserve levels, cost of defaults and revenues earned from services. In some case the cost and revenue components studied by Camacho and Mesalles (1993) reflect inefficiency of a state bureaucracy and in others they reflect free-riding by the private sector (i.e. transaction costs that the private sector can avoid because the state banks are incurring them in full due to their mandate). As noted earlier, real transaction costs may simply be higher in Costa Rica and, thus, also account for some of the apparent inefficiency suggested by the large margins.

It is difficult then to actually quantify the impacts that the oligopsonistic/oligopolistic nature of the capital markets has on market rates in Costa Rica. The private sector margin (9.5%) calculated by Camacho and Mesalles (1993) is in fact quite similar to the nominal margin calculated above (11%). If it is assumed that the former margin is a reasonable guide to an efficient margin it is difficult to justify substantially adjusting either the deposit or borrowing rate derived in this study in order to reflect the potential efficiency gains of moving to a more competitive capital market.

Private Cost of Capital

Due to the interest expense deduction that is allowed on payment of both personal and corporate tax in Costa Rica, tax rates do not influence the real cost of capital for either individuals or corporations. As a result the private opportunity cost of capital does not vary from the figure of 9.65% calculated earlier as the economy-wide borrowing rate. For the ten years during which this rate was calculated the standard deviation of the rate was 4.5% yielding a confidence interval at the 95% significance level of 2.8%. As a result it is possible to suggest a likely range of from 7 to 12.5% for the private cost of capital based on this sample. Given the brief measurement period and the year to year variability in these rates a larger range a larger range may be required. Nonetheless, data from this period are the only available data on which to base longer-term estimates of the private rate of discount. As noted earlier, the rate for personal loans of 13% may also be used as an upper bound as it is suggestive of the marginal cost of capital.

Riskless Short-Term Rates of Return in Costa Rican Capital Markets

In Table 4 information on inflation and nominal deposit rates is combined with the earned interest tax and the effects of both a 10% and 15% income tax rate to yield nominal and real after-tax rate of return on short-term deposits. As compared with the ten year average for the pre-tax real rate of return of 0.3% (from Table 3) the real after tax return is negative, varying between -2.4% to -4.5% depending on the tax bracket.

Table 4. Real After Tax Riskless Rates of Return

	Nominal After Tax		Real After Tax	
Year	10% Tax Bracket	25% Tax Bracket	10% Tax Bracket	25% Tax Bracket
1986	13.8	11.5	1.8	(0.3)
1987	11.6	9.7	(4.5)	(6.1)
1988	12.6	10.5	(6.8)	(8.6)
1989	12.9	10.8	(3.1)	(4.9)
1990	17.5	14.6	(1.3)	(3.7)
1991	22.6	18.8	(4.7)	(7.7)
1992	13.1	10.9	(7.1)	(8.9)
1993	14.0	11.7	3.8	1.7
1994	14.7	12.2	1.0	(1.1)
1995	19.8	16.5	(2.8)	(5.5)
Average	15.3	12.7	(2.4)	(4.5)

This analysis demonstrates the rather heavy penalty imposed on effective deposit rates by the current tax regime. As indicated earlier, low or even negative rates of return on deposits are not an infrequent occurrence, particularly in developing countries.[6] Nonetheless, it remains a difficult task to explain just why savers are willing to consistently lose the real purchasing power of their deposits. One possibility, that income tax may not actually be paid on interest earnings (due to slack enforcement of tax laws), provides only a partial answer. Recalculating the ten year real average rate of return with a 0% income tax still leads to a negative rate of 0.9%. Another observation arising from the results is that just as the extent to which the effective rate is negative increases with income and, hence the incentive to evade the situation, so does the ability of the individual to invest abroad or purchase government bonds (another low risk investment).

In conclusion, the results indicate at least a medium term tendency towards a negative private rate of return of 3% or more on short-term deposits. With a standard deviation of approximately 3.5% the upper range may just barely reach positive territory at 0.5%.

Consumption Rate of Interest

Each of the components used in calculating the consumption rate of interest is discussed in turn below. The emphasis is on deriving a best estimate for each variable based on data available and following the methodology outlined earlier from Pearce and Ulph (1995). The best estimates are chosen to reflect either long term historical data or recent trends depending on which figure is most appropriate to the purpose (and what data is available). Again, depending on the parameter, the period average, median and/or growth rate are calculated for each data series. The latter are based on estimation of the compounded annual growth rate necessary to move from the original level to the level at the end of the period. Upper and low bounds are developed and used to develop a sensitivity analysis for the CRI. These ranges are chosen based on historical variation in the parameters, as well as expected future variation (where it is not likely to be reflected in historical averages). Figures used by Pearce and Ulph (1995) for the United Kingdom are also employed where empirical evidence is scanty or as suggestive of upper or lower bounds. The time series data employed in deriving the parameters is presented in Annex 1.

