Financial modelling in turbulent scenarios: *A didactic for the financial valuation of companies and projects*

Modelación financiera en escenarios turbulentos:
Una didáctica para la valoración financiera de empresas y proyectos

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Abstract- The actual professional needs to process large volumes of real information from companies and projects, to test and to validate various solution scenarios for the most successful decision making in difficult situations. This proposal summarizes the experience of several years of university teaching in finance courses, undergraduate and postgraduate, of mixed groups of students from the Faculty of Engineering and Business School of the Universidad Tecnológica de Bolívar, in Cartagena, Colombia. After working with various didactic approaches, you get to understand the importance of the interaction with theoretical and practical elements that enable the development of analytical skills, systemic and critical thinking, among others, based on the review of the use of spreadsheets, sensitivity analysis and simulation tools, for modeling projections and financial valuation of a company or project.

Keywords-- Didactic, spreadsheets, Financial Modeling, Risk, Uncertainty, Montecarlo Simulation.

Resumen- El profesional de hoy necesita procesar grandes volúmenes de información real de empresas y proyectos, probar y validar diversos escenarios de solución para la toma de decisiones más acertada en escenarios turbulentos. Esta propuesta resume la experiencia de varios años de docencia universitaria en cursos de finanzas, de pregrado y posgrado, de grupos mixtos de estudiantes de la facultad de Ingenierías y Escuela de Negocios de la Universidad Tecnológica de Bolívar, en Cartagena, Colombia. Luego de trabajar con diversos enfoques didácticos, se llega a comprender la importancia de la interacción de elementos teóricos y prácticos que posibiliten el desarrollo de habilidades de análisis, pensamiento sistémico, crítico, entre otros, partiendo de la revisión del uso de hojas de cálculo y herramientas de análisis de sensibilidad y simulación, para la modelación de las proyecciones y valoración financiera de una empresa o proyecto.

Palabras claves- Didáctica, modelaje financiero, riesgo, simulación Montecarlo, hojas de cálculo.

I. INTRODUCTION

The present study is based on problems experienced in the classroom, particularly in terms of addressing problem-solving in the field of business finance, which require working with data amounts that are sometimes difficult to handle and in which working with an authentic reality turns out to be very important. Many teachers continue to teach courses using traditional teaching techniques and tools, with exercises that are far from reality [1].

This practice leads to costly, operational exercises and limits students to applying formulas, without developing their thinking to achieve the generation of proactive ideas [2] that involve decision-making in contexts of uncertainty, a situation that is completely removed from the reality of the current world where turbulent scenarios constitute a starting point to achieve relevant and meaningful learning.

The methodology behind this model breaks the traditional teaching paradigm of financial planning and business valuation courses that are focused on scenarios under certainty and, instead, encourages analysis in turbulent, real scenarios, with tools that offer a more holistic and systemic view of the results, in order to make better decisions.

II. THE SOCIAL PRACTICE APPROACH TO TEACHING FINANCIAL MODELLING

According to various research studies, [3], [4], [5], [6], social epistemology [7], is an approach based on the social construction of knowledge, through which a concept can be acquired by students in situations of social practice. In a social and cultural context, it is necessary to seek the application of teaching practice that is more associated with the student's reality, with authentic situations where the experiential context provides the basis of meaningful learning for students.

According to [4], having students model in technological environments gives them a favourable environment to collect data, display them in charts and provide the corresponding

analysis, which involves thought development and decision-making.

Applying mathematical modelling to a problem situation, as quoted [8], makes modelling a tool that allows actions to be carried out, ranging from proposing and designing the problem situation, taking into account the conditions within the diverse scenario, interacting with the data and knowledge, explaining, and arguing, until eventually acquiring the knowledge or response as a result of analysing the information and understanding the results.

In fact, the modelling approach allows students to learn by involving them in a series of deep processes such as problem-solving, relational reasoning, summarizing, testing and analysing [9]. Along these lines, [10] and [11], recognize that modelling-based education can be a valuable pedagogical method and a challenge for the science and engineering of learning.

Currently, it is more suitable and effective to learn within a context rather than in isolation; therefore, the teacher's objective should be to promote interest-based learning by explaining appealing tasks that are meaningful to students while promoting the development of systemic thinking [12].

