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NET PRESENT VALUE CALCULATION: REAL LIFE APPROACH

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Abstract

Net Present Value (and IRR) is calculation considered as the most widely accepted measures of investment's financial evaluation. Both methods apply long-term cashflows for 5 to 15 years ahead. During that period inflation certainly has an effect on both cash inflow and outflow figures. Litereture often does not take into account the inflation or suggest a simplified inflation-corrected calculation method. Author proves that it is not appropriate in case of long-term physical investments. A new method: life-long financial simulation is suggested by the author for financial evaluation of physical investments.

Keywords: NPV, investment, inflation

1. INTRODUCTION

This paper deals with the inflation treatment in case of medium- and long-term real (physical) investments. Pure financial investments are not topic of this paper, just a physical investment in a company environment where those real investments are contributing for increased sales of the company's product(s) and by it to the increased net income of the company.

Inflation definitely will be experienced during the 5 15 years' life-cycle of the investment in real business environment. Question is how to treat the inflation in the NPV (and IRR) calculation in case of a new physical investment in real company framework. This paper reflects the Author's opininion that recent inflation treating methods are not appropriate for physical investments and in the CONCLUSION point Author suggest a new calculation method for this purpose.

2. NPV CALCULATION

General formulae of NPV calculation can be found below in Formula 1 and Formula 2. While Formula 1 shows the generally accepted method of NPV calculation, Formula 2 is characteristic for the physical investments, where cash inflow and cash outflow figures has to be calculated separately and the net cashflow figure is the outcome of a substraction in a given time period.

NPV Calculation formulae:

$$\text{Formula 1:} \quad NPV = \sum_{t=0}^{n} \frac{NCF_t}{(1+D/100)^t} \quad \text{, where:}$$

t = time factor, that is basically a year

n = maximum number of time periods, expressed in years (see above). It also includes the year 0, when the investment starts and being finished

NCF_t = net cash-flow, directly associated with the investment in year t. It is calculated as shown in Formula 2.

D = discount factor, expressed in percentage, applied throughout in the calculation, that means that it should not be changed for a later year figures' calculation.

NCF_t = net cash-flow, directly associated with the investment in year t. It is calculated, as shown in Formula 2.

Formula 2: $NCF_t = CIF_t - COF_t$, where:

CIFt = cash inflow, directly associated with the investment in year t, expressed in local currency

COFt = cash outflow, directly associated with the investment in year expressed in local currency

It is interesting to see that inflation, per se, is not included in the formulae above. It is taken into account indirectly in the discount factor (increasing it by the possible future inflation rate) or in the yearly cash flow figures (increasing both the cash inflow and cash outflow figures).

Treatment of inflation differs according to literature sources. In point 3 the possible treatment methods by the recent literature resources can be found.

3. REVIEW OF LITERATURE

There are three main streams in the relevant literature regarding the treatment of inflation. Below some examples are shown from each approach.

Approach 1: literature does not deal with the inflation at all or inflation is mentioned, but not any further discussion can be found in the text. This approach is characteristic in case of "early" publications of 1970-1990 years as well as publications where stronger theoretical support can be found in connection with capital investments. From the Reference list, the following publications can be classified into this group: Gisser (1981), Joy (1983), Nagy (2011), Neven(1985) and Reekie (1975).

Approach 2: literature does deal with the problem of inflation, however not any specific method is described how to treat the inflation properly in capital investments. From the Reference list, the following publications can be classified into this group: Black-Hirt (1987), Damodaran(2002), Francis (1980) and Pálinkó-Szabó (2006).

Approach 3: literature in this group does deal with inflation and also gives a suggestion to its treatment. From the Reference list, the following publications can be classified into this group: Andor (2017), Boudreaux (2017) and Brealey-Myers-Allen (2017). It seems that some authors recognised the importance of inflation treatment in recent years and incorporate it into their publication. The suggested method, however, is the same in each case, that is worthwhile to review on the basis of the worldwide recognised textbook of Brealey-Myers-Allen (B.M.A), (2017), see the example below from the pages of 137-138 of this book.