Pure Rate of Time Preference (ρ). There exists considerable disagreement amongst economists as to the nature and likely magnitude of the pure rate of time preference (Pearce and Ulph 1995; Price 1993). The only empirical evidence available that may bear on this matter in the case of Costa Rica is the negative result on the rate of return on short-term deposits. While there are many potential explanations for this result, it certainly does not add support to any claim that Costa Ricans have a high (or higher than other nationalities) pure rate of time preference. Following on Pearce and Ulph (1995) an upper bound of 0.5% is adopted. Given the disagreement over whether it is possible on ethical terms to argue for a positive pure rate of time preference, the best estimate is taken as 0%. Reflecting the available evidence, which supports the possibility that Costa Ricans are willing to accept a negative effective rate of return on deposits a lower bound of -0.5% is explored to see if the CRI is

[6] Or in developed countries, as Cline (1992) notes by citing a study in which the after-tax return on US three month Treasury Bills over the 1946-1980 was -1.1%.

sensitive to a negative rate of time preference.

Risk to Life (L). Data on mortality per thousand is available for Costa Rica for the period 1941-1992. The average mortality over that period is 8.2 per thousand (0.82%), however, there has been a steady decrease from the 1941 to 1950 average of 15 per thousand to the 1981 to 1990 average of 4 per thousand. This is a rather low rate of mortality (0.4%) compared to the figure used by Pearce and Ulph (1995) for the United Kingdom (1.1%). While this fall clearly reflects improvements in health care during this period, the disparity with the UK rate is probably more a result of the demographic effect of having a relatively young and burgeoning population (Costa Rica) versus a relatively aging population of senior citizens (the United Kingdom). It is worth noting that, following a rapid decrease in the 1960s and 1970s, little appreciable change in the mortality rate was observed in the 1980s and early 1990s. Given the consistent low mortality prevalent over the last two decades the best estimate is set at 0.4%.[7] Given the lack of continued downward movement it appears unlikely that the rate will fall further. Thus, no low range is specified for this parameter. Over the longer term it may be expected that Costa Rica's demographic situation will evolve to reflect those currently experienced by developed countries such as the UK. However, as this may take fifty to one hundred years to occur, there is little need to incorporate such a high range in the sensitivity analysis.

Rate of Time Preference ($\delta = \rho - L$). The estimates of the pure rate of time preference and the risk to life produce a best estimate of the rate of time preference of 0.4%.

Rate of Return on Investment (r). For a best estimate of the rate of return on investment the real, weighted average for the economy-wide cost of capital of 9.65% (as calculated above) is chosen. As suggested earlier a range of from 7% to 13% may usefully be employed in the sensitivity analysis.

Savings as Percent of Income (S/Y). Central Bank data is available on national savings as a percentage of GDP for the period from 1970 to 1993. The period average is 12% with a range of from 7 to 21%. However, the trend is definitely towards increased local mobilisation of savings as the average for the 1970s hovered around just 8%. Since the 1980s the percentage of domestic savings as a percentage of GDP has ranged from 10 to 20%. As a result 15% is used for the best estimate with a range of from 10 of 20%. It is interesting to note that Pearce and Ulph (1995) adopt the figure of 10% for the UK, suggesting that the long-term trend may be to return to lower mobilisation levels.

Growth Rate of Incomes from Work (y). Reliable and comprehensive data on salaries and participation rates from different sectors is not available for Costa Rica. Time series on the change in the real minimum wage is available. For the period 1970 to 1992 the annual compounded real rate of change in the minimum wage was 0.8%. This ignores any change in hours worked. However, as these reflect the wages paid to general labourers this reflects only the bottom segment of the employment market. For the economy as a whole a surrogate measure is the growth of per capita GDP. This assumes that the rate of growth of this variable

[7] Please note again that these figures are negative but are subtracted from the pure rate of time preference, effectively yielding a double negative and having a positive effect on the CRI.

is not affected by using total population in place of total workforce. IMF data for 1961 to 1994 shows a compounded annual real growth rate for this variable of 2.0%. This figure will include the influence of the rate of return on capital that, at 10%, would bias this growth rate away (upwards) from the true growth rate of incomes. As a result, 0.8% and 2.0% probably, respectively, understate and overstate the desired value. For the purposes of the analysis, then, a best estimate of 1.4% is used with a range of from 0.8 to 2.0%.