III. CONSTRUCTING KNOWLEDGE AND PROBLEM-BASED LEARNING

In 1913, John Dewey justified that the quality of interest-based learning is better than that of effort-based learning [13]; If teachers continue to prioritize effort-based learning in their classes, they are attached to a traditional paradigm. Thus, while the theory of effort teaches and practices skills in isolation, the theory of interest attempts to incorporate them into the context in which our students are immersed.

A methodology aimed at these objectives is problem-based learning (PBL), where the learning strategy begins with the presentation or delivery of information so that students, organized in small groups, examine their knowledge of the subject, determine what they need to learn, look for the necessary information and finally solve the problem [14].

In PBL, students work together to find alternatives and propose and validate information. In that interaction process, they develop systemic and critical thinking skills. The students also learn solidarity and how to work in teams; they reflect on and take responsibility for what they have to do [12].

The use of modelling to solve problems is connected to meta-cognition activities, where the concepts learned correspond to "this awareness (that) not only has to do with the knowledge of specific cognitive strategies but also with knowing how and when to use them" [15]. Then, there is a process where the learner monitors the task, reviews what failed, corrects the use of comparison strategies and compares them with the expected response.

Of course, teachers also change their managerial role to that of guide and facilitator, capable of designing learning strategies to teach thinking instead of being an expert on the content itself. They supervise the students and ask strategic questions, letting students construct their knowledge and training together with other students [16].

IV. FINANCIAL MODELLING BACKGROUND

[17] define financial modelling as a simplification of reality that seeks to represent the financial relationships that occur within a company [project], identifying the interactions between the different variables that form it, in order to understand its behaviour dynamics and to produce and analyse its results. Therefore, financial modelling consists of discovering the relationships that occur in a given situation and using symbols to express it in a model that can calculate results.

Ideas from leading authors are presented below. These authors have promoted the use of electronic spreadsheets and simulation tools in the financial field in the last three decades and laid the foundations for financial modelling.

[18] for the first time, presents financial models that use functions of financial mathematics and that make projections of financial statements of a company with Lotus 1.2.3 spreadsheets. [19], [20], [21], [22], [23] proposes a financial model to project a company's financial statements without quadrant accounting and to calculate free cash flows based on a company's valuation using Excel.

[24] address finance issues by solving them with Lotus 1-2-3, initially in 1995, and then with the latest editions of Excel.

[25], [26], [27] y [28], [29], in each chapter of their books, present the development of exercises with three alternative solutions: using arithmetic and basic algebra, financial calculators and Excel spreadsheets, with completely certain scenarios and constant interest rates over time.

[30] were the first to incorporate the use of electronic spreadsheets to address and solve financial problems, maintaining the manual solutions that traditional formulas use. They also include a simulation section that uses probabilities to familiarize students with real situations that they will face while working in the profession.

[31], [32], [33] shows that Excel can be used to solve problems related to corporate finance, valuation of options, cost of capital, and real options, among other issues.

[34] say that different methods are taken into account for risk assessment, including sensitivity analysis, which considers several possible alternatives (or scenarios) in order to obtain an understanding of the degree of variation among performance.

[35], propose an evaluation model for investment projects under risk conditions using Monte Carlo quantitative risk analysis simulation with Oracle's Crystal Ball software.

V. THE INNOVATION IMPLEMENTATION AND THE STUDENTS OUTCOME DEFINITION

The experience described in this document is based on the systematic application of PBL, by exposing students to using databases of companies in the real sector, available on government portals and those purchased by the university, so that as first learning outcome are able to project the future

financial situation of a company based on the diagnosis of the behavior of the business in relation to its environment (meso, macro and micro) and the evaluation of its past and present situation, considering low risk scenarios and uncertainty. The second learning result is that they make decisions ensuring the generation of value for the company where they operate and for each of their stakeholders, based on the analysis, interpretation and control of reports, metrics and financial indicators.

The learning strategy that details are given in this document is far from the traditional one that is based on the use of hypothetical problems that deliver partial information about a company and does not allow the student to analyze the environment beforehand and in some cases not even access is given to historical information of the proposed company.

The financial modelling tool proposed in this article is based on historical financial statements that were used to pull a company's policies and historical indicators, which will serve to establish the projection model's input variables for the three basic financial statements: general balance sheet, income statement and cash flow. The latter is the input used to calculate a company's value (it could also be the value of a project), based on the concept of net present value (NPV), that according to [22] is an appropriate indicator to choose investment alternatives among a group of mutually exclusive alternatives. The decision rule for the NPV method, which is a mathematical and normative model, indicates what decision should be made under certainty, considering the following:

– If the NPV is greater than zero, it is accepted.
– If the NPV is equal to zero, it is irrelevant.
– If the NPV is less than zero, it is rejected.

