Investment Decisions and Inflation

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Abstract

The present article reports on a study of investment appraisal techniques giving particular emphasis to the treatment of inflation. It is well known that several practicing managers usually estimate the results of proposed investment projects in terms of current prices and they completely ignore the effect of inflation. An investment normally involves a cash outlay followed by the receipt of cash benefits and inflation increases current prices by an amount that becomes larger with the passage of time. It seems possible that methods of dealing with inflation in project appraisal represent one set of factors which contribute to under-investment. It should be noted, that the bias from the neglect of inflation is likely to be higher, the higher the expected rate of inflation. We will show that the treatment of inflation in the appraisal process does no more than ensure the rejection of risky projects, in other words it acts as a proxy allowance for a factor, named risk.

Keywords: Risk, inflation, investment appraisal, cost, return.

1. Introduction

The contemporary business environment is highly competitive and fluctuating (Chalikias & Skordoulis, 2014; Chalikias & Skordoulis, 2016; Tsitmideli et al., 2016); thus, managers face a significant uncertainty (Wiesemann et al, 2010). As we know, inflation is a fact of life. So it must be considered in any capital budgeting analysis (Arnold, 2008). We need to investigate more than the treatment of inflation in the estimation of costs and benefits. We must study the techniques of calculation used in the method of appraisal an investment project and find out whether they introduce any bias or offset any bias introduced by the treatment of inflation. The key role of the inflation rate should be emphasized as the implications of not taking into account may be much wider than it is expected. The neglect of inflation in investment appraisal might result in a particular bias against the undertaking of certain kinds of labor savings investments. In addition, the neglect of inflation in estimates of future labor costs may lead to greater error than the neglect of inflation of other prices.

Inflation rates affect and have many serious implications for multinational financial decisions (Aizenman et al., 2011; Skordoulis et al., 2014; Weale et al., 2015). Relative inflation rates will greatly influence future production costs at home and abroad. Equally important, inflation has a dominant influence on relative interest rates as well

as on the exchange rates. Consequently, both of these factors influence decisions by multinational corporations for financing their foreign investment projects and both have an important effect on the profitability of foreign investments.

In the following, we shall emphasize the impact of inflation on the basic methods used to evaluate investment projects. We will also examine the relationship between risk and inflation and we will also examine its impact on the cost of capital of a business firm.

2. The optimal method of appraisal and the net present value criterion

Net present value has long been regarded between academics as the best criterion for project appraisal (Pasqual et al., 2013). The net present value method of appraisal involves calculating the present equivalents of expected receipts and payments involved in a project and ascertaining whether the present value of receipts outweights the present value of payments. The net present value method is founded on the assumption that the objective of a firm is to maximize the wealth of its owners, named shareholders, or of some other groups. Wealth is defined as the value put on potential future consumption at the present time. The objective of the firm may therefore be the wish to choose the set of investments and other activities which will generate the stream of consumption having the highest possible value (Van Horne James, 2002).

The present value method measures the relative value of satisfaction from having 1 euro at a given point of time in future from having 1 euro for consumption today at a given discount rate. For example, a discount rate of 10% means that 1 euro in a year time has the same degree of satisfaction today with 0,909 euros.

We may now summarize the steps involved in the appraisal of an investment by net present value criterion:

- An estimate is prepared to the amounts and timing of differences to cash receipts and payments, caused by the investment. Cash effects have primary relevance rather than effects on accounting profits because cash alone gives consumption power.
- The cash differences are converted to a common unit of measure by using the discount rate to calculate present values. In effect, the satisfaction given from future consumption is measured in terms of the expenditure which will give equivalent satisfaction at the present time.
- Present values of receipts and payments are added up and the investment is accepted if the former exceed the latter, which means if it generates increases in consumption which have a higher value than the required sacrifices of consumption.

Let us illustrate with a simple example the application of the net present value method to the appraisal of a simple project set in an economy in which no price changes of

any kind are expected. The project involves the proposed investment of 1,000 euros, on a machine with a life of three years and no scrap value at the end of the life. It is expected that the purchase of the machine will contribute to the reduction of the annual labor costs by 400 euros at current wage rates. We assume a discount rate of 10% per annum and it is also assumed that the cash savings arise at the end of each year. In the table which follows we show all the necessary calculations to derive the value of the net present value of the project without taking into consideration the impact of inflation.

Table 1: Calculation of net present value with no inflation assumed.