Elasticity of the Marginal Utility of Consumption (μ). The elasticity of the marginal utility of consumption is calculated as 3.7 based on the preceding three factors and the best estimate for the pure rate of time preference (Equation 13). Note that this is far higher than the limit suggested by Pearce and Ulph (1995) in their study of the United Kingdom, although it is unclear to what extent their expectations in this regard are country-specific.

Growth Rate of Per Capita Consumption (g). Data for private and government consumption during the period 1951-1994 is used to calculate real per capita total consumption. This assumes that government consumption ultimately is reflected in per capita effective consumption. The long-term average annual compounded growth rate comes to 2.6%. Private consumption over this period grew at 2.3% and government consumption at 4.85%. The lower, private consumption rate is used as the best estimate. A range of 2.6% is selected for the high estimate and for a low estimate a corresponding bound of 2.0% is chosen.

Consumption Rate of Interest ($s = \delta - \mu g$). The best estimate of the consumption rate of interest emerging from the analysis is 8.8%. This is not far from the weighted average cost of capital developed above of 9.65%. Pearce and Ulph (1995) obtained a best estimate CRI of 2.4% for the United Kingdom with lower and upper bounds of 0.9 and 5.0% respectively. The results for the best estimate and the sensitivity analysis are presented in the following table. For the latter the lower and upper bound parameters are substituted in place of the best estimate parameters to explore the responsiveness of the best estimate to changes in individual parameters.

Table 5. Consumption Rate of Interest

		Best	Sensitivity Analysis					
	Scenarios	Estimate	Lower Bound			Upper Bound		
			New Value	New CRI	Change	New Value	New CRI	Change
CRI		8.8						
δ		0.4						
ρ	pure rate of time preference	-	(0.5)	8.8	1%	0.5	8.9	1%
L	life chances	(0.4)	-	-	-	-	-	-
μ	elasticity of the marginal utility of consumption	3.7						
r	rate of return on investment.	9.7	7.0	7.6	14%	13	9.9	13%
ρ	pure rate of time preference	(as above)						
S/Y	savings/income	15	20	7.7	13%	10	10.4	18%
y	growth rate of incomes from work	1.4	2.0	7.5	15%	0.8	10.8	23%
g	growth rate of per capita consumption	2.3	2.0	7.7	12%	2.6	9.9	12%

Notes: In the sensitivity analysis "New Value" is the upper/lower bound value for the parameter and "New CRI" is the consumption rate of interest as recalculated substituting the corresponding "New Value." "Change" refers to the percent change between the new CRI and the best estimate CRI.

The results of the sensitivity analysis suggest that the CRI is robust as the maximum responsiveness of the CRI to the range employed is 23% with most of the parameters causing the CRI to vary by from 10 to 15%. The CRI ranges from an upper bound for the analysis of 10.8% to a lower bound of 7.5%. The effect of altering the pure rate of time preference is insubstantial as discussed further below.

Key differences between the figures developed by Pearce and Ulph (1995) and those developed here (as shown in Table 5) are the comparatively higher rate of return on investment, higher growth rate of consumption and lower growth rate of incomes from work in Costa Rica (as opposed to the United Kingdom).[8] Most notable is that in the United Kingdom the growth rate of incomes from work (2.5%) is higher than the growth rate in per capita consumption (1.3%) whereas in Costa Rica this relationship is reversed (1.4% and 2.3% respectively). Whether this represents a fundamental difference between the two economies or an error in one of the two studies bears further exploration. For the moment, the only explanation that can be offered is that the comparatively higher return on capital and the lack of political power wielded by lower socio-economic classes in a developing country such as Costa Rica may serve to restrain work incomes while increasing per capita consumption.

Given that a number of the parameters employed in the sensitivity analysis do not reflect conditions in Costa Rica, the range in the CRI that might be useful to investigate when applying these rates is probably more limited than that shown above. Employing figures relevant to Costa Rica and rounding off the resulting estimates of the CRI suggests a range of from 7 to 11% with a best estimate of 9%.