This static normative model has already been reassessed by incorporating statistics and moving from a deterministic model to a stochastic one, as [35] state, "in project management literature, Monte Carlo simulation is generally associated with risk management and specifies certain conditions and simulations including environmental variables and decision variables, both key for a project's results, such as NPV or internal rate of return (IRR), based on risk profiles for all relevant risk variables".

VI. DESCRIPTION OF THE FINANCIAL MODELLING PROPOSAL TO VALUE COMPANIES AND PROJECTS

Financial modelling is conducted for projections and financial valuations of a hypothetical company, recreating the potential results with the company's value under certainty and under uncertainty using sensitivity and simulation tools.

This financial model is constructed using basic disaggregated information, such as inflation rates, real interest rates, debt risk premium, quantities, real price increases and the company's other operating policies.

Designing and constructing the model involved the following four steps: 1. determining input variables, 2. identifying which of these variables are critical, 3. determining the probability distributions of these input variables and 4. simulating the model.

The input data used in the normative model constructed for this example are shown in Annexes in **Table I**.

This disaggregation provides the advantage of performing a sensitivity analysis (alternate scenario runs) and the Monte Carlo simulation run, as required.

This model is based on the one designed and explained in detail in the book Valoración Financiera de Proyectos y Empresas [Investment Decisions for the Financial Valuation of Projects and Companies] by Vélez-Pareja (2006). The model's focal point is cash flow (CF) where the expected behavior of cash inflows and outflows is recorded. This CF interacts with the income statement (IS) and with the balance sheet (BS).

This CF has five modules:

Module 1: This first module covers the company's or project's operational and functional activities (in the short-term), sales revenue entries, accounts payable, accounts receivable, purchases, general expenses, etc. including income taxes (needed from the IS). The net cash balance (NCB) from this module gives us the short-term financial needs (or short-term [ST] deficit) that define the ST debt if required.

Module 2 (investments in fixed assets module): The NCB of this module is the need for long-term cash. However, because the company could use internally generated funds to finance long-term investments, the NCBs from Modules 1 and 2 are added, and this results in real long-term (LT) needs.

Module 3: This module records financial activities and lists the ST and LT loans to cover the corresponding deficits from Modules 1 and 2. The LT need can be shared with equity investments. Therefore, the LT deficit could be covered with a percentage of LT debt (D%) and the remainder (1-D%) with equity investments.

Module 4: This includes shareholder transactions, based on capital investments, dividends and share buybacks. Capital investment shares the same formula for Module 3's LT deficit, covering the requirement that was not met by LT debt.

Module 5: This module records the surpluses or excess cash that could be invested in the stock market. The model has internal logic: when you have a loan, there is no excess cash to invest and vice versa.

After Module 5, the accumulated and yearly NCB can be calculated. This accumulated NCB must be the same as cash on hand in the BS at the end of the year. This cash can be defined as a policy that can be estimated from the company's or industry's historical financial statements or simply an internal policy that has been adopted. The CF that has been constructed with the input data and policies mentioned above is presented in **Table II** in Annexes.

The IS and BG that accompany the previous CF can be reviewed along with the complete model at the following link:

https://goo.gl/q4UmNM (Article Model - Cárdenas and Castilla)

The company and its assets are valued based on this projection model to obtain the results presented in **Table III**, shown in Annexes.

VII. ANALYSIS AND DISCUSSION OF RESULTS OBTAINED WITH THE MODELING TOOL

In practice, financial models are comprehended through basic tools of what-if, sensitivity or hypothesis analysis, including search objectives, scenarios and data tables with one and two variables.

In the base scenario that results from using the input variables shown above, the NPV is very close to 0, equivalent to 7.

In a first approach to a simple sensitivity analysis, we can evaluate the different potential NPV values from the changes in the "actual increase in sale price" and "increase in volume" variables, as shown in **Table IV** in Annexes.

The potential analysis of the different results obtained from the NPV is limited based on the results of this sensitivity analysis tool, called a two-variable data table, under scenarios of certainty, the simultaneous change in the two selected input variables, with the rest of variables remaining constant. This is because, in the NPV formula, the tool is limited to only changing the pair of input variable values in each scenario, omitting the risk quantification, which can eventually modify decision-making according to the interested party's risk profile.

