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ASSESSMENT OF THE ANNUAL EFFECT OF INVESTMENTS TO BE IMPLEMENTED STEP BY STEP

A SUPPLEMENT TO THE CONCEPT OF BASE EFFECT

Several economists suggest that the average annual effect of a production unit be measured on the basis of the profit of its most typical trading year — i. e. the year of account [1, p. 182; 2, p. 87]. Unfortunately, this suggestion does not enable to reach the right conclusion in the case of units which are to be put into operation by steps and whose predictable annual effect is stable and the operating period infinite.

When taking for the year of account of production units or economic events the year of receiving a stable income, the financial results of the implementation period will not be reflected in calculations, as a result of which the effect to be found proves to be distorted. Relying on the indices of some previous year will not help. Moreover, there are no criteria for selecting the most suitable ones among the latter. Therefore, finding out the actual annual effect and efficiency of units (events) under study may seem an insoluble task.

However, this is not so. A solution has been presented in [3, 4, and 5] where the method of the so-called base effect measurement was introduced. The correctness of the effect and efficiency assessed using this method is guaranteed by the fact that it does not depend on the year of account chosen more or less arbitrarily but on an objectively determined index — the length of lag of the invested capital.

In the referred literature it has been suggested that the base effect (ε_b) be measured by the formula

$$\varepsilon_b = D - E\acute{K}, \tag{1}$$

where $\acute{K}$ is expressed by the formula

$$\acute{K} = K \sum_{t=1}^{T} a_t (1+E)^{t-1}, \tag{2}$$

or

$$\acute{K} = K(1+E)^{l-1}, \tag{3}$$

and D — stable annual income after putting the unit into operation; E — discount rate; K — investments in the year preceding the year the unit was put into operation (or which are discounted to this year); $\acute{K}$ — investments discounted to the stipulated moment of putting the unit into operation (a moment after making the investments following the period the length of which is the lag minus one year); T — implementation period (in years); t — the year of implementation ($t=1, 2, \ldots, T$); a_t — coefficient characterizing the increase of profit in the year of implementation t ($\sum_{t=1}^{T} a_t = 1$); l — lag of investments (in years).

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Base efficiency (E_b) is expressed by the quotient of the annual income D and the investments K

$$E_b = \frac{D}{K}. \tag{4}$$

While this characteristic of profitableness can be used in practice without difficulties, then the same cannot be said about the base effect calculated by formula (1). The fact that the index in question does not reflect the sum discounted to the specified time reduces its informative value. That is why when introducing the concept of base effect it is necessary to describe how to find the base effect discounted to the year following the investment as it is clearer than the efficiency index implemented without additional calculations. As the referred literature lacks the necessary explanation, an attempt is made to present one here.

To measure the base effect discounted to the year following the investment first the following indices are measured for each implementation year:

(1) increase of profit (ΔD_t) as the difference between the profits of the year concerned and the previous year

$$\Delta D_t = D_t - D_{t-1}; \tag{5}$$

(2) coefficient of the increase of profit (a_t) as a quotient

$$a_t = \frac{\Delta D_t}{D}; \tag{6}$$

(3) a proportionate part of the investments corresponding to the increase of profit as a product

$$\mathring{K}_t = K a_t. \tag{7}$$

After that the increase of annual effect in the year t, ($\Delta\varepsilon_t$), can be found using the formula

$$\Delta\mathring{\varepsilon}_t = \frac{\Delta D_t}{(1+E)^{t-1}} - E\mathring{K}_t. \tag{8}$$

As the base effect to be determined, ($\mathring{\varepsilon}_b$), represents the total of increases, then

$$\mathring{\varepsilon}_b = \sum_{t=1}^{T} \Delta\mathring{\varepsilon}_t. \tag{9}$$

It can be concluded from the preceding that $\mathring{\varepsilon}_b$ can also be calculated by the formula

$$\mathring{\varepsilon}_b = \sum_{t=1}^{T} \frac{\Delta D_t}{(1+E)^{t-1}} - EK. \tag{10}$$

Replacing the expression

$$\sum_{t=1}^{T} \frac{\Delta D_t}{(1+E)^{t-1}} \tag{11}$$

by the symbol $\mathring{D}$ we can express the base effect and efficiency discounted to the year following the investment in the following way

$$\mathring{\varepsilon}_b = \mathring{D} - EK, \tag{12}$$

$$E_b = \frac{\mathring{D}}{K}. \tag{13}$$

The following example is to illustrate the use of this method.

It is necessary to prognosticate the annual effect and profitability of an enterprise with an indefinite operating time. The enterprise costs 1 million kroons and will yield a profit of 75 000 kroons in the first implementation year, 195 000 in the second, and 255 000 in the third year. In the fourth year the enterprise will work at full capacity and yield an annual profit of 300 000 kroons.