Based on this method, therefore, there is little reason to expect the CRI to differ greatly from the private opportunity cost of capital in Costa Rica. Note, however, the large difference between the after tax riskless lending rate (-3%) and the calculated CRI. These two appear to be at odds as the former is often used as a proxy for the rate of time preference. In the case of Costa Rica, as with other developing countries, it is likely that fundamental economic factors, such as the growing rate of consumption, high rates of return on investment and the high marginal utility of additional consumption, are more appropriate indicators of the CRI than market lending rates.

The astute observer will note that the denominator of Equation 13, which is used to calculate μ, represents an estimate of the growth rate of total income. This denominator is subsequently multiplied by g (in the numerator), which represents another growth rate, this time of consumption. Should these two elements be equal the effect of incorporating ρ, the pure rate of time preference, in to the CRI relationship (Equation 10) is negated as its two occurrences will cancel out (i.e. one is left with $s = \rho - L + r - \rho$).

While this may seem a weakness of this approach (i.e. that the CRI in the end may depend almost exclusively on the rate of return, r) a number of points are worth considering. First and foremost is that the range of estimates suggested for ρ is quite narrow and quite close to zero.

[8] Note that even in the same document, Pearce and Ulph (1995:4) employ a rate of return on capital of 8% in calculating the shadow price of capital, a figure much closer to available estimates for developed economies than 5%.

Indeed, there is reason to assume it is zero, as is done in the present analysis. If this is the case, then the issue of whether or not the growth rates are equal, leading the pure rate of time preference to subsequently drop out of the equation, does not really have much practical import. Secondly, there is no reason why the two growth rates mentioned above must be exactly equal. For instance, in Pearce and Ulph (1995), they are 2.75% and 1.3% respectively. In the best estimate derived above for Costa Rica the ratio of these growth rates is equal to 0.88 (2.3% divided by 2.64%). It is for this reason that the CRI is not terribly responsive to the high and low bounds for the range employed in the sensitivity analysis.

The more salient point emerging from this criticism is the relative importance assumed by the rate of return. If ρ is zero and the growth rates are not far off each other, then the CRI will reduce to the absolute value of L plus a rather high percentage of the rate of return. Note that this criticism reflects in particular on Equation 13 as a method for determining the elasticity of the marginal utility of consumption. It does not directly reflect on the use of Equation 10 to calculate the CRI. The difficulty will be, of course, estimating what u will be in a given country, particularly in a developing country where sophisticated empirical models of the sort that may be available in the United Kingdom, for instance, are not available. If Equation 13 is used, there is of course no guarantee that the growth rates will be similar, as in the case of the United Kingdom, however this discussion highlights the need for further investigation along these lines.

Shadow Price of Capital

As indicated earlier, the consumption-equivalent method calls for consumption flows to be discounted by the CRI, while investment flows are converted into consumption equivalents by the shadow price of capital and then discounted by the CRI. For the calculation of the shadow price of capital, estimates of the rate of return on capital, the CRI and the average lifetime of capital are required. As indicated earlier Cline (1993) use rates of 8%, 1.5% and a lifetime of fifteen in arriving at a shadow price of capital of 1.56. Clearly the similarity between the rate of return on investment and the CRI found in this study will lead to a substantially different result in the case of Costa Rica.

As developed previously the rate of return on capital in Costa Rica is 9.65% and the calculated CRI is 8.8%. It is difficult to estimate the exact average lifetime of capital in Costa Rica. However, it is reasonable to suggest that, given the extreme climactic conditions (humidity and rainfall) and the low investment in maintenance typical of developing countries, the average lifetime of capital will be shorter than that of developed countries such as the United Kingdom. Thus, a value of 10 is used for a best estimate of the average lifetime of capital. Employing Equation 17, the shadow price of capital is calculated to be 1.037. Varying the length of life (see Table 6 below) has little effect on the shadow price of capital due to the minor difference observed between the return on investment and the CRI. The shadow price varies between 1.022 and 1.050 when the lifetime is changed to five and fifteen years respectively.

Social Discount Rate

With the information developed above it is also possible to calculate an overall social discount rate for Costa Rica. The only remaining requirement is an estimate of the percentage share of investment in the economy. Using data on national accounts for the period 1950 to 1995 the average share of investment in GDP is 20%. This corresponds exactly to the figure expected by both Cline (1992) and Pearce and Ulph (1995). Multiplying the CRI by the best estimate of the shadow price of capital, weighting it by the share of investment in the economy and adding it to the corresponding figure for the CRI (that is the CRI weighted by the share of consumption in the economy) leads to a best estimate of the social discount rate of 8.9%. Again, it can be seen that varying the lifetime of capital to five and fifteen years has little effect on the outcome, leading to only a one basis point change in the discount rate.