In contrast, the results of the Monte Carlo simulation are shown, based on selecting the following input variables from the projection model, with the following being the most important: actual increase in sales price, increase in volume, debt risk premium, % of depreciation to invest in fixed assets and sales commissions.

The probability distributions of these input variables are as follows:
- Actual increase in sale price: triangular distribution with a minimum = 1.50%, most likely value = 1.80% and maximum value = 2.10%;
- Volume increase: uniform distribution with a minimum = 1.20% and a maximum = 1.80%;
- Debt risk premium: normal distribution with a mean = 4.40% and a standard deviation = 0.40%;
- Sales commissions: Uniform distribution with a minimum of = 3.00% and a maximum of = 6.00%; and
- As for the simulation process, 10,000 tests were run with a 95% confidence level.

This task sought to demonstrate how changing critical variables directly affects the company's value and, therefore, its main indicators of financial performance, NPV in particular. The simulation allows different scenarios among the most critical variables to be defined so that it is possible to determine the relative ranges in which they can be moved and, in their absence, the NPV.

At this stage, some activities to start the simulation process must be considered, such as defining the number of simulations to be performed; verifying the relationship between the standard error of the mean and the median obtained to assess whether the result is acceptable; defining the number of scenarios; and, finally, running the simulation and recording the results. Below, **Tables V and VI** show the results of the Monte Carlo simulation where the characteristics associated with the dispersion and central tendency of the NPV are analyzed.

TABLE V
STATISTICS (NPV)

Tests	10,000
Base case	7
Mean	9
Median	9
Standard deviation	20
Variance	417
Coefficient of variation	2.25
Minimum	-44
Maximum	66
Range width	110

Note: Designed by the authors based on a Crystal Ball report

TABLE VI
PERCENTILES (NPV)

0%	-44
10%	-18
20%	-9
30%	-2
40%	3
50%	9
60%	14
70%	20
80%	27
90%	37
100%	66

Note: Designed by the authors based on a Crystal Ball report

This analysis provides a comprehensive view of the company's operational situation of implicit risk (variability of the results) and its effect on convenience measures such as the NPV. In this case, the NPV's interval and the probability of each value's occurrence can add an element for the decision-

maker to consider. For this particular case, as shown in **Fig. 1** in Annexes, the probability that the NPV would be negative is 33.92%, considering all tests that have been conducted. This measurement adds many elements to the table to consider, when only having a regulatory scenario where factors such as those mentioned above are probably not considered.

In this case, a decision-maker's perception will be completely different knowing that the NPV will be seven and that the probability of the NPV being negative is 33.92% (relatively high, for those who consider it as such).

Some results, such as the average NPV results and the difference resulting from the baseline scenario, can also help in considering whether this baseline scenario is actually representative within the entire realm of possibilities that are being studied with simulations through distributions and the input variable parameters that were chosen.

Properly choosing these variables and their parameters depends on many factors: a detailed study of the history, knowledge of the company and market, and the degree of relevance that this variable has within the financial results.

One way to validate the true effect of the input variables on the outcome variables is to perform an elasticity analysis such as a tornado diagram or spider chart. (See **Fig. 2** in Annexes)

This tool is used to validate the degree of impact on the resulting variable, in this case NPV, when each input variable changes by ±1% (for this example, the analysis used ±10%). (See **Table VII**)

In this exercise, we see the NPV's absolute dependence on the actual increase in sales price. This exercise will allow decision-makers to also understand where the NPV variability comes from and how to mitigate some risks. In some cases, these variables may be controlled or optimized, and in others, this will not be possible. For example, increasing the price will likely lead to a negative effect on the units sold by the market response for that increase. This type of relationship between input variables can also be modelled in packages such as Crystal Ball if the correlation between several input variables is known. Thus, this tool will also allow financial analysts to understand what the most important input variables are. Then, they can focus on finding the best assumptions and dedicate their efforts to a better valuation according to the company's reality.

VIII. THE ASSESSMENT PROCESS IMPLEMENTATION

Students who have passed the Finance I course in undergraduate and Financial Planning in postgraduate courses are able to adapt the proposed model, concentrating their efforts on the collection and organization of information on the macro, meso and micro environment of the company assigned. or choose within an industrial sector of interest, being able at the end to put together a report and support it, before a "board of directors" made up of the professor of the subject and a couple of guests invited by the professor.

