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Analysis of the evaluation of investment projects with constant prices versus current prices approaches

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Resumen

En este trabajo se hace un análisis comparativo de la evaluación de un proyecto de inversión, considerando dos enfoques uno con flujos de efectivo a precios constantes y el otro a precios corrientes. El objetivo es determinar cuál de estos dos enfoques es mejor para la evaluación de proyectos para tomar la decisión de inversión correcta. En la actualidad permanecen ambas posturas pues algunos autores recomiendan que el mejor enfoque para evaluar proyectos de inversión es utilizar flujos de efectivo a precios corrientes mientras que otros se inclinan por el enfoque de precios constantes. El estudio aquí presentado realiza un análisis del crecimiento de dichos flujos considerando un aumento de producción real en ambos enfoques a precios constantes y corrientes y se realiza la evaluación del proyecto mediante dos métodos: VAN y TIR. Con los resultados obtenidos se elabora una discusión donde se muestra que la principal conclusión es que el enfoque de precios constantes es mejor para la evaluación de proyectos de inversión y determinar su viabilidad sin incurrir en riesgos adicionales a los del proyecto.

Abstract

This work makes a comparative analysis of the evaluation of an investment project, considering two approaches, one with cash flows at constant prices and the other at current prices. The goal is to determine which of these two approaches is best for project evaluation to make the right investment decision. At present, both positions remain, as some authors recommend that the best approach to evaluate investment projects is to use cash flows at current prices, while others prefer the constant prices approach. The study presented here performs an analysis of the growth of these flows considering an increase in real production in both approaches at constant and current prices, and the project is evaluated using two methods: NPV and IRR. With the results obtained, a discussion is carried out where it is shown that the main conclusion is that the constant prices approach is better for evaluating investment projects and determining their viability without incurring additional risks to the project.

Keywords: Investment Projects, Evaluation of Investment Projects, Cash Flows

JEL classification: E31, G24, G31 y G32.

1. Introduction

One of the dilemmas that arise when evaluating investment projects in an economic environment with inflation is deciding whether the basis for determining cash flows will be at current prices or at constant prices. The existing literature in this regard shows that, in the studies carried out, no conclusive results have been reached on which is the best alternative to evaluate investment projects, since there are still contradictions in this regard.

According to (Meza, 2009). "The Financial Evaluation of Projects is the process by which, once the initial investment, future benefits and costs are defined during the operation stage, it allows determining the profitability of a project."

A correct and adequate evaluation of investment projects is crucial to determine the success or failure of business. There are several methods of project evaluation, the most effective being those that take into account the value of money over time, such as the Net Present Value (NPV), and the Internal Rate of Return (IRR), among others.

This paper focuses on doing an analysis to determine which of the two approaches is best for evaluating investment projects with the least risk: Future cash flows at constant prices, or Future cash flows at current prices.

In both approaches, the evaluation of a project is carried out using the NPV and IRR methods, since, as mentioned, these two methods take into account the value of money over time.

The objective of the study is to determine which of the two approaches (constant weights or current weights) is best for the evaluation of investment projects and to determine their viability, profitability and obtain a greater probability of success in their implementation.

Investing money in any type of business involves assuming various types of risks, which could be minimized by properly evaluating investment projects.

The study has been carried out taking into account an economy with inflation and nominal and real interest rates.

The variables used are: Expected inflation, Nominal interest rate, Real interest rate, Current prices and Constant prices.

According to other authors, there are different approaches for evaluating investment projects, for example; (Velez-Pareja, 2001) mentions that "there are three approaches to evaluating projects in inflationary conditions."

The first approach calls it *"nominal or current prices* (projected prices) and mentions that this approach *projects increases in the prices* of inputs and products and discounts future cash flows with future nominal or current discount rates" (Velez-Pareja, 2001, p. 108).

The second describes it as "*The Constant Prices* Approach (mentioning that it is known as neutral inflation). This approach "does not project an increase in prices, but rather that prices remain the same throughout the life of the project, and discounts future cash flows at a real discount rate", (Velez-Pareja, 2001, p. 108).

The third approach he mentions is "*The pesos approach* (or any other currency) approach, mentioning that this approach" projects relative increases in prices and discounts future cash flows at the real discount rate "(Velez-Pareja, 2001).

The third approach has not been taken into account for this work, considering that there is a contradiction in calling it constant pesos and at the same time projecting relative increases in prices, since with any relative increase in prices they would no longer be constant pesos.

Other authors mention a fourth approach that consists of evaluating projects with cash flows in a hard currency (foreign currency), for example in US dollars, based on the fact that inflation in the United States is almost zero. In this case, we do not consider this approach appropriate either because the economies of the countries are not comparable and, despite the fact that inflation in the United States is zero, the differences in the exchange rates will produce bias in the evaluation of the projects, since the differences in rates Exchange rates not only result from inflation differences between the economies of different countries, but also include other macroeconomic factors that are not the subject of this research work.

It is frequently discussed whether financial projections should be made at current prices or at constant prices, in this regard (Meza, 2009). He mentions that "projections at current prices consider the effect of inflation on prices and that projections at constant prices abstract of the inflationary effect on prices, which results in price invariance".

It is important to highlight the need to clearly define the variables; current prices and constant prices to avoid confusion in your application that can lead to errors. The consequences of this type of mistakes can result in the acceptance of bad projects as if they were really good.
(Meza, 2009) Defines "Current prices, also called nominal or absolute prices, as the prices of the products affected by inflation, which are given by the market".

Likewise (Meza, 2009) mentions that "the real or constant prices of a product are its price expressed in purchasing power units of year zero. The real or constant price ignores the inflationary effect on the price of a good or service". For example, in an inflationary economy if you have $ 100 at the beginning of the year, with that money you can buy a certain amount of goods, identifying the purchasing power of $ 100. After a year if inflation is 10%, to Maintaining purchasing power must have $ 110. Both the $ 100 in year zero and the $ 110 at the end of the year give the consumer the same purchasing power. The real or constant price of $ 110 would be $ 100 that we would obtain by removing the inflationary effect from $ 110. Therefore, it is necessary to define what is the base moment to which we must bring the values of the other periods.