Time	Cash Flow	Sum at time in (a) equivalent to 1 euro now	Present value
(a)	(b)	(c)	(d) = (b) : (c)
0	payment of 1,000	1.000	-1,000
1	saving of 400	1.10	+363.6
2	saving of 400	1.10^2	+330.6
3	saving of 400	1.103^3	+300.5
			-5.3

Note that time 0 represents the present time, time 1 represents one year later and so on. The calculations involve conversion of future cash flows to current cash flows valued equally.

For example, since the receipt of 1.10 euros after one year is valued equally with 1 euro now, it follows that the receipt of 400 euros after one year is valued equally with 400/1.10 = 363.6 euros now. It is obvious that the value of all expected receipts is equal to 994.7 euros at the present time. Acceptance of the project requires an immediate outlay of 1,000 euros. Thus, a deficit is yielded in present terms of 5.3 euros and consequently the project cannot be accepted.

It should be noted that the net present value represents the additional benefit given to the shareholders from the projectôs evaluation. When the net present value is positive then the project is accepted, when it is negative it is rejected and when it is zero the investor is indifferent.

Let us examine what would be the impact of inflation when business firms evaluate investment projects. Inflation rate has a direct impact on the prices throughout the economy.

Let us suppose that the inflation rate is 15% per annum. The initial outlay of the project will be unchanged as it arises immediately. The cash saving at time 1 will now be increased to 400x(1.15) = 460 euros.

Similarly, the saving at time 2 will be 400 x (1.15)x(1.15) = 529 euros and the saving at time 3 will be 400 x (1.15)x(1.15)x(1.15) = 608.4 euros.

The existence of inflation assures that a larger sum of money will be required to secure a fixed amount of future consumption. If 1.10 euros was required after one year with the absence of inflation, 1.10 x (1.15) = 1.265 euros will be required with inflation rate at 15% when other variables being equal. Therefore, we should now use a discount rate of 26.5% per annum. This rate, called market rate, is the discount rate which is used to calculate the present values of all net cash flows derived from a project.

The appraisal of our investment project under the new situation would proceed as before, using estimates of cash flows and a discount rate which reflects the relative values of cash at different times. The discount rate implies a minimum satisfactory return, allowing both for the delay in time and the effect of inflation.

The calculation of net present value in money terms with inflation is shown in the following table.

Table 2. Calculation of net present value in money terms with inflation assumed.

Time	Cash Flow	Sum at time in (a) equivalent to 1 euro now	Present value
(a)	(b)	(c)	(d) = (b) : (c)
0	payment of 1,000	1.000	-1,000
1	saving of 460	1.265	+363.6
2	saving of 529	1.265^2	+330.6
3	saving of 608.4	1.265^3	+300.5
			-5.3

The calculation confirms that nothing of importance has changed relative to the original situation. The measuring scale is different but the net present value is unchanged. The project remains unacceptable. From the above analysis we can conclude on the following points.

Cash flows allowing for inflation are known as money cash flows. The discount rate that converts future money cash flows into present amounts having the same value, is known as a money discount rate. Thus, an acceptable method of investment appraisal under condition of inflation is to estimate money cash flows and then discount at a money rate.

On the other hand, cash flows may also be measured in real terms. It means in units having a constant purchasing power. A real cash flow is the cash sum required on the average at the present time to purchase the same quantity of goods and services as can be purchased with a given future sum of money. The real cash flows are obtained by dividing money cash flows by the year end index of inflation. A real discount rate may be defined as the rate that expresses the relationship between a future cash flow in real terms and the current cash sum valued equally.

Table 3. Calculation of net present value in real terms under inflation.

Time	Money Cash Flow	Index of Inflation	Real Cash Flow	Real Discount Rate	Present Value
(a)	(b)	(c)	(d) = (b): (c)	(e)	f = (d):(e)
0	payment of 1,000	1.00	-1,000	1.00	-1,000
1	saving of 460	1.15	+400	1.10	+363.6
2	saving of 529	1.15^2	+400	1.10^2	+330.6
3	saving of 608.4	1.15^3	+400	1.10^3	+300.5
					-5.3

From the above tables 2 and 3 we can conclude that the net present value calculations may be equivalently in money terms or in real terms. Appraisal in real terms can be made in two stages a) estimating money cash flows and discounting them by the rate of inflation to obtain real cash flows and b) discounting real cash flows by the real discount rate.

In addition, by comparing table 2 (money terms) and table 3 (real terms) we note that corresponding cash flows and discount factors are both multiplied by 1.15 in order to move from the real terms to the money terms. Consequently, it is obvious that appraisal in money terms is equivalent to appraisal in real terms.