Since 2006, when this strategy has been used, there are more than 1,200 undergraduate students and 500 postgraduate students from the business school, formerly the economics and business school, who have been exposed to the strategy, with results for undergraduates in the Saber Pro tests (previously known as ECAES), applied by the state, in the Financial Management component, above the regional and national average. In the case of postgraduate courses, the periodic evaluations of the course applied to the impacted student cohorts highlight the value of the delivered tool and the potential of the application.

IX. CONCLUSIONS AND FUTURE WORK

The results of this research study allow us to confirm that teaching finance courses through the use of financial models built with Excel promotes students' understanding of a series of difficult topics and, consequently, facilitates teacher intervention.

The methodology behind this model breaks the traditional teaching paradigm of financial analysis courses focused on knowing what happened and the numerical results. Instead, they provide a systemic view of the company or project operation's situation of implicit risk by validating the true effect of the critical input variables on those of results and their effect on convenience measures on the company's or project's value.

Finally, constructing conceptually correct models in Excel allows active learning methodologies to be applied, where students are responsible for their own learning, and they acquire and develop skills in seeking, selecting, comparing, analyzing and evaluating information, applying systemic and holistic thinking and assuming a more active role in constructing knowledge and making decisions.

The reflections addressed in this article open the discussion on teaching methodologies and addressing financial problems in higher education classrooms, which involve training and supporting teachers in this field.

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TABLE I
INPUT DATA, ASSUMPTIONS AND POLICIES FOR THE SAMPLE COMPANY'S PROJECTIONS

Input data	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Initial investment in fixed assets	220.0										
Linear depreciation	5.0										
Initial equity investment	73.0										
Tax rate		34.0%	34.0%	34.0%	34.0%	34.0%	34.0%	34.0%	34.0%	34.0%	34.0%
Initial inventory	4.0										
Initial purchase price	5.0										
General expenses	22.0										
Labour costs	24.0										
Initial long-term loan term	5.0										
Long-term loan term	10.0										
Short-term loan term	1.0										
Minimum cash balance year 0 based on % of fixed expenses and commissions	23.0%										
Inflation rate	5.75%	4.00%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%
Actual increase in sale price		1.80%*	1.80%	1.80%	1.80%	1.80%	1.80%	1.80%	1.80%	1.80%	1.80%
Actual increase in purchase price		2.50%	2.50%	2.50%	2.50%	2.50%	1.00%	1.00%	1.00%	1.00%	1.00%
Actual increase in overhead		2.00%	2.00%	2.00%	2.00%	2.00%	1.50%	1.50%	1.50%	1.50%	1.50%
Actual payroll increase		1.33%	1.33%	1.33%	1.33%	1.33%	1.33%	1.33%	1.33%	1.33%	1.33%
Volume increase		1.50%*	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Real interest rate		4.73%	4.73%	4.73%	4.73%	4.73%	4.73%	4.73%	4.73%	4.73%	4.73%
Debt risk premium		4.42%*	4.42%	4.42%	4.42%	4.42%	4.42%	4.42%	4.42%	4.42%	4.42%
Premium risk for short-term return on investment		-0.26%	-0.26%	-0.26%	-0.26%	-0.26%	-0.26%	-0.26%	-0.26%	-0.26%	-0.26%
Policies and goals	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Advertising and promotion expenses		5.0%	5.0%	5.0%	5.0%	5.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Inventory policy % of sales for the year		8.3%	9.7%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%	6.9%
Accounts receivable (AR) as % of sales		5.0%	4.7%	5.2%	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%
Advances received from customers as % of sales for the following year			5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Accounts payable (AP) as % of purchases		11.0%	9.0%	9.5%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Advance to suppliers as % of purchases for the following year		10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Percentage of profits distributed		70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
% of sales as cash and banks		6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%	6.00%
% of depreciation to invest in fixed assets		70.0%*	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
% of long-term investment financing with debt and the remainder with equity		60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
Minimum cash balance for year 0 as % of expenses	15.2										
Sales commissions		5.0%*	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Data and coefficients to simulate the elasticity study											
Initial sale price	7.8										
Elasticity coefficient b	-0.35										
Elasticity coefficient b₀	100.00										

Note: In Table 1, the asterisk (*) identifies the assumption variables that will work with the Monte Carlo simulation designed by the authors.