2. Literature review

(Bodie & Merton, 2003) They explain the NPV rule for a project as “the amount by which the wealth of the company's current shareholders is expected to increase. They also show how to estimate cash flows, the discount rate, and how to calculate NPV. However, they do not comment on the best alternative for evaluating investment projects, current prices or constant prices.

Other authors like (Ross, Westerfield, & Jaffe, 2009) add other NPV rules, for example: “Accept the project if the VAN is greater than zero or reject the project if the NPV is less than zero. They also mention that the NPV uses all the cash flows of the project and that it discounts the cash flows appropriately”, but they do not clarify anything regarding the use of the approaches (current prices or constant prices) in the cash flows.

(Dumrauf, 2006) He adds that “the mathematical assumption implicit in the NPV is that the reinvestment of the funds generated by the project occurs at the opportunity rate that was used to calculate the NPV until the end of its useful life”, but nor does it mention anything about current prices or constant prices.

Given the ease it represents for the analyst to know the information from both perspectives, (Miranda, 2005) proposes “to start calculations with constant prices from the date the project is formulated and later if he considers it useful to apply the inflationary coefficients that allow advance the respective projections in current prices”.
(Brealey, Myers, & Marcus, 2007) And (Weston & Copeland, 1995), They argue that "the same NPV is obtained either with cash flows at current prices and current (nominal) discount rates, than with cash flows at constant prices and real discount rates, and they warn the reader not to mix real rates with cash flows at current prices and cash flows at constant prices with nominal rates ”.

They also clarify that "it is necessary to be careful and consistent: the cash flows at current prices must be discounted with nominal or current discount rates and the cash flows at constant prices with the real discount rate."

However, they acknowledge that taxes and depreciation introduce some bias into the analysis.

(Levy & Sernat, 1986) They point out that "the correct answer is obtained with any of the methods and that the only precaution that must be taken is not to mix interest rates and cash flows." However, they dedicate a good space to demonstrate that when there are taxes, depreciation introduces an upward bias (higher NPV) when working with constant prices. ” They also present a detailed example and show that when there is no inflation (or when there is neutral inflation) the results are the same. When inflation is not neutral, the results differ; however, the reader ends up with the idea that the resulting decision is the same.

(Damodaran, 1996) Presents an example that shows the equivalence of working with any method and warns the reader not to mix rates and cash flows.

(Dixon, Hufschmidt, & Maynard, 1986) They state that “constant price methodologies are biased and overvalue a project because they oversimplify reality and produce undesirable results, for which they consider that the correct method is current prices and any Another method that does not represent reality as closely as possible should be discarded."

(Navarro, 2001) He made an analysis where “he evaluates and calculates the IRR and the NPV using the two approaches: with constant or real values and with current values showing that they were equivalent, clarifying that this equivalence will only occur effectively when the following conditions are present”:

a) That the increase in sales prices is exactly equal to the increase in costs. A consumer may forget about inflation when the highest value, in the price of the basket of goods and services that he consumes, is identical to the increase in his salary.
b) In the absence of project financing. Interest and principal amortization must be covered in current values.
c) Charges for depreciation of fixed assets and amortization of deferred assets may not be included in the evaluation, since these assets are depreciated and amortized at constant values.

It concludes (Navarro, 2001) that "the simultaneity of these conditions is unreal, therefore the evaluation of projects at current values is proposed in almost all events".
For their part (Puig-Andreu & and Renau-Piqueras, 1981) suggest that "for decision-making it is not convenient to work with current prices, affirming that the correct procedure is that of constant prices".

(Dixon, Hufschmidt, & Maynard, 1986) They recognize that "neutral inflation cannot be assumed (when working with constant prices) and propose to work with the relative increase in prices, they believe that the results are identical once include relative price increases.”

Continuing with (Dixon, Hufschmidt, & Maynard, 1986) they also affirm that “the projected data to calculate the cash flows must be done at nominal or current prices and those future cash flows must be discounted based on the current discount rate or nominal".

(Van Horne, 2001) He has expressed that "it is better to evaluate a project at constant prices or in a hard currency because it is possible to compare figures in different years". He also mentions that “for decisions on equipment replacement it is not equivalent to work with current prices and constant prices and that it is necessary to clarify that when the NPV is found with cash flows at constant prices, the base period is period zero, where usually initial investment occurs”.

(Velez-Pareja, 2001) Affirms that "it is not true that evaluating projects with constant prices is equivalent to evaluating them with nominal or current prices, and adds that the methodologies of constant prices and weights are biased and overvalue a project". He also mentions (Velez-Pareja, 2001) “These methodologies oversimplify reality and produce undesirable results. The correct methodology is that of current prices; Any other

approach that does not represent reality as closely as possible must be immediately discarded".

These latter positions are very important, and they are because many believe (at least), according to what is found in the recommendations of some financial institutions such as the Inter-American Development Bank (IDB), that the correct procedure is that of constant prices, this entity supports constant pricing methodology. It should be noted that some economists argue that this methodology may involve relative price increases, *but this is obviously a contradiction.*

The main argument that he uses (Velez-Pareja, 2001) to defend this methodology is that "possible errors are not incurred when trying to forecast inflation or price increases and that the same results are also obtained".

From the above it is inferred that very few authors make sufficient clarity to commit to the correct approach.

3. Methodology

This work analyzes an investment project "X" to manufacture the product "Y", through a quantitative approach in spreadsheet, a data treatment is performed with the following operations:

Tables are drawn up to determine the annual amount of sales, both at constant prices and at current prices.