Table 6. Shadow Price of Capital and Social Discount Rates

	Costa Rica (this study)			In General (other studies)		
Scenarios	Best	Low	High	Cline (1992)	World Bank[1]	World Bank[2]
Parameters						
return on investment (*r*)	9.65%	9.65%	9.65%	8%	8%	8%
Consumption rate of interest (*s*)	9.10%	9.10%	9.10%	1.5%	3%	3%
Average lifetime of capital (*N*)	10	5	15	15		15
Results						
Shadow price of capital	1.037	1.022	1.050	1.56	2.0	1.395
social discount rate (I=20%)	8.88[3]	8.85[3]	9.90[3]	1.67%[4]	3.6%[4]	3.24%[4]
social discount rate (I=100%)[5]	9.14	9.01	9.26	2.34%	6.0%[6]	4.18%

Notes: [1]Using the *r*, *s* and shadow price of capital as suggested by Birdsall and Steer (1993:8). [2]An actual recalculation of both the shadow price of capital and the social discount rates as per the parameters for *r*, *s* and *N* mentioned by Birdsall and Steer (1993). [3]Using shares of I=20% and C=80% as calculated in this study. [4]Using shares of I=20% and C=80% as suggested by Cline (1992). [5]Using I=100% as suggested by Birdsall and Steer (1993), this is equivalent to the rate applied to consumption equivalents being simply the shadow price of capital multiplied by the CRI. [6]Note that Birdsall and Steer (1993) arrive at 8.0% in their calculations.

Considerable discussion surrounds just how the consumption-equivalent method should be applied and, similarly, what is the appropriate weight to use for the purposes of arriving at a social discount rate. Given the low shadow price of capital, it may even be difficult to justify the effort required to distinguish between the investment and consumption flows and to make the shadow price adjustment. In any case the process is not likely to be as straightforward an exercise as might be expected

This problem can be illustrated using examples from livestock production. Compare expenditure on fencing material (a capital investment producing benefits in more than one year) and on feed (a recurrent expenditure producing benefits in only one period) in year thirty of an analysis of a ranching operation. According to the consumption-equivalent approach, the fencing investment should be discounted over thirty years at a higher rate (the CRI multiplied by the shadow price of capital) than the expenditure on feed (by only the CRI). The rationale for this approach is that the former is assumed to be an allocation of funds to capital investment and thus displaces other investment, whilst the latter simply displaces the ranchers consumption at the beginning of the period (of other goods and services) in return for more consumption at the end of the period (following the sale of stock).

Unfortunately, this approach ignores the possibility that the rancher may also be making an implicit tradeoff between marginal expenditure on feed and other investment possibilities; in other words that the opportunity cost of capital may in fact be the relevant opportunity cost. Birdsall and Steer (1993) conclude that it is the economist's job to identify the net benefits of investments and to recommend those with the highest return. In their view it does not, therefore, make sense to make *a priori* assumptions about how society will finance such investments (eg, whether consumption or investment will be displaced in undertaking a given expenditure). In this sense, Birdsall and Steer (1993) point out that in the appraisal of investment expenditure it is the capital share displaced that matters (ie, the component that could be employed in another investment).

Consequently, Birdsall and Steer (1993:7) argue that if economists should not be making *a priori* assumptions about financing, the capital share should be weighted at unity, thus arriving at a rate that is "conceptually equivalent to the opportunity cost of capital." Unfortunately, this conclusion is not correct. With a weighting of one for the capital share, the resulting discount rate is still the product of the CRI and the shadow price of capital. Both of these parameters incorporate the CRI, which, conceptually, reflects the effect of displacing consumption (not just investment as with the opportunity cost of capital approach).

Some numerical examples provide an indication of this result (see Table 6). Taking the best estimate shadow price of capital for Costa Rica and weighting the capital share at unity leads to a social discount rate of 9.3% (not 9.65%). Birdsall and Steer (1993) actually suggest that by using a CRI of 3% (1% time preference plus 2% of per capita income growth), a shadow price of capital of 2, and a capital share equal to unity results in a discount rate equal to 8% (their opportunity cost of capital). A recalculation (as shown in the table) suggests that the correct social discount rate in this case would be 6.0% (3%*2). Furthermore, as the CRI plays a role in determining the shadow price of capital, raising the rate to 3% would clearly lower this shadow price. As shown in the final column of Table 6, using a CRI of 3%, opportunity cost of capital of 8% and the 15 years of average life of capital (as cited by Cline 1992) yields a shadow price of capital of 1.4. The corresponding discount rate would be 4.2% if the capital share is set at unity.