In our previous analysis, we made the assumption that all prices are increasing at the same rate. In reality, different resources are subject to different rates of price change, the effect of inflation on goods and services has to be estimated statistically and the resulting index named index of retail prices represents only an approximation of the effect of inflation in any actual application.

3. The effect of risk

From the above analysis we concluded that firms will normally fail to maximize their wealth if they appraise investments by estimating cash flows in terms of current prices and discounting them at a money discount rate. Appraisal in terms of current prices reduces net present value. Such reduction may be taken as a proxy allowance for risk, assuming that no explicit allowance is made. The weakness of this approach is that no measurement is made of the risk of a project and no assessment is made of the extent to which a given level of risk detracts from the worth whileness of a project in a way that would enable the risk to be related to the inflation effect. Thus, we must analyze more precise the meaning of risk and the significance of cash flow estimates when we consider risk.

Despite the fact that the implications of uncertainty for investment decisions are still under controversy (Arrow & Lind, 2014) it is essential to deal with the potential risk. In most of the cases, there are alternatives that differ in the degree of risk and firms

must choose among them (Friedman & Savage, 1948). In order to measure risk in investment analysis, we may express estimates of the results of a project as probability distributions that is by giving a list of the possible cash flows at each time with an estimate of the relative possible probability of the occurrence of each one (Lumpy, 1991). This leads to a characterization of the results of a project in two measures i.e. the expected value, means the weighted average of the present values of the various possible outcomes, using probabilities as weights and secondly, a measure of the dispersion of possible outcomes, the risk of the project which statistically is measured by the variance or standard deviation. It is well known, that investors dislike risk and consequently in order to accept a project with high risk they will ask for a higher return to compensate the higher degree of risk (Mao & Helliwell, 1969). The higher the risk, the higher the discount rate and the lower the net present value.

The analysis made so far to evaluate investment appraisal under risk is shown to be too simple, simply because an investor holds a portfolio of investments and that it is the effect on the aggregate risk of the whole portfolio that is important in decisions about particular investment activities. The analysis leads to the conclusion that the risk of a project considered independently, is relatively important because part of that risk can be diversified away when the project is combined with others. The separate risk of a project would be no deterrent to its acceptance, rather it would normally be seen as a high desirable investment. Such a project may be said to have a low relative risk. Another investment, having a high level of risk in itself may tend to have returns which are positively associated with returns from other investment opportunities. It may have high returns when the other projects have also high returns and low returns when they have low returns. We can say that an investment project with high returns which are positively associated with the returns of other investments may be said to have a high relative risk.

The discount rate used in the appraisal of some projects should be adjusted to reflect the relative risk of the project. The discount rate would be relatively low for a project which is good hedge and relatively high for a project with a high degree of risk that is a project for which the risk cannot be reduced greatly by diversification (Freear, 1973). Thus we can say that the real discount rate can be derived, when nominal rate and inflation rate are known, by the formula given below:

$$r=\frac{i-p}{1+p}$$

Where: r = real interest rate
i = money interest rate
p= inflation rate (consumer index)

It is important to note that if a firm is concerned solely with the well being of its shareholders, it should assess the relative risk of an investment project in the context

of the whole securities market when shareholders are able to hold a diversified portfolio of securities.

4. The cost of capital and the impact of inflation

A companyôs cost of capital is the total cost of money derived from the combination of share capital, loan capital and bond capital. It is actually the discount rate by which the company calculates the net present value of its future investment projects. It is well known that the higher the financial risk the company faces the greater the return required by its shareholders and consequently, the higher the weighted average cost of capital.

Estimation of the required rate of return on equity capital is more difficult than estimation of the required return on debt capital. It is assumed that the required rate of return on new equity would be equal to the rate of return which present holders of equity securities expect to earn and it depends on the relationship between the current market price of the securities and the cash returns expected by holders (Arnold, 2008). The model for the estimation of the return on equity capital takes into consideration that cash returns will grow at a constant percentage rate on average (Archer et al., 1967). If r is the return, then its value is given by:

$$r=\frac{D_1}{P_0}+g$$

Where: r = the expected return on equity capital
D_1 = the expected dividend in time 1 ($D_1 = D_0(1+g)$)
P_0 = the market value of share
g = the companyôs growth rate

The above expression defines the cost of capital in money terms. If the growth rate is estimated in money terms, then the expression gives the discount rate in real terms. In order to calculate the real cost of capital we may either estimate the money cost of capital and adjusting for inflation or estimate the real growth rate and hence the real cost directly. Both approaches are equivalent provided that a constant rate of inflation is assumed throughout the calculations. Calculation of the growth rate in real terms is based on the assumption that the growth rate will be constant in real terms over the future. Calculation of the growth rate in money terms supposes that the money rate of growth will be constant over the future and that the real rate of growth will decline if the rate of inflation increases. It should be noted that the overall cost of capital is found as the weighted average of the cost of equity and the cost of debt using as weights the market values of equity and of debt.