Using formulas 5—7 we shall have the following data for solving this problem:

Initial data for calculating the base effect and efficiency

Index	Years				
	0	1	2	3	4
Investments, thous. kr.	1000	—	—	—	—
Annual profit, thous. kr.	—	75	195	255	300
Increase of profit (ΔD_t), thous. kr.	—	75	120	60	45
Coefficients of increase in profit (a_t)	—	0.25	0.40	0.20	0.15
Investments necessary for increase of profit ($\mathring{K}_t$), thous. kr.	—	250	400	200	150

When taking for the discount rate 10% then according to formula (8) the increase of effects ($\Delta\varepsilon_t$) in the years 1—4 will be (in thous. kr.):

$$\Delta\mathring{\varepsilon}_1 = \frac{75}{1.1^0} - 0.1 \times 250 = 50.0;$$

$$\Delta\mathring{\varepsilon}_2 = \frac{120}{1.1} - 0.1 \times 400 = 69.09;$$

$$\Delta\mathring{\varepsilon}_3 = \frac{60}{1.1^2} - 0.1 \times 200 = 29.59;$$

$$\Delta\mathring{\varepsilon}_4 = \frac{45}{1.1^3} - 0.1 \times 150 = 18.81.$$

Adding the results we get the base effect of the year following the investment (in year 1):

$$\mathring{\varepsilon}_b = 50.0 + 69.09 + 29.59 + 18.81 = 167.49 \text{ thous. kr.}$$

To obtain the base efficiency we have to find out D:

$$\mathring{D} = \sum_{t=1}^{T} \frac{\Delta D_t}{(1+E)^{t-1}} = \frac{75}{1.1^0} + \frac{120}{1.1} + \frac{60}{1.1^2} + \frac{45}{1.3^3} = 267.49 \text{ thous. kr.}$$

Dividing the above-given sum by the investment we shall have the profitability of investment

$$E_b = \frac{267.5}{1000} = 0.2675 \text{ or } 26.75\%.$$

One more method could be used for solving this problem. Namely, after calculating the average lag of investments the value of $\mathring{D}$ could be found by the formula

$$\mathring{D} = \frac{D}{(1+E)^{l-1}}, \tag{14}$$

where the lag (l) is calculated as follows

$$l = \sum_{t=1}^{T} a_t \cdot t; \tag{15}$$

in the case of the observed example the lag will be

$$l = 0.25 \times 1 + 0.40 \times 2 + 0.20 \times 3 + 0.15 \times 4 = 2.25 \text{ years.}$$

Proceeding from this time interval and using formula (14) we get

$$\mathring{D} = \frac{300}{1.1^{1.25}} = 266.31 \text{ thous. kr.}$$

and using formula (12)

$$\mathring{\varepsilon}_b = 266.31 - 0.1 \times 1000 = 166.31 \text{ thous. kr.}$$

We can see that the result nearly coincides with the result obtained using the first method.

The trustworthiness of the result can be demonstrated by the comparison with the sum we get when the profit gained when the enterprise operates at full capacity is taken for the basis of the calculation. In that case the annual effect will be

$$\varepsilon = \frac{300}{1.1^3} - 0.1 \times 1000 = 125.39 \text{ thous. kr.}$$

It is considerably smaller than the above-given. And so it must be, since in calculating ε the profits during the implementation period were not taken into account.

What would be the base effect discounted to the stipulated initial moment of putting an enterprise into operation? According to formula (3) the value of $\acute{K}$ will be

$$\acute{K} = 1000 + 1.1^{1.25} = 1126.5 \text{ thous. kr.,}$$

from which we get by using formula (1)

$$\varepsilon_b = 300 - 0.1 \times 1126.5 = 187.35 \text{ thous. kr.}$$

The sum is bigger than that found above, because it is gained 1.25 years later. Its value in the year following the investment can be estimated by the quotient

$$\mathring{\varepsilon}_b = \frac{\varepsilon_b}{(1+E)^{l-1}}. \tag{16}$$

Substituting the numbers for symbols in the quotient we get the result already familiar to us

$$\overset{\circ}{\varepsilon}_b = \frac{187.35}{1.1^{1\cdot 25}} = 166.31 \text{ thous. kr.}$$

The base efficiency does not depend on the moment at which investments or profits are discounted. So, the quotients

$$E_b = \frac{266.31}{1000} \quad \text{and} \quad E_b = \frac{300}{1126.5}$$

both give the profitability coefficient 0.266.

To sum up it may be said that by determining the base effect and base efficiency it is possible to characterize objectively the profitableness of many economic projects.

While the discounted net profit (integral effect) and the coefficient of the discounted net profit reflect their profitableness during the whole period of account, then the base effect and efficiency show the average annual financial results of an investment.

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JÄRKJÄRGULISTE KAPITALIMAHUTUSTE AASTAEFEKTI SELGITAMISEST

Täienduseks baasefekti kontseptsioonile

On kirjeldatud autori soovitatud tulukusnäitaja, nn. baasefekti leidmise metoodikat ja selle näitaja suuruse kindlaksmääramist investeeringujärgsele aastale.

Soovitus on kasutatav seesuguste tootmisobjektide puhul, mis antakse ekspluatatsiooni osade kaupa ning mille tegutsemisaeg on määramatu ja eeldatav aastatulu stabiilne.