Contrary, then, to the conclusion reached by Birdsall and Steer (1993) accepting the CE method does imply moving away from the opportunity cost of capital no matter how heavily the capital share is weighted. In other words, once the CE method is accepted, the only real justification for continuing to use rates on the order of those employed by the World Bank would be evidence that the CRI is in fact much closer to the rate of return on investment than is commonly thought. As discussed by Birdsall and Steer (1993), and as demonstrated in the analysis for Costa Rica, there are valid reasons for supposing that the CRI in developing countries is higher than that in developed countries and, therefore higher than the estimates developed by Cline (1992) and Pearce and Ulph (1995).

At the same time, there is the impression that the consumption rates of interest proposed by Cline (1992) and Pearce and Ulph (1995), 1.5% and the 2.4% respectively, might be rather higher if a more appropriate opportunity cost of capital, such as the 8% proposed by Birdsall and Steer (1993) were used. In fact, substituting in 8% in place of the 5% (for r) in the best estimated developed by Pearce and Ulph (1995) leads to a CRI of 4.7% and a social discount rate of just under 5%.

Conclusions

The examination of real private and social discount rates in Costa Rica returns an economy-wide opportunity cost of capital of 9.65%, a consumption rate of interest of 8.8%, a shadow price of capital of 1.037 and a social discount rate of 8.9%. Based on this work the following two recommendations for the use of discount rates in Costa Rica emerge:

1. In financial analysis the real opportunity cost of capital should be set at 10%. A range of from 7 to 13% may be used in sensitivity analysis, however the central figure should be considered to be relatively accurate.

2. In economic analysis a discount rate of 9% is appropriate, with a range for sensitivity analysis of from 7 to 11%.

In sum, the investigation does not radically contradict the existing tendency to use 10% as the rate with which to discount all flows in private and economic analysis in the Costa Rican context. There is, therefore, no need to revise existing practice or the conclusions reached by previous studies using a rate of this magnitude. At the same time, analysts uncomfortable with the narrow range of rates recommended above may employ the oft-used 5 - 15% range in sensitivity analysis without straying far from the results of this study. In general it is hoped that the paper may serve to stimulate further empirical research into the determinants of the consumption rate of interest in Costa Rica, given the preliminary nature of these findings.

The conclusions reached for Costa Rica differ rather strongly from those reached by other analysts in calculating social discount rates for the world (Cline 1992) and the United Kingdom (Pearce and Ulph 1995). Further, the paper suggests that once the consumption equivalents method is accepted the application of economic rates of discount in the realm of 8 to 10% can only be justified if the consumption rate of interest and the private opportunity cost of capital are much more closely matched than previously suspected. In other words, this paper indirectly supports the contention, that discount rates typically applied in economic analysis in developed countries may be overstated if not quite as much as suggested by the studies by Cline (1992) and Pearce and Ulph (1995).

Clearly, additional work on this topic would be of great assistance in establishing discount rates appropriate to different settings. At a minimum this paper suggests that methods exist for calculating the different measures required in the estimation of social discount rates. The paper also provides a preliminary idea of the relative importance of the parameters involved in arriving at empirical estimates of these rates, as well as of the methodological questions that surround the approach. Ideally, future theoretical and empirical work might tackle these issues and parameters first, leaving aside the unresolved issues that are of lesser practical importance.

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Appendix 1. Macroeconomic Time Series Data for Costa Rica