5. The alternative methods of investment appraisal

In the present we analyzed the impact of inflation in the calculation of the net present value of an investment project. This method of evaluation is acknowledged widely as

the best method for appraising an investment. However, many firms use other methods of evaluating their projects.

One possible alternative method is the internal rate of return which also involves discounting of cash flows as the net present value method. It is defined as the rate of interest used as a discount rate which equates the net present value to zero. If we have to choose between alternative projects we have to choose the project with the highest rate of return. The two methods of appraising projects, the net present value and the internal rate of return, give the same result concerning acceptance or rejection of an investment project. A project which has a positive net present value will normally have only one internal rate of return and that will be higher than the cost of capital. The main difficulty in using the internal rate of return for accept / reject a project arises when the cash flows for a project do not comprise one or more payments followed in strict sequence by receipts. The difficulty arises in the case a project has a net cash outflow in some period after one in which net receipts have arisen. In that case the internal rate of return may cause confusion because several interest rates satisfy the basic definition of the method. The net present value method may rank projects in a different order from that given by the internal rate of return. The source of conflict between the two methods is that the net present value is a measure of the absolute gain from a project whereas the internal rate of return measures gain relative to outlay and in addition is a percentage of return and not a value expressed in money terms.

The treatment of inflation affects the internal rate of return method as well as the net present value similarly. The internal rate of return can be defined as the discount rate which gives a zero net present value to the real cash flows and should be compared with a cost of capital in real terms or the money internal rate of return can be compared with the money cost of capital.

Another simple method of evaluating investment projects is the so called payback method. The basic form suggests estimation of the length of time which will elapse between the incurring of the outlay for the project and the date by which aggregate receipts will have equaled the outlay. The main drawback of this method is that it ignores interest costs and also some of the cash flows from the project i.e those arising after the end of the payback period. It should be noted that use of the payback method rather than the net present value method in evaluating investment projects may lead to under or over investment. In addition, if the payback period is estimated from cash flow forecasts which ignore inflation, it will be overestimated judged against a similar calculation which allows for inflation and the degree of over estimation will be higher, the higher the expected rate of inflation.

Finally, a common method of investment appraisal, among those which do not use the discounting cash flow technique, involves comparing the accounting rate of return expected to be earned by a project with some standard rate of return (Brigham & Ehrhardt, 2013). The accounting rate of return is calculated by estimating a) the

change in accounting profit as a result of accepting the project and b) the change in fixed assets plus working capital and then expressed (a) as a percentage of (b). It is difficult to draw general conclusions about any bias involved in using the accounting rate of return method to rank alternative investments (Carsberg, 1974). In general the method seems likely to involve bias against the acceptance of large investments mainly due to the fact that all rate of return measure the returns in relation to the outlay and do not evaluate the absolute worth of the returns.

6. Conclusions

Let us summarize our analysis of the effects of using different methods to evaluate investment projects under condition of inflation. We argued that the best method of investment appraisal involves the calculation of the net present value of the project. Two equivalent methods of detailed calculation were used. The discounting of real cash flows at a real required rate of return or alternatively, the discounting of money cash flows at a money required rate of return and this would lead to understatement of the worth of an investment which results to underinvestment. The rational of this method is straightforward as a positive net present value means that it is generating more cash than it is needed to service the debt and to provide required return to shareholders. Thus, the excess cash accrues solely to the firmôs shareholders. A zero net present value signifies that the projectôs cash flows are exactly sufficient to repay the invested capital. A negative net present value signifies that the projectôs net cash flows are not sufficient to repay the invested capital and consequently the project should be rejected.

The internal rate of return method equates the net present value of the project to zero. It is the rate of interest at which the outlay for the project would accumulate to the receipt and comparing that rate with the minimum acceptable rate of interest.

The effect of using the payback method depends on the target payback period adopted by the firm and on the pattern of the projectôs cash flows. It was also emphasized that the neglect of inflation would lead to an overestimation of the payback period.

The bias in investment decisions resulting from the use of an accounting rate of return method compared to use of the net present value method, depends on the pattern of profits from the projectôs life (Bierman Jr & Smidt, 2012). The neglect of inflation would be likely to increase the bias of the calculation.

Finally, the argument that the neglect of inflation in investment appraisal and the consequent understatement of the benefits of a project could be justified as an allowance for the risk of the project.

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