Baasefekt (ε_b) selgitatakse valemiga

$$\varepsilon_b = D - E\acute{K}, \tag{1}$$

milles

$$\acute{K} = K \sum_{t=1}^{T} a_t (1+E)^{t-1} \tag{2}$$

või

$$\acute{K} = K(1+E)^{t-1} \tag{3}$$

ja kus D on stabiilne aastakasum pärast objekti evitamist; E diskontonorm; K kapitalimahutused, mis on tehtud objekti ekspluatatsiooni andmisele eelneval aastal (või mis on diskonteeritud sellele aastale); $\acute{K}$ objekti ekspluatatsiooni tinglikule alghetkele (hetkele, mis saabub pärast kapitalimahutuste tegemist perioodi järel, mille pikkus on viitaeg miinus üks aasta) diskonteeritud kapitalimahutused; T evitusperiood aastates; t objekti evitusaasta ($t=1, 2, \ldots, T$); a_t koefitsient, mis iseloomustab kasumi juurdekasvu evitusaastal t ($\sum_{t=1}^{T} a_t=1$); l kapitalimahutuste viitaeg aastates.

Investeeringujärgsele aastale diskonteeritud baasefekt ($\overset{\circ}{\varepsilon}_b$) on välja arvutatav valemiga

$$\overset{\circ}{\varepsilon}_b=\sum_{t=1}^{T}\frac{\Delta D_t}{(1+E)^{t-1}}-EK \tag{4}$$

või valemiga

$$\overset{\circ}{\varepsilon}_b=\frac{\varepsilon_b}{(1+E)^{l-1}}, \tag{5}$$

kus viitaja pikkus (l) on kindlaks määratud summana

$$l=\sum_{t=1}^{T} a_t\cdot t \tag{6}$$

ja kasumi juurdekasv evitusaastal t (ΔD_t) vahena

$$\Delta D_t=D_t-D_{t-1}. \tag{7}$$

On selgitatud ka objekti rentaabluse taset väljendava baasefektiivsuse koefitsiendi kindlaksmääramise korda. Baasefekti ja -efektiivsuse reaalsuse tagab asjaolu, et nad ei sõltu rohkem või vähem meelevaldselt valitud arvestusaastast, vaid objektiivsest näitajast — kapitalimahutuste viitaja pikkusest.

Уно МИККОВ

ОПРЕДЕЛЕНИЕ ГОДОВОГО ЭФФЕКТА ПОСТЕПЕННО ОСУЩЕСТВЛЯЕМЫХ КАПИТАЛЬНЫХ ВЛОЖЕНИЙ

В дополнение к концепции базового эффекта

Описывается методика нахождения рекомендуемого автором показателя прибыльности — т. н. базового эффекта — и определения его величины на следующий за инвестированием год.

Рекомендуется использовать эту методику в случае производственных объектов, которые осваиваются поэтапно, срок функционирования которых неопределен и предполагаемая годовая прибыль стабильна.

Базовый эффект (ε_b) определяется формулой

$$\varepsilon_b=D-E\acute{K}, \tag{1}$$

где

$$\acute{K}=K\sum_{t=1}^{T} a_t(1+E)^{t-1} \tag{2}$$

или

$$\acute{K}=K(1+E)^{t-1}. \tag{3}$$

Здесь D — стабильная годовая прибыль после освоения объекта; E — норма дисконтирования; K — капитальные вложения, осуществленные в предшествующий сдаче объекта в эксплуатацию год (или дисконтированные в этот год); $\acute{K}$ — капитальные вложения, дисконтированные на условный момент начала эксплуатации объекта (на момент, наступающий после периода осуществления капитальных вложений, продолжительность которого равна лагу минус один год); T — период освоения, годы; t — год освоения объекта ($t=1, 2, \ldots, T$); a_t — коэффициент, характеризующий прирост прибыли в год освоения t ($\sum_{t=1}^{T} a_t=1$); l — лаг капиталовложений, годы,

Базовый эффект, дисконтированный на следующий за инвестированием год ($\overset{\circ}{\varepsilon}_b$), вычисляется по формуле

$$\overset{\circ}{\varepsilon}_b = \sum_{t=1}^{T} \frac{\Delta D_t}{(1+E)^{t-1}} - EK \tag{4}$$

или по формуле

$$\overset{\circ}{\varepsilon}_b = \frac{\varepsilon_b}{(1+E)^{t-1}}, \tag{5}$$

где продолжительность лага определяется как сумма

$$l = \sum_{t=1}^{T} a_t \cdot t \tag{6}$$

и прирост прибыли в год освоения t (ΔD_t) как разница

$$\Delta D_t = D_t - D_{t-1}. \tag{7}$$

В статье описывается и порядок определения коэффициента базовой эффективности, отражающего уровень рентабельности объекта.

Реальность базового эффекта и базовой эффективности обеспечивается тем, что они зависят не от более или менее субъективно выбранного расчетного года, а от объективного показателя — продолжительности лага капитальных вложений.