Preparation of annual statements of income, to determine cash flows, at constant prices and at current prices.

Evaluation of the investment project "X" using 2 methods: Net Present Value (NPV), and Internal Rate of Return (IRR) considering two approaches:

a) Cash flows at constant prices and the "real interest" rate (nominal rate minus inflation rate)
b) Cash flows at current prices and nominal discount rate.

In the current or nominal prices approach, *an increase in the prices of inputs and products is projected* according to expected inflation and cash flows are discounted at future nominal discount rates.

In the constant prices approach, *no price increases are projected,* because it assumes that prices remain equal (constant) at the price of instant zero throughout the life of the project, and future cash flows are discounted at the *"rate real discount",* that is, the nominal rate minus the expected inflation. Therefore, using the NPV formula, the "X" project is evaluated in its two versions, cash flows at constant prices discounted at the real rate and cash flows at current prices discounted at the nominal rate.

The quantitative method is used by preparing tables and graphs in an Excel spreadsheet, to show the relationship between inflation, the discount rate and the Internal Rate of Return on investment, considering inflation levels of 4%, 6%, 8%, 10% and 12% annually. Tables and graphs are also produced to demonstrate that the growth of cash flows at constant prices is linear, while that of current prices with different levels of inflation is exponential.

A data analysis is then performed using the Pearson correlation coefficient to determine the correlation coefficient between the variables: inflation rate, discount or nominal rate, and IRR to infer which of the two approaches is the best alternative to evaluate projects. investment, constant prices or current prices.

Project "X" data to evaluate:

a) The initial investment is $ 1,500,000
b) The project has a useful life of 7 years.
c) The salvage value is considered to be equal to zero.
d) The objective of the company is to have a real growth of 3%, that is to say, to increase the production and sale in units by 3% each year until reaching its maximum installed capacity.
e) The expected inflation is 4% per year during the life of the project.
f) Investors would accept a minimum nominal rate of return of 20% or real, of 15.3846% (nominal less the effect of inflation), considering inflation of 4%.

Project assumptions.

a) The price of the product is $ 240.00 at time 0 (zero).
b) The project considers an installed capacity of 24,000 “Y” products.
c) The first year we will work at 75% of the installed capacity, so that sales and production will amount to 18,000 “Y” products = (24,000 x 0.75%)
d) From the 2nd year the company will have a "real" growth (in product units) of 3% per year.
e) There is a sufficient market for product "Y", so it is expected that 100% of the production will be sold and collected in the same period.
f) The cash flows, in both cases (current prices and constant prices) will be net profits (after taxes and profit sharing for workers) due to the tax and labor obligation that companies have to pay for these concepts.

4. Work development.

Considering the assumptions of the project described in paragraphs a) to d), the calculations corresponding to sales based on constant prices have been made using the following method: First, sales are projected in units with an annual growth of 3% (objective of the company). They are then converted into pesos by multiplying them by the sale price at time zero (project start) without projecting any increase in price during the useful life of the project, thus determining sales or income at constant prices (see table 1 last row) .

Table 1, Calculation of sales at constant prices

Concepts /Years	1	2	3	4	5	6	7
Sales in Units	18,000	18,540	19,096	19,669	20,259	20,867	21,493
Price	240	240	240	240	240	240	240
Amount	**4,320,000**	**4,449,600**	**4,583,088**	**4,720,581**	**4,862,198**	**5,008,064**	**5,158,306**

Source: own elaboration.

Table 2 shows a synthetic income statement for each year of the project's life, starting with sales until reaching net profit, which is being taken as cash flow at constant prices for evaluation purposes.

Table 2 Cash flows at constant prices.

Years	Net Sales	Cost of Sales	Gross Profit	Operating Expenses	Operating Profit	ISR y PTU	Net Profit or Flows
1	4,320,000	3,366,000	954,000	388,800	565,200	226,080	339,120
2	4,449,600	3,466,980	982,620	400,464	582,156	232,862	349,294
3	4,583,088	3,570,989	1,012,099	412,478	599,621	239,848	359,772
4	4,720,581	3,678,119	1,042,462	424,852	617,609	247,044	370,566
5	4,862,198	3,788,463	1,073,735	437,598	636,138	254,455	381,683
6	5,008,064	3,902,117	1,105,947	450,726	655,222	262,089	393,133
7	5,158,306	4,019,180	1,139,126	464,248	674,878	269,951	404,927

Source: own elaboration.

The calculation of cash flows at *constant prices* begins with the net sales calculated in Table 1 considering sales in units of the first year plus a growth of 3% per year, (similar to estimated GDP) without considering any increase in prices of the products.

To determine the cost of sales, the three basic elements of cost have been considered: raw materials, labor and manufacturing indirect expenses. Each of these three variables has only been affected by the company's growth of 3% (increase in real production) without increasing prices every year.

It has also been considered necessary to calculate the income tax (rate of 30%) and the participation of profits for workers (rate of 10%) as it is a legal obligation.

The calculation corresponding to sales based on current prices was made as follows: First, sales are projected in units with an annual growth of 3% (similar to estimated GDP). They are then converted to monetary units by multiplying them by the sale price, which includes a 4% increase in expected annual inflation over the life of the project.

Table 3

Calculation of sales at current prices

Concepts/Years	1	2	3	4	5	6	7
Sales in Units	18,000	18,540	19,096	19,669	20,259	20,867	21,493
Zero moment price $ 240	250	260	270	281	292	304	316
Amount	**4,492,800**	**4,812,687**	**5,155,351**	**5,522,412**	**5,915,607**	**6,336,799**	**6,787,979**

Source: own elaboration.

With the sales calculated in Table 3, Table 4 has been prepared, which shows a synthetic income statement for each year of the project's life until it reaches net profit, which is being taken as cash flow at current prices for purposes of your evaluation.

Table 4

Cash flows at current prices.