A calculation example suggested by B.M.A:

- Cash flow in year 0= -100 (Million USD)
- (Net) Cash flow in year 1: +35 (Million USD)
- (Net) Cash flow in year 2: +50 (Million USD)
- (Net) Cash flow in year 3: +30 (Million USD)
- Inflation rate projected at 10 % a year
- Nominal discount rate: 15 %

Calculation of discounted cashflow:

- Cash flow in year 0: no change
- Cash flow in year 1: 35*(1+10/100=1.1)= 38.5
- Cash flow in year 2: 50*1.1*1.1= 60.5
- Cash flow in year 3: 30*1.1*1.1*1.1= 39.9

Supposing that (net) cash flows above were expressed in costant prices, but the discount rate reflects the effect of inflation, the cash flows and the discount factor should also be expressed in real terms, as below:

- NPV=
  -100+38.5/(1+15/100)+60.5/(1.15*1.15)+39.9/(1.15*1.15*1.15)
  NPV= +5.5 (Million USD)
  Since NPV is >=0, therefore, this investment (100 Million USD) is suggested

Next, the suggested method of the inflation treatment by B.M.A. is shown below:

- Real discount rate= (1+nominal discount rate)/(1+inflation rate)-1
- Real discount rate= (1+15/100)/(1+10/100)-1= 4.5 %
- NPV =-100+35/(1.045)+50/(1.045*1.045)+30/(1.045*1.045*1.045)
- NPV= +5.5 (Million USD), that is the same figure as previously calculated

Based on this calculation method the inflation rate is mathematically eliminated from both the nominator and denominator of the formula. How B.M.A. (and some other authors) solve this problem, the future inflation rate does not play any role in the calculation of several years' cashflow and financial effectivity calculation of a capital investment. This elegant solution could definitely "calm down" the investors, because along with several other problems, they do not have to deal with problem of inflation, at least. A cautious planner, however, can raise a question in connection with this "elegant" solution, it really can solve the issue of long-term inflation in case of real, physcal investments? Answer of Author of this paper is definitely: NOT, and rest of this text deals with its problem and the possible solution.

4. PROBLEMS IN NPV CALCULATION

The main problems of the NPV calculation is threefold, as below:

A. General planning problems that are not directly related to inflation:

A.1. Estimation of yearly cashflows. This is a general problem of medum- and long-term planning, especially in case of cash inflow figures. Those considerations are not topic of this paper.

A2. Determination of the discount factor. Although it correlates with inflation, however its estimation requires special calculations that is not topic of this paper.

B. Inflation-related calculation problems:

B.1. Uncertainty in later years' inflation rates. It can also be considered as a general problem of the long-term planning.

B.2. Acceptance of the unified inflation rate throughout the whole calculation. With a relatively long time horizon of the calculation, risk of calculation operators are also increasing, so establishing a unified rate of inflation is really questionable.

C. "System error" in case of real (physical) investments. How it was shown above in Formula 2., net cashflow is to be calculated as difference between cash inflow and outflow figures in a given year. It means that net cashflow, per se, does not exist in case of physical investments, it is just a product of a substraction of two somewhat independent operators.

In summarizing the points above, it can be stated that inflation rates is worthwhile to take into account separately for cash outflow and cash inflow figures in the calculation, how it is shown in points 5 and 6 below.

5. INFLATION IN CASH OUTFLOW

Cash outflow figures are influenced by inflation differently, since:

- Purchased materials' cost change can be the closest figure to the general inflation rate because they are comprised several (hundreds) of material purchases, tending towards the (calculated or projected) material inflation rate
- Labour cost change is also influenced by the inflation, but just a long-run. In certain periods they can be over- or below the general inflation rate. For example recent years in Hungary the general inflation rate was between 1 and 3 per cent yearly, while labour cost increased by close to 10 per cent.
- Some other cost items change, like service cost rates, are influenced by the general status of the economy, rather than the general inflation rates. See above the example of Hungary: labour-centered services grow higher rate while public services' prices remained on low level.

Suggestion: treat the different cost items differently and NOT BY A UNIFIED INFLATION RATE!

6. INFLATION IN CASH INFLOW

Cash inflow basically can be calculated as the product of quantity sold and the average unit price. In connection with it there are two basic problems:

- Problem 1. Uncertainty about the future market situation is related to "our product", too.
- Problem 2. Sales quantity of our product is also influenced by our sales price, generally in negative direction.

