Definition, interpretation and calculation of the *B index*

The B-index is a measure of the level of pre-tax profit a "representative" company needs to generate to break even on a marginal, unitary outlay on R&D (Warda, 2001), taking into account provisions in the tax system that allow for special treatment of R&D expenditures. It is customary to present this indicator in the form of an implied subsidy rate, namely *one* minus the *B index.* More generous provisions imply a lower breakeven point and therefore a higher subsidy. The *B index* is defined, in the case of a firm with sufficiently large profits and only current R&D expenditures[1], as:

$$B\ index \equiv \frac{1-\mathrm{A}}{1-\tau}.$$

In this expression, τ is the corporate tax rate and A is the combined net present value of allowances and credits applying to R&D outlays. For example, in the case of a θ allowance rate on R&D (deduction from taxable profits), $\mathrm{A} = \tau \cdot \theta$. When $\theta = 1$, current expenditures are fully (100%) deductible, the benchmark scenario in most countries, *B index* =1 and the subsidy rate is zero.

Another possible interpretation of the B-index relates to the cost of R&D capital faced by firms. Under some conditions,[2] it can be shown that:

$$\mathrm{u} + \delta = (B\ index) \cdot (\mathrm{r} + \delta),$$

where u is the cost of capital for a marginal investment in R&D which only increases the stock of R&D capital in one period, financed by retained earnings, r is the real interest rate and δ is the rate of economic obsolescence for the stock of R&D capital.[3] In other words, the *B index* can be interpreted as the tax-based adjustment to the minimum pre-tax rate of return on an investment required by an investor.

In recent years, the adverse economic climate has dented the profitability of many companies, particularly in the early phase of the global economic crisis where operating surplus has been negative in many countries' corporate sector. This calls into question the relevance of the headline *B index* as a representative indicator for all R&D-performing companies, especially R&D start-ups. In recognition of the fact that there are significant differences in the provisions made by countries for scenarios in which companies cannot immediately realise the entire value of tax incentives on R&D, the B-index formula has been generalised as follows:

$$B\ index \equiv \frac{1-\tau\cdot(x+(1-x)\cdot\psi)\cdot\theta}{1-\tau\cdot(x+(1-x)\cdot\psi)},$$

1. This assumption is only made for illustrative purposes. This general framework has been adapted to account for R&D capital expenditures or specific types of eligible current expenditures. Across the OECD, current expenditures account on average for 90% of R&D expenditures and hence capital provisions account for a very minor component of the final estimate.
2. The simplified version of the *B-index* abstracts from issues concerning the tax treatment of alternative finance sources of R&D, provisions on the taxation of R&D outputs and the asset-like nature of R&D knowledge, including its actual economic obsolescence and that of its capital components.
3. The user cost is derived by imposing that the economic rent from such an investment is zero at the margin. The company boosts its R&D investment in period t and undertakes a downward correction in t+1. This shifts profits in period t (higher losses), t+1 (increased revenues from higher stock, lower R&D), It is possible to derive the effective marginal tax rate: $EMTR = \frac{\mathrm{u}-\mathrm{r}}{\mathrm{u}} = \frac{(\mathrm{r}-\delta)\tau(1-\theta)}{(1-\tau\theta)(\mathrm{r}-\delta)+\delta}$. When $\theta = 1$, $EMTR = 0$.

In this formula, if the firm has a sufficiently large profit to claim the incentives, then $x = 1$ and $x = 0$ otherwise. ψ is the net present value adjustment factor for the allowance (or equivalent incentive) in the scenario with an insufficiently large profit base ("loss making" for brevity). $\psi = 1$ if the incentive is fully and immediately refundable in the "loss" case and $0 < \psi < 1$ if the incentive can be carried forward.[4]

The value of ψ has been modelled, using some additional, simplifying assumptions, to reflect the terms of carry-forward provisions as well as instances when refunds are postponed for a given number of years if not previously used. A firm with low or negative profits faces an implicit lower tax rate $\hat{\tau} = \tau \cdot \psi$ through which to realise the incentives theoretically available. For this reason, when $\theta > 1$, i.e. when the tax system subsidises R&D, $B\ index(loss) > B\ index(profit)$ and the subsidy rate is lower for loss than for profit making firms. In the opposite case, when $\theta < 1$ (e.g. where no incentives are provided and R&D capital costs cannot be immediately amortised), a net tax is in place and the breakeven point is thus higher in the profit-making case $B\ index(loss) < B\ index(profit)$.

In the case where authorities apply different carry forward provisions to general losses and special allowances and credits, the following formulation has been derived:

$$B\ index \equiv \frac{1 - \tau \cdot \left[x \cdot \theta + (1 - x) \cdot \psi_\infty \cdot \left(1 + \frac{(\theta - 1) \cdot \psi_T}{\psi_\infty}\right)\right]}{1 - \tau \cdot (x + (1 - x) \cdot \psi_\infty)}$$

where ψ_∞ is the expected net present value of a unit of loss which can be carried forward indefinitely, and ψ_T is the net present value that reflects a time limit *T* for carrying forward special credits and allowances.

Incremental R&D tax incentives have been modelled considering the impact that current decisions have on future baseline R&D levels. This is formally equivalent to implementing adjustments to the credit or allowance rates, a correction that also needs to be made when modelling the provisions in countries that treat credits as taxable income. For companies with planned declining R&D profiles over time, the modelled B index may overstate the level of incentive as these firms are unlikely to qualify for the incremental component of the incentive, as the formula assumes that the marginal outlay qualifies for the incentive.

References

Warda, J. (2001), "Measuring the Value of R&D Tax Treatment in OECD Countries", *STI Review No.27: Special Issue on New Science and Technology Indicators*, OECD Publishing. http://www.oecd.org/sti/37124998.pdf.

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4. The NPV of an allowance carried forward depends is $\psi(T, \lambda, \mathrm{i}) \coloneqq [1 - \left(\frac{\lambda}{1+\mathrm{i}}\right)^{\mathrm{T}}]\left(\frac{\lambda}{1+\mathrm{i}}\right)/(1 - \left(\frac{\lambda}{1+\mathrm{i}}\right))$ in the case of a constant probability λ of returning to profit (arbitrarily set to 50%), and interest rate i (10% in line with the literature). It can be noted that $\psi(T, \lambda, \mathrm{i}) < \psi(\infty, \lambda, \mathrm{i})$. This formula has been further adapted to the case of specific countries which allow a full refund of outstanding credits at the end of the period.