Years	Net Sales	Cost of Sales	Gross Profit	Operating Expenses	Operating Profit	ISR y PTU	Net Profit
1	4,492,800	3,500,640	992,160	404,352	587,808	235,123	352,685
2	4,812,687	3,749,886	1,062,802	420,526	642,276	256,910	385,365
3	5,155,351	4,016,877	1,138,473	437,347	701,126	280,450	420,676
4	5,522,412	4,302,879	1,219,533	454,841	764,692	305,877	458,815
5	5,915,607	4,609,244	1,306,363	473,035	833,329	333,331	499,997
6	6,336,799	4,937,422	1,399,376	491,956	907,420	362,968	544,452
7	6,787,979	5,288,967	1,499,012	511,634	987,378	394,951	592,427

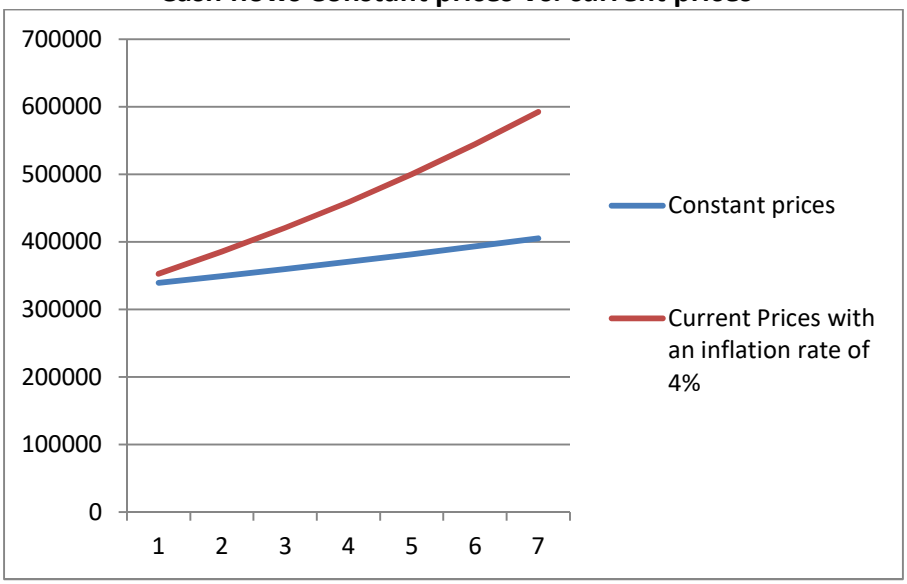
Source: own elaboration.

The determination of cash flows at current prices begins with the net sales calculated in table 3. The cost of sales has been calculated immediately, considering the three basic elements of cost: raw materials, labor and manufacturing indirect expenses, variables that have been affected with an increase of 3% due to real growth and 4% of expected inflation. It has also been considered necessary to calculate the income tax (rate 30%) and the share of profits to workers (10%) as they are legal obligations and therefore it is

necessary to reduce them from profits.With the data in column 8 of tables 2 and 4, graph 1 has been prepared to illustrate the behavior of cash flows at constant and current prices.

Graph 1

Cash flows Constant prices Vs. current prices



Source: own elaboration.

They have only been affected by the 3% increase in real production each year. Therefore, if the production remained constant, the line would be a horizontal line parallel to the axis of the (X) abscissa. On the other hand, the behavior of flows at current prices is an exponential curve because it is affected both by growth in real production (3% each year), and by the increase in prices caused by the effect of inflation (4 % every year).

Immediately the evaluation of project "X" was carried out using two alternatives:

a) At constant prices (see tables 1 and 2)
b) At current prices (see tables 4 and 6)

With the net cash flows, from Table 2 Table 5 has been prepared containing the evaluation of the project at constant prices. As mentioned at the beginning of this work, the cash flows of a project at constant prices must be discounted with a *real discount rate*.

According to point 6 of the project data, the nominal rate accepted by investors is 20%.

To determine the real rate we apply the following formula:

$$R = [(1+N) / (1+i)] - 1 \qquad (1)$$

Where:

R is the Real Interest Rate, N is the Nominal Interest Rate and i is the expected inflation rate.

Substituting:

$$R = [(1+0.20) / (1+.04)] = 1.153800 \quad (2)$$

For the purposes of the Discount Factor, the unit is not subtracted because this factor is part of the NPV formula, which is noted in column 4 of Table 5.
The Net Present Value is determined with the following formula:

$$VAN = -I_0 + \sum_{t=1}^{n} \frac{F_t}{(1+i)^t} = -I_0 + \frac{F_1}{(1+i)} + \frac{F_2}{(1+i)^2} + \cdots + \frac{F_n}{(1+i)^n} \quad (3)$$

Where:

NPV = Net Present Value
VP = Cash flows of each period at Present Value
i = Discount rate (interest)
n = Number of years or periods
Io = Initial investment of the project.

For greater clarity in the application of the formula, table 5 presents the present value of each cash flow, and their sum, considering a real discount rate of 15.38% because the cash flows are at constant prices. With the result of the evaluation, the decision will be made to invest or not in an investment project, considering the NPV rules that establish the following:
When the NPV is ≥ 0 the project is considered viable and must be accepted.
When the NPV is < 0, the project is not viable, therefore it must be rejected.

Table 5
Project evaluation at constant prices

Initial Investment	1,500,000	Recovery Period	Discount factor	Current Value
Useful life 7 Years	Cash flows	5 Years	$(1 + i)^n$	Cash flow.
1	339,120	339,120	1.153846	293,904
2	349,294	688,414	1.331361	262,359
3	359,772	1,048,186	1.536185	234,198
4	370,566	1,418,752	1.772521	209,062
5	381,683	1,800,435	2.045216	186,622
6	393,133		2.359865	166,591
7	404,927		2.722920	148,711
Amount	2,598,495			1,501,447
		N.P.V. =		**1,447**

Source: own elaboration.