	Inflation			Population	National Accounts				
	CPI	CPI	GDP Deflator	Mid-Year	GDP	GDP	C	G	I
					Real	Nominal	Nominal	Nominal	Nominal
	% / year	1990=100	1990=100		1990 colon.	colones	colones	colones	colones
Source:	IMF	IMF	Calc.	IMF	IMF	IMF	IMF	IMF	IMF
Year	1	2	5/6*100	3	4	5	6	7	8
1948	-	-	-	760,000	-	-	-	-	-
1949	-	-	-	780,000	-	-	-	-	-
1950	-	2	-	860,000	-	1,446	1,014	99	222
1951	7%	3	-	890,000	-	1,564	1,094	114	243
1952	-3%	3	-	920,000	-	1,709	1,190	134	297
1953	0%	3	-	950,000	-	1,887	1,340	140	318
1954	3%	3	-	990,000	-	2,039	1,460	177	314
1955	4%	3	-	1,030,000	-	2,225	1,585	206	362
1956	1%	3	-	1,070,000	-	2,292	1,656	230	403
1957	3%	3	-	1,110,000	-	2,500	1,889	234	409
1958	3%	3	-	1,150,000	-	2,609	1,943	255	431
1959	0%	3	-	1,190,000	-	2,679	2,031	286	450
1960	1%	3	2	1,250,000	132,057	2,861	2,200	296	460
1961	2%	3	2	1,300,000	130,964	2,929	2,156	340	504
1962	3%	3	2	1,350,000	141,635	3,187	2,306	366	591
1963	3%	3	2	1,390,000	148,412	3,404	2,523	413	621
1964	3%	3	2	1,440,000	154,570	3,608	2,719	457	591
1965	-1%	3	2	1,490,000	169,763	3,929	3,080	495	730
1966	0%	3	2	1,540,000	183,125	4,288	3,186	537	736
1967	1%	3	2	1,590,000	193,472	4,634	3,444	586	834
1968	4%	3	2	1,630,000	209,865	5,127	3,804	636	882
1969	3%	4	3	1,690,000	221,391	5,655	4,116	706	1,024
1970	5%	4	3	1,730,000	238,002	6,525	4,805	820	1,270
1971	3%	4	3	1,800,000	254,135	7,137	5,146	990	1,579
1972	5%	4	3	1,840,000	274,918	8,216	5,748	1,182	1,800
1973	15%	5	3	1,870,000	296,111	10,162	6,924	1,417	2,252
1974	30%	6	4	1,920,000	312,530	13,216	9,772	1,889	3,175
1975	17%	7	5	1,960,000	319,094	16,805	12,036	2,558	3,695
1976	3%	7	6	2,010,000	336,700	20,676	13,718	3,306	4,846
1977	4%	8	7	2,070,000	366,681	26,331	17,171	4,208	5,889
1978	6%	8	8	2,120,000	389,664	30,194	20,412	5,069	6,952
1979	9%	9	8	2,170,000	408,918	34,584	23,139	6,243	9,050
1980	18%	10	10	2,250,000	411,993	41,405	27,140	7,544	9,895
1981	37%	14	14	2,270,000	402,683	57,103	34,344	8,987	13,737
1982	90%	27	26	2,420,000	373,347	97,505	56,397	14,192	19,808
1983	33%	35	34	2,500,000	384,023	129,314	79,481	19,527	23,269
1984	12%	40	39	2,570,000	414,854	163,011	99,837	25,503	32,679
1985	15%	46	47	2,640,000	417,843	197,920	118,974	31,175	38,240
1986	12%	51	56	2,720,000	440,945	246,579	144,381	37,951	46,023
1987	17%	60	62	2,780,000	461,954	284,533	176,475	42,652	56,313
1988	21%	72	73	2,850,000	477,840	349,743	215,794	54,630	66,211
1989	17%	84	84	2,920,000	504,913	425,911	256,923	72,283	87,224
1990	19%	100	100	2,800,000	522,848	522,848	321,143	94,948	117,071
1991	29%	129	129	2,870,000	534,677	690,164	411,105	111,876	136,098
1992	22%	157	157	2,940,000	576,012	906,278	544,608	144,448	188,318
1993	10%	172	175	3,000,000	612,523	1,069,259	648,463	178,453	248,535
1994	14%	195	204	3,070,000	640,194	1,306,302	779,307	226,635	257,763
1995	23%	241	253		656,506	1,659,385	978,513	278,761	304,367

Sources for this Appendix (as noted in the headings) are as follows: IMF data is from IMF (1996), MIDEPLAN is data compiled by Vargas and Sáenz (1993), and BCCR (S/Y) data comes from the Central Bank for the period 1985-1993 and from Jiménez and Céspedes (1990) for 1970-1984. In the latter case the authors state that 7% represents the 1970-1974 average and 9% the 1975-1979 average. “Calc.” refers to values derived from previous columns as indicated in the following row