In Figure 1. a general picture can be seen in connection with life-cycle phases of a theoretical market situation of a product (own editing, based on several literature sources).

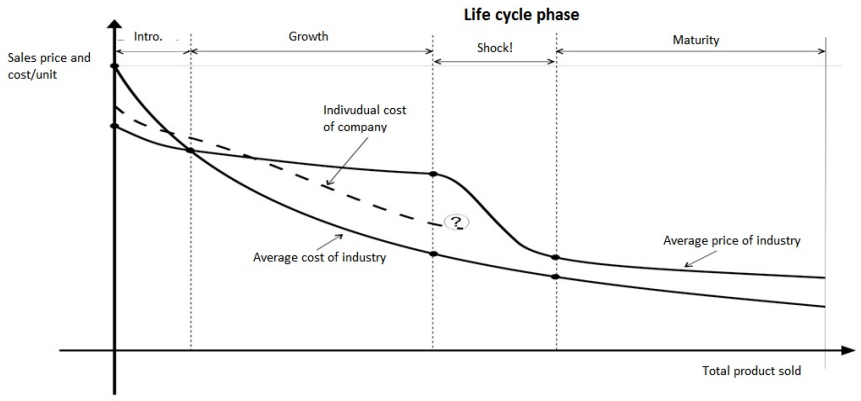

Figure 1 Theoretical life-cycle picture of a product market.

As it can be seen above, sales prices are constantly decreasing (in real term) throughout the course of the full life-cycle of the product in question. This phenomenon is explored by business science long time ago and verified as a general tendency most of the cases of real sales histories.

Deriving from the facts above that sales prices are to be set according to the general market situation of the life-cycle phase and the sales intention of the individual company, so inflation plays just an indirect role in the price setting.

7. CONCLUSION

In case of physical investments the main conclusions can be formulated in connection with treatment of inflation, as below:

- In real (physical) investments cash inflows and cash outflows should be calculated differently in order to get an appropriate net cashflow.
- In case of cash outflow(s), different types of cost items should be inflated by their projected behaviour-influenced individual inflation rates.
- In case of cash inflows, determination of the price(s) should be the subject of the intended market moves of the given company at the market's actual life-cycle phase and not just the expected future general inflation rate of the market.
- To suppose a situation that future inflation rates for the cost items and the sales price is EXACTLY THE SAME IS CONSIDERED AS A RARE EXCEPTION RATHER THAN A RULE!

Just to show the financial consequences of the points above, see a modified NPV calculation of the example by Brealey-Myers-Allen shown at point 3.

Yearly cashflows: unchanged

Cost inflation: 10 per cent (unchanged)

Discount rate: 15 per cent (unchanged)

Profit content of 1 unit (for example 1 Million USD) sales value: 20 per cent (estimation of the Author)

Inflation of product sales price: 9 per cent – only 1 per cent less than cost inflation!

New NPV: -3.7 Million USD, against the originally calculated +5.5 Million USD, that is a BIG CONTRADICTION! Based on the original calculation the investment is suggested financially, but only 1 per cent difference between cost and price inflation rates (that is quite realistic) means a

negative financial judgement for the investment. It is not exaggeration to establish that the traditional inflation treatment method is not solid enough for such an important decision making.

We can make a conclusion based on the facts above that the simple inflation treating method in NPV calculation suggested by Brealey-Myers-Allen CANNOT BE HOLD in case of real physical investments!

New NPV (and IRR) calculation suggestions from the Author:

- In case of a real physical investments a full life-cycle financial calculation method is suggested.
- In case of cash inflow calculation the physical sales of the product(s) and sales prices can be taken into account according to the given phase of the market life-cycle and the intended market move of the given company.
- In case of cash outflow calculation, different cost items' individual inflation rates can be determined by their expected future behaviour.
- Yearly net cashflows of the full life-cycle should be calculated and to be discounted by an appropriate discount rate that reflects not just the future inflation, but business risks, too.
- Several business scenarios should be calculated and evaluated by the same methodology in order to obtain a more realistic financial picture of the investment variant.

Note: Author developed a financial model (LIBFIMS) to assist the calculations described above.

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