The evaluation of the project at constant prices by the NPV method has been greater than zero. Therefore, according to the rules of said method, it has been determined that it is viable and the project must be accepted.

The project evaluation is then carried out by the same NPV method, using the net cash flows at current prices, with the data taken from Table 4 presented in Table 6. The discount rate will be the nominal rate (20 %).

Table 6
Project evaluation at current prices

Initial Investment	1,500,000	Recovery Period	N.P.V.	Current Value
Useful life 7 Years	Cash flows	4 Years	(1 + i)n	Cash flow.
1	352,685	481,699	1.200000	293,904
2	385,365	867,064	1.440000	267,615
3	420,676	1,287,740	1.728000	243,447
4	458,815	1,746,555	2.073600	221,265
5	499,997		2.488320	200,938
6	544,452		2.985984	182,336
7	592,427		3.583181	165,336
Amount	3,254,417	Amount: C.F.P.V.		1,574,839
A.P.B.	464,917	N.P.V. =		**74,839**

Source: own elaboration.

The result of the evaluation of the project with cash flows at *current prices* has also been positive as it is a figure greater than zero, therefore the project is considered viable and must be accepted.

It can be seen that in both cases, constant prices and current prices, the evaluation of project “X” has been viable due to having a positive NPV. However, the NPV calculated at current prices is much higher compared to the result of the NPV at constant prices. From the above, it can be inferred that evaluating projects with cash flows at current prices, and at constant prices, is not equivalent, even when the differences are small. Therefore, evaluating at current prices is not the same as at constant prices, as indicated by some authors.

Evaluating investment projects with the wrong alternative, either at current prices or constant prices, increases the risk of the project, since it increases the financial risk by not actually obtaining the return on investment or the expected profitability during its useful life of the project.

According to the results of the Evaluation of Project "X" both at constant prices and at current prices, it can be affirmed that it is better to use constant prices than current prices to evaluate investment projects and make sound investment decisions. Our affirmation is based on the fact that, with current prices, a higher NPV is obtained, which induces the acceptance of projects with additional financial risks than the normal ones, plus the ones inherent to the project, that is to say that bad projects can be accepted (not profitable) as if they were good.

To confirm the above, we have prepared Table 7 which shows the relationship between inflation, the discount rate and the Internal Rate of Return on investment.

Table 7

Inflation Ratio, Discount Rates and IRR

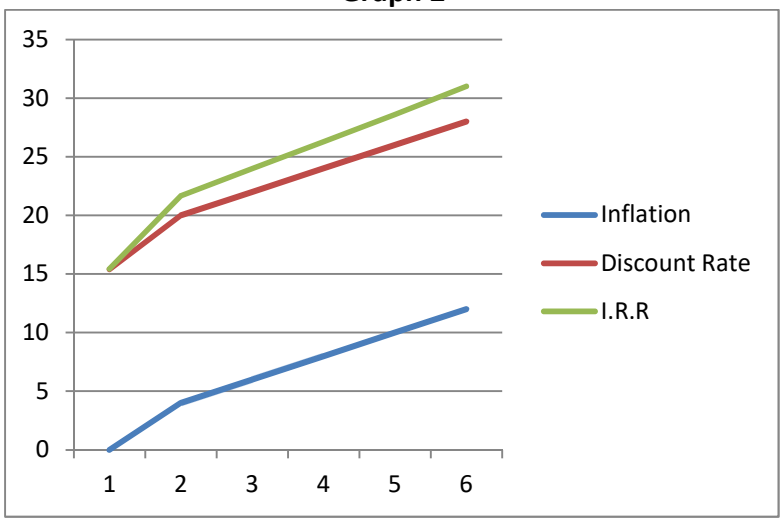
Inflation	Discount Rate.	IRR.
0	15.3846	15.4400
4	20.0000	21.6670
6	22.0000	23.9800
8	24.0000	26.2850
10	26.0000	28.5890
12	28.0000	30.9950

Source: own elaboration.

The first row of Table 7 presents inflation of zero (first column); A discount rate of 15.3846 (second column) equivalent to the real rate calculated on the nominal rate of 20% with expected inflation of 4%; An IRR of 15.44 with cash flows at constant prices.
The following rows (2 to 6) show in the first column the expected inflation rate during the useful life of the project at different levels (from 4% to 12%); in the second column are the nominal rates to evaluate the project at current prices at each inflation level; and in the third column the Internal Rate of Return on Investment (IRR) calculated on cash flows at current prices and different levels of inflation.

For better illustration of Table 7, Figure 2 is presented, where the relationship between the three variables is observed: inflation, discount rate and IRR.

Graph 2



Source: Own elaboration with data from table 7

Note that inflation and the discount rate have a directly proportional relationship, that is, there is a correlation of (1) because the nominal rate is equal to the discount rate (used to evaluate projects at current prices) and is subtracts inflation to determine the real rate used in investment projects at constant prices. On the other hand, the correlation of the variables *Discount Rate and Internal Rate of Return* on investment is less than 1 because, the higher the inflation, the greater the gap between both variables (DR and IRR).

To reinforce our research, we have prepared tables and graphs comparing flows at constant prices, with flows at current prices at different levels of inflation ranging from 4% to 12%, presented in Table 8 and Figures 3 and 4.