TABLE II

Cash Flow	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Module 1: Operational activities											
Cash revenue											
Total revenue from sales and portfolio	0.0	403.7	429.8	454.1	486.3	517.3	550.8	586.5	624.5	665.0	708.0
Total revenue	**0.0**	**403.7**	**429.8**	**454.1**	**486.3**	**517.3**	**550.8**	**586.5**	**624.5**	**665.0**	**708.0**
Expenses											
Total purchase payments	46.0	233.7	286.6	291.5	318.3	343.1	363.0	383.4	405.1	427.9	453.4
Sales and administrative expenses	0.0	88.9	93.8	99.0	104.5	110.3	105.3	110.9	116.8	123.0	129.6
Income tax	0.0	0.0	0.0	0.0	0.0	0.0	9.0	13.9	18.8	24.4	31.0
Total expenses	**46.0**	**322.6**	**380.4**	**390.4**	**422.7**	**453.4**	**477.3**	**508.2**	**540.7**	**575.4**	**614.0**
Net cash balance before asset purchases	**-46.0**	**81.1**	**49.4**	**63.7**	**63.6**	**63.9**	**73.6**	**78.3**	**83.8**	**89.6**	**94.0**
Module 2: Investment in fixed assets											
Investment in fixed assets	220.0	30.8	35.1	40.0	45.6	52.0	28.5	28.2	27.2	25.4	22.6
Net balance of NCB cash for asset purchases	**-220.0**	**-30.8**	**-35.1**	**-40.0**	**-45.6**	**-52.0**	**-28.5**	**-28.2**	**-27.2**	**-25.4**	**-22.6**
Net balance of NCB cash after asset purchases	**-266.0**	**50.3**	**14.3**	**23.6**	**17.9**	**11.9**	**45.1**	**50.1**	**56.6**	**64.1**	**71.4**
Module 3: External financing											
Loan income											
Short-term loans	61.21	46.20	52.11	45.44	39.43	34.11	0.00	0.00	0.00	0.00	0.00
Initial long-term loans	147.0										
Long-term loans		18.48	21.07	24.02	27.38	31.21	11.97	0.00	0.00	0.00	0.00
Total loan income	**208.21**	**64.68**	**73.17**	**69.46**	**66.81**	**65.33**	**11.97**	**0.00**	**0.00**	**0.00**	**0.00**
Loan payments											
ST capital payment		61.2	46.2	52.1	45.4	39.4	34.1	0.0	0.0	0.0	0.0
Interest on ST loans		8.2	5.7	6.4	5.6	4.9	4.2	0.0	0.0	0.0	0.0
Initial LT loan capital payment		29.4	29.4	29.4	29.4	29.4	0.0	0.0	0.0	0.0	0.0
Interest on LT loans		19.6	14.5	10.9	7.3	3.6	0.0	0.0	0.0	0.0	0.0
LT loan payment		0.0	1.8	4.0	6.4	9.1	12.2	13.4	13.4	13.4	13.4
LT interest		0.0	2.3	4.7	7.1	9.7	12.5	12.4	10.8	9.1	7.5
Total loan payments	**0.0**	**118.4**	**100.0**	**107.4**	**101.2**	**96.1**	**63.0**	**25.8**	**24.2**	**22.5**	**20.9**
NCB financing	**208.2**	**-53.7**	**-26.8**	**-38.0**	**-34.4**	**-30.8**	**-51.0**	**-25.8**	**-24.2**	**-22.5**	**-20.9**
Module 4: Shareholder transactions											
Equity investments	73.0	12.3	14.0	16.0	18.3	20.8	8.0	0.0	0.0	0.0	0.0
Dividend payments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	18.9	25.5	33.2
NCB of shareholder transactions	**73.0**	**12.3**	**14.0**	**16.0**	**18.3**	**20.8**	**8.0**	**-12.3**	**-18.9**	**-25.5**	**-33.2**
NCB of previous transactions	**15.2**	**8.9**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**12.0**	**13.5**	**16.1**	**17.4**
Module 5: Discretionary transactions											
Liquidation or maturity of temporary investments		0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.8	21.8	37.1
Return on temporary investments		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.7	2.8
Total income from ST investments		0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	23.5	40.0
Temporary investments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.82	21.81	37.13	54.75
NCB of discretionary transactions	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-9.8**	**-11.2**	**-13.6**	**-14.8**
Yearly NCB	**15.2**	**8.9**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.1**	**2.3**	**2.4**	**2.6**
Accumulated NCB	**15.2**	**24.1**	**25.7**	**27.4**	**29.1**	**31.0**	**33.0**	**35.2**	**37.5**	**39.9**	**42.5**

Note: Designed by the authors.