	Mortality	GDP Per Capita Real	Minimum Wage Nominal	Minimum Wage Real	S/Y	C Per Capita Real	G Per Capita Real	C+G Per Capita Real	I/GDP
	per '000	1990 col	1984=100	1990=100	%	1990=100	1990=100	1990=100	%
Source:	MIDEPLAN	Calc.	MIDEPLAN	Calc.	BCCR	Calc.	Calc.	Calc.	Calc.
Year	9	4/3	10	10/2	11	6*100/2/3	7*100/2/3	(6+7)*100/2/3	8/5
1941	17.2	-	-	-		-	-	-	-
1942	20.0	-	-	-		-	-	-	-
1943	16.8	-	-	-		-	-	-	-
1944	15.8	-	-	-		-	-	-	-
1945	14.6	-	-	-		-	-	-	-
1946	13.1	-	-	-		-	-	-	-
1947	13.9	-	-	-		-	-	-	-
1948	12.2	-	-	-		-	-	-	-
1949	11.8	-	-	-		-	-	-	-
1950	11.8	-	-	-		48,467	4,713	53,180	15%
1951	11.7	-	-	-		47,310	4,939	52,248	16%
1952	11.6	-	-	-		51,202	5,761	56,963	17%
1953	11.7	-	-	-		55,570	5,794	61,364	17%
1954	10.6	-	-	-		56,628	6,873	63,500	15%
1955	10.5	-	-	-		56,972	7,419	64,391	16%
1956	9.6	-	-	-		56,726	7,882	64,608	18%
1957	10.1	-	-	-		60,588	7,517	68,105	16%
1958	8.6	-	-	-		58,611	7,686	66,297	17%
1959	9.1	-	-	-		59,033	8,317	67,351	17%
1960	8.6	105,646	-	-		60,411	8,131	68,541	16%
1961	7.9	100,741	-	-		55,567	8,774	64,341	17%
1962	8.5	104,915	-	-		55,747	8,838	64,585	19%
1963	8.5	106,771	-	-		57,557	9,418	66,975	18%
1964	8.8	107,340	-	-		57,944	9,739	67,682	16%
1965	8.8	113,935	-	-		63,859	10,258	74,117	19%
1966	7.4	118,912	-	-		63,787	10,750	74,537	17%
1967	7.1	121,680	-	-		65,993	11,219	77,212	18%
1968	6.5	128,752	-	-		68,309	11,420	79,730	17%
1969	6.9	131,000	-	-		69,451	11,909	81,360	18%
1970	6.6	137,573	8	2.12	7%	75,689	12,914	88,602	19%
1971	5.9	141,186	9	2.25	7%	75,578	14,540	90,118	22%
1972	5.9	149,412	9	2.22	7%	78,951	16,235	95,187	22%
1973	5.2	158,348	10	2.11	7%	81,222	16,623	97,845	22%
1974	5.0	162,776	12	1.98	7%	85,832	16,592	102,424	24%
1975	4.9	162,803	14	1.97	9%	88,235	18,752	106,986	22%
1976	4.6	167,512	16	2.16	9%	94,760	22,840	117,600	23%
1977	4.3	177,141	17	2.30	9%	110,559	27,095	137,654	22%
1978	4.0	183,804	20	2.45	9%	121,047	30,058	151,105	23%
1979	4.2	188,441	22	2.49	9%	122,781	33,127	155,908	26%
1980	4.1	183,108	26	2.51	7%	117,578	32,683	150,261	24%
1981	3.9	177,394	32	2.25	11%	107,603	28,157	135,760	24%
1982	3.9	154,276	56	2.09	10%	87,178	21,938	109,115	20%
1983	3.9	153,609	85	2.40	12%	89,676	22,032	111,708	18%
1984	3.9	161,422	100	2.52	14%	97,878	25,003	122,881	20%
1985	4.0	158,274	120	2.62	17%	98,692	25,860	124,552	19%
1986	3.9	162,112	137	2.68	20%	103,942	27,321	131,263	19%
1987	3.8	166,171	154	2.58	17%	106,383	25,711	132,094	20%
1988	3.8	167,663	176	2.45	17%	105,018	26,586	131,605	19%
1989	3.9	172,915	211	2.51	16%	104,744	29,469	134,212	20%
1990	3.8	186,731	254	2.54	16%	114,694	33,910	148,604	22%
1991	3.9	186,298	317	2.46	21%	111,291	30,286	141,577	20%
1992	-	195,923	393	2.51	21%	118,174	31,344	149,517	21%
1993	-	204,174	-	-	20%	125,609	34,567	160,175	23%
1994	-	208,532	-	-		129,927	37,785	167,712	20%
1995	-	-	-	-					18%
Average	8.2				12%				20%
Median	7.4				11%				22%
Growth		2.0%		0.78%		2.3%	4.9%	2.6%	

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