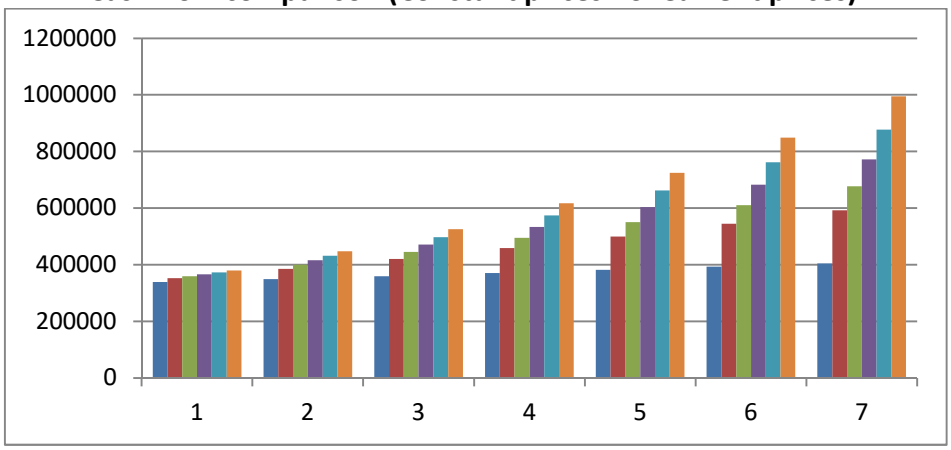
Table 8
Cash flows constant prices VS current prices.

Years	Constant Prices	Inflation-4%	Inflation-6%	Inflation-8%	Inflation-10%	Inflation-12%
1	339,120	352,685	359,467	366,250	373,032	379,814
2	349,294	385,365	400,330	415,579	431,113	446,933
3	359,772	420,676	445,415	471,106	497,766	525,414
4	370,566	458,815	495,140	533,580	574,216	617,129
5	381,683	499,997	549,959	603,837	661,857	724,254
6	393,133	544,452	610,372	682,814	762,282	849,313
7	404,927	592,427	676,928	771,556	877,304	995,239
TOT.	2,598,495	3,254,417	3,537,611	3,844,722	4,177,570	4,538,096

Source: own elaboration.

Table 8 shows in the second column the flows at constant prices where it is observed that each year it increases by 3% corresponding to the increase in real production and not an increase in price. While the third to seventh columns show the cash flows that include, in addition to the 3% increase in growth in production, an increase due to inflation ranging from 4% to 12%.

Graph 3
Cash flow comparison (Constant prices VS. Current prices).



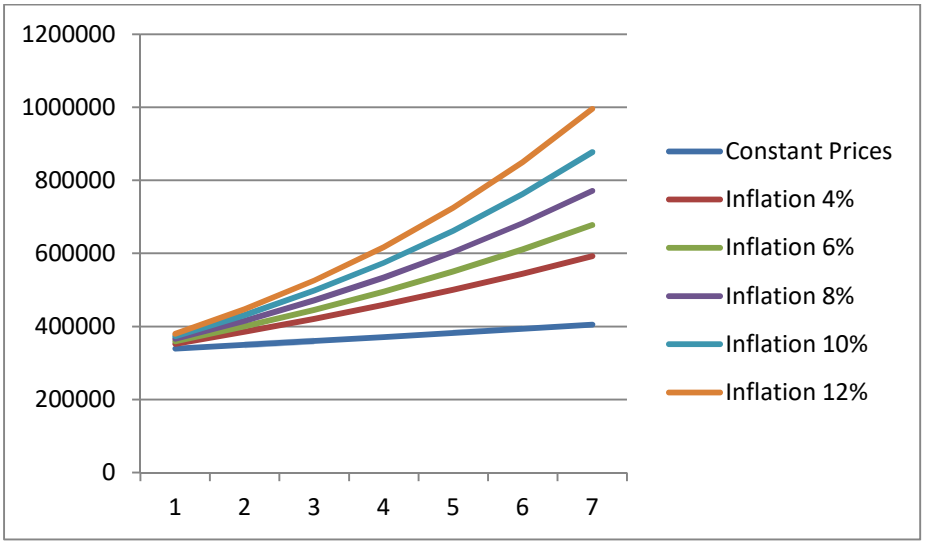
Source: Own elaboration with data from Table 8

Graph 3 shows that the growth of cash flows at constant prices is linear, while the behavior of cash flows at current prices at different inflation levels is exponential.

For a better illustration, Chart 4 has also been prepared, where the performance of cash flows at constant prices and at current prices with their different levels of inflation is observed, where it is again observed that the behavior of flows at constant prices is linear while at current prices it behaves with exponential growth, which confirms that evaluating projects with current prices is not convenient because it produces a bias in the

results, that is, a higher NPV that would induce them to be accepted unfeasible projects as if they were profitable.

Chart 4
Cash flow behavior



Source: Own elaboration with data from table 8

To corroborate our study, the correlation coefficient analysis presented in Table 9 and graph 5 has been performed, where an almost perfect negative correlation of cash flows at constant prices with cash flows at current prices is observed in different inflation levels (4% to 12%).

$$r = \frac{\sum(X - \overline{X})(Y - \overline{Y})}{(n-1)S_x S_y}$$

Where:
r = correlation coefficient
n = number of observations
X = cash flows at constant prices
$\overline{X}$ = sum of variable X divided by the number of observations
Y = cash flows at current prices
$\overline{Y}$ = sum of the variable Y divided by the number of observations
S_x= standard deviation of X
S_y= standard deviation of Y