TABLE III
SAMPLE COMPANY VALUATION

Valuation											
Unlevered beta average	0.9277	Auto & Truck: Emerging Markets - Damodaran									
2016 inflation	5.750%										
Adjusted market risk premium (MRP)	8.360%	Country Risk Premiums - Damodaran									
Risk-free rate (Rf)	10.75%										
Nominal K observed in 2016	18.51%										
Real K observed in 2016	12.07%										
Recurrent indebtedness in perpetuity	7.64%	D% = DF/adjusted TV									
Inflation expected in perpetuity	3.00%										
Real growth (G) year 10 onwards (TV)	3.00%										
Real K	12.07%	12.07%	12.07%	12.07%	12.07%	12.07%	12.07%	12.07%	12.07%	12.07%	12.07%
Inflation rate	5.75%	4.00%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%	3.05%
Nominal K	18.51%	16.55%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%
Recurrent indebtedness in perpetuity, D%	7.64%										
Tax rate (T)	34.00%										
Nominal G for TV	6.09%										
K for TV	12.07%										
K for TV	15.43%										
WACC Perp = K-Kd*T*D%	15.11%										
NOPAT = OI*(1-T)											63.2
Terminal Value = NOPAT*(1+G)(1-G/K)/(WACC-G)											**558.9**
Cash and banks											42.5
AR (discounted to WACC Perp)											31.4
Temporary investments											54.7
AP (discounted to WACC Perp)											-72.0
Net liquidation of current assets											**56.6**
Adjusted terminal value											**615.4**
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Nominal K	18.51%	16.55%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%	15.48%
FCC		41	13	22	16	10	43	38	43	48	54
Company value	**289**	**295**	**328**	**357**	**396**	**447**	**473**	**508**	**544**	**580**	**615**
Invested capital	281	251	245	227	208	188	180	181	185	194	207
NPV	**7**	**44**	**82**	**130**	**188**	**258**	**293**	**327**	**359**	**386**	**408**
IRR flow	-281	41	13	22	16	10	43	38	43	48	670
IRR	**16.024%**										

Note: Designed by the authors.

TABLE IV
TWO-VARIABLE DATA TABLE

				Volume increase							
NPV	**-1.00%**	**-0.50%**	**0.00%**	**0.50%**	**1.00%**	**1.50%**	**2.00%**	**2.50%**	**3.00%**	**3.50%**	**4.00%**
0.40%	-270	-292	-261	-255	-263	-248	-246	-171	-160	-148	-136
0.60%	-248	-233	-254	-242	-278	-167	-155	-143	-131	-118	-104
0.80%	-249	-237	-168	-165	-153	-141	-128	-114	-100	-85	-70
1.00%	-168	-165	-152	-140	-127	-113	-98	-83	-68	-52	-36
1.20%	-154	-141	-127	-113	-99	-84	-68	-52	-35	-18	0
1.40%	-130	-115	-101	-86	-70	-54	-37	-20	-2	16	35
1.60%	-104	-89	-74	-57	-41	-23	-6	13	32	52	72
1.80%	-79	-63	-46	-29	-11	7	26	46	66	87	108
2.00%	-53	-36	-18	0	19	39	59	79	100	122	145
2.20%	-26	-8	11	30	50	70	91	113	136	159	184
2.40%	1	20	39	59	80	102	124	148	172	196	222
2.60%	28	47	68	90	112	135	158	183	208	234	260
2.80%	55	76	98	121	144	168	193	218	244	271	299
3.00%	83	105	128	152	176	201	227	254	281	309	339
3.20%	112	135	159	184	209	235	262	289	318	348	379
3.40%	141	165	190	215	241	268	297	326	356	387	419

Actual increase in sales price (row axis label)

Note: Designed by the authors.

TABLE VI
VARIABLE SENSITIVITY

Input variable	Downward	Upward	Range	Variation explanation	Downward	Upward	Base case
Actual increase in sales price	-20	36	56	95.79%	1.62%	1.98%	1.80%
Volume increase	2	13	11	99.65%	1.35%	1.65%	1.50%
Sales commissions	9	6	3	99.90%	4.5%	5.5%	5.0%
Debt risk premium	6	8	2	100.00%	3.98%	4.87%	4.42%

Note: Designed by the authors based on a Crystal Ball report.