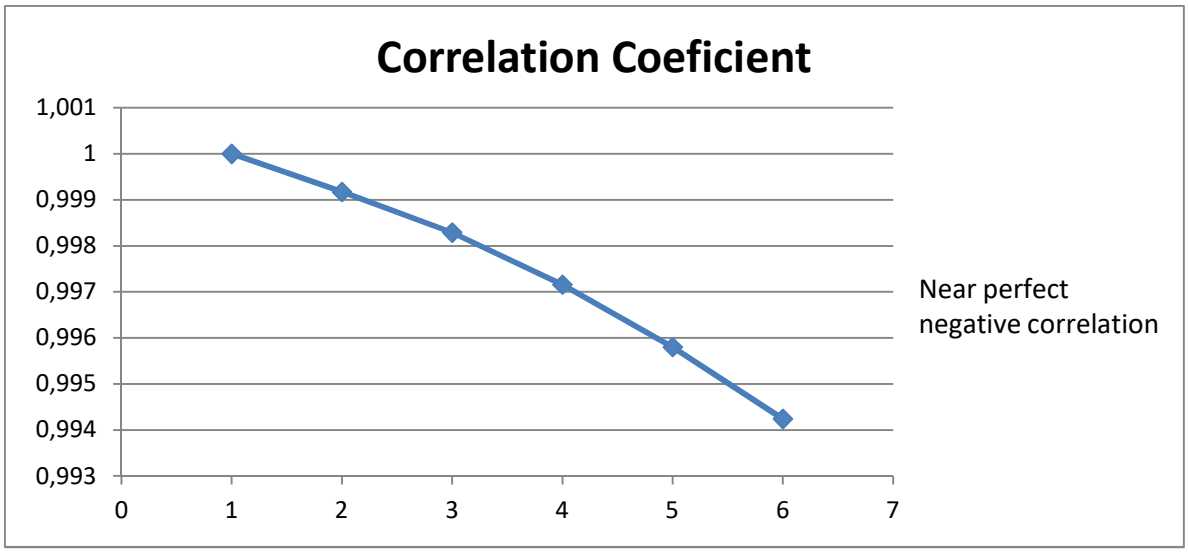
Table 9
Correlation coefficient

	Constant Prices	Inflation 4%	Inflation 6%	Inflation 8%	Inflation 10%	Inflation 12%
Constant Prices	1					
Inflation 4%	0.9991718	1				
Inflation 6%	0.99828938	0.99984146	1			
Inflation 8%	0.9971565	0.99939627	0.99985643	1		
Inflation 10%	0.99579949	0.99869843	0.99944808	0.99986745	1	
Inflation 12%	0.99424016	0.99777376	0.99880247	0.99948791	0.99987638	1

Source: Own elaboration with data from table 8

In the results of Table 9, it can be seen that the higher the inflation, the lower the correlation coefficient from which it is inferred that, as inflation increases, the difference in cash flows increases, which shows that current prices produce a bias that grows with on par with inflation over time. Therefore, it is once again shown that the evaluation of investment projects at constant prices is the best alternative.

Graph 5
Correlation of constant prices and current prices at different inflation levels



Source: Own elaboration with data from table 9

In graph 5, the almost perfect negative correlation curve can be better appreciated, showing that the higher the level of inflation, the lower the correlation coefficient, and therefore the gap between constant prices and current prices increases. Thus, it is

demonstrated that evaluating investment projects at current prices is not the best alternative since it produces a bias that distorts the evaluation results, and causes non-viable investment projects to be accepted. Therefore, the results of this last analysis again confirm that the best alternative to evaluate investment projects is the constant prices approach.

5. Results

The result of the research work presented here has been the evaluation of an investment project "X" using two approaches:

a) one using cash flows at constant prices, discounted with a real rate and
b) another through the use of cash flows at current prices, discounted at a nominal rate.

To avoid biases in the results, in both approaches (constant and current prices) the same procedure was used, the same assumptions or premises and the results have been different. However, in both alternatives, the NPV has been positive and the project has been considered viable.

The difference in NPV calculated at current prices is very high compared to the result of NPV at constant prices. From the above, it can be inferred that evaluating projects with cash flows at current prices, and at constant prices, *is not equivalent*, as indicated by some authors.

According to the results of the Evaluation of Project "X" both at constant prices and at current prices, it is concluded that *the best alternative to evaluate investment projects is to use constant prices.* This statement is based on the fact that, with current prices, a higher NPV is obtained, which induces the acceptance of projects with financial risks in addition to the normal and inherent risks of the project.

Inflation and the discount rate have a directly proportional relationship, that is, there is a correlation of (1) because the nominal discount rate (used to evaluate projects at current prices) is subtracted from inflation to determine the rate real used in investment projects at constant prices. On the other hand, the correlation of the variables Discount rate and Internal Rate of Return on investment is less than 1 because, the higher the inflation, the greater the gap between the two variables.

The performance of cash flows at constant prices and at current prices with their different inflation levels is different. Cash flows at constant prices in this case with an increase in real production of 3% each year have had a linear growth, while cash flows at current prices with the same 3% growth in real production have had a linear growth. behavior with exponential growth due to the increase in input prices, which confirms that evaluating projects with current prices is not convenient because it produces a bias that results in a higher NPV.

Chart 4 shows that there is an almost perfect negative correlation, which shows that the higher the level of inflation, the lower the correlation coefficient, and therefore the gap between constant prices and current prices increases. Thus, it is demonstrated that

evaluating at current prices is not the best alternative since it produces a bias that distorts the evaluation results, and causes non-viable investment projects to be accepted. The results and conclusions of this work provide entrepreneurs, investors and consultants in project evaluation with some recommendations on the best practices for preparing investment projects to achieve benefits with the minimum risk.

6. Discussion

The selection of one of the two approaches (constant or current prices) is very important for the financial evaluation of investment projects in economies with inflation. Because the results of both approaches are different, the decision made based on these results is crucial for the success or failure of business.

With the results of this work, some comments have been made regarding our position on the use of cash flows, either constant or current prices, in contrast to the opinion of various authors. In the first place, we agree with the opinion of (Velez-Pareja, 2001) only in the part of his work in which he concludes: "It is not true that evaluating projects with constant weights and current prices is equivalent".

By reviewing the bibliography, it has been detected that there is still a diversity of opinions regarding the selection of cash flows to evaluate investment projects, (constant prices or current prices), which we have classified into 4 aspects:

The first aspect is that several authors such as (Miranda, 2005), (Navarro, 2001), (Dixon, Hufschmidt, & Maynard, 1986) and (Velez-Pareja, 2001) agree that to evaluate projects, cash flows are calculated at current prices.

The results of this study do not coincide with the opinions of this aspect, since several analyzes were carried out on project "X", which has been evaluated at constant prices and current prices, at different levels of inflation, proving that the best alternative to evaluate investment projects is with flows at constant prices.

The second aspect includes authors such as (Puig-Andreu & and Renau-Piqueras, 1981) and (Van Horne, 2001) who are inclined towards the constant prices methodology, *an opinion with which we do agree* because the results of this work have done so demonstrated. In the project under study, a positive NPV of 1,447 was obtained in the alternative at constant prices, while in the alternative of current prices, a NPV of 74,839 was obtained. Therefore, it has been considered that *the best alternative is that of constant prices* to measure its viability and be accepted a project to ensure its success, since there is less risk as it is a lower result (more pessimistic), because if it is taken in account the alternative of current prices by generating a higher NPV (more optimistic), non-viable projects could be accepted, as if they were viable and in the end not have the expected success.

The third aspect is where researchers such as (Brealey, Myers, & Marcus, 2007), (Damodaran, 1996), (Levy & Sernat, 1986) and (MarkerDeposition1) do not lean towards either approach, that is, it is possible use either approach.

The fourth aspect is where the authors do not speak for either of the two alternatives, among them are (Bodie & Merton, 2003), (Dumrauf, 2006) and (Ross, Westerfield, & Jaffe, 2009), among others.

In summary, the result of *this work coincides with the authors who recommend using cash flows at constant prices to evaluate investment projects* to demonstrate their viability and decide on their acceptance or rejection.

The authors' arguments in favor of the current price methodology are that constant price methodologies are biased and overvalue a project. However, the opposite has been shown in this work. They also mention that these methodologies oversimplify reality and produce undesirable results. They also believe that, making the analysis in current pesos, it is about modeling or predicting the future reality and when doing it in constant weights, there are assumptions completely removed from reality.

In this work it has been shown that, on the contrary, it is current prices that distort reality because they are only estimates of what will happen in the future.

The present work also demonstrates that the results of both methods are different and that a higher inflation rate requires a higher nominal discount rate to evaluate the projects, which causes the gap between the real discount rate and the IRR to increase as which increases the inflation rate. The fact of making the evaluation *at current prices is not guaranteed reality,* because the current prices of the future *are only forecast and not real*, the same happens with inflation. Therefore, there may be more error in trying to predict the behavior of future prices and costs because the changes in the prices of all the inputs of a product are not the same.

Another argument of the works that favor current prices is that the project should not be evaluated only from the point of view of its economic and financial convenience, that other aspects should also be considered, such as the viability of the project in terms of liquidity, but this applies to both approaches, both for current prices and for constant prices.

The authors also argue in favor of current prices, that when comparing liquidity needs to pay contracted loans, even at zero time, it could not be known whether or not the project can pay it, because liquidity at constant prices says nothing about the actual availability of money. This, apart from the difficulty of defining the needs for funds well, this argument is also applicable for both approaches.

They also mention that it should not be forgotten that the cash flow is distorted with underestimated taxes at constant prices and that a projected cash flow at constant prices does not mean anything to management. These cash flows are distorted for many reasons, but the most important is the undervaluation of taxes.

The appreciation of those who are in favor of current prices is incorrect, because the evaluation of projects at constant prices does demonstrate the economic and financial viability, as well as the liquidity and resource needs to carry it out and measure its profitability. This is done when preparing projected cash flow statements at constant

prices, where needs for loans or temporary investments are detected, due to shortages or surpluses of cash.

On the contrary, when projecting cash flows and other financial statements at current prices, the entire reality of the project is distorted, because it is not possible to foresee in what proportion the prices and costs of goods and services, inflation, interest rates, etc. will increase..., nor to accurately determine future financing needs, much less forecast liquidity to meet interest and principal payments.

The fact of evaluating investment projects *at current prices is not assured of reality*, nor has financial validity been demonstrated, because current prices of the future *are only forecast, estimated, and not real,* the same is true of projected inflation.

Instead, the results of this study have shown that by discounting cash flows at current prices, the NPV is inflating. It is also important to emphasize that taxes must be considered in any investment project, that is, to evaluate the projects, cash flows must be taken at constant prices after taxes (ISR) and Participation of profits to workers (PTU) for being a fiscal obligation.

It is no coincidence that organizations and institutions as important as the IDB (Inter-American Development Bank) and other international financial organizations recommend that the evaluation of investment projects be carried out with cash flows at constant prices.

7. Conclusions

This work shows that the results of the financial evaluation of investment projects using both approaches, constant prices and current prices, are different because projects with cash flows at current prices are discounted with a nominal rate and projects with prices constants are discounted at a real rate, verifying that the NPV at current prices is higher than the NPV at constant prices.

The fact of evaluating investment projects at current prices is not assured of reality, nor has their economic-financial viability been demonstrated, because current prices of the future *are only forecast, estimated, and not real*, the same happens with expected inflation.

When projecting cash flows and other financial statements at current prices, the entire reality of the project is distorted, because it is not possible to predict in what proportion the prices and costs of goods and services, inflation, interest rates, etc…will increase in the future.

Considering that the most important scientific objectivity criteria are the reliability and validity of the data, we conclude that the evaluation of projects based on cash flows at constant prices is more reliable because the data used is of greater validity because they are based on in real data from the beginning of the project and does not influence the subjectivity resulting from an estimation of prices in the future as is the case of current prices.

Therefore, the result of *this work coincides with the authors who recommend using cash flows at constant prices to evaluate investment projects* to demonstrate their viability and recommend their acceptance or rejection.

It is important to emphasize that in all investment projects taxes must be considered, that is to say that to evaluate the projects, cash flows must be taken at constant prices after taxes and Participation of profits for workers, as it is a tax obligation.

Our recommendation is that when evaluating investment projects by methods such as NPV and IRR, they should be based on cash flows at constant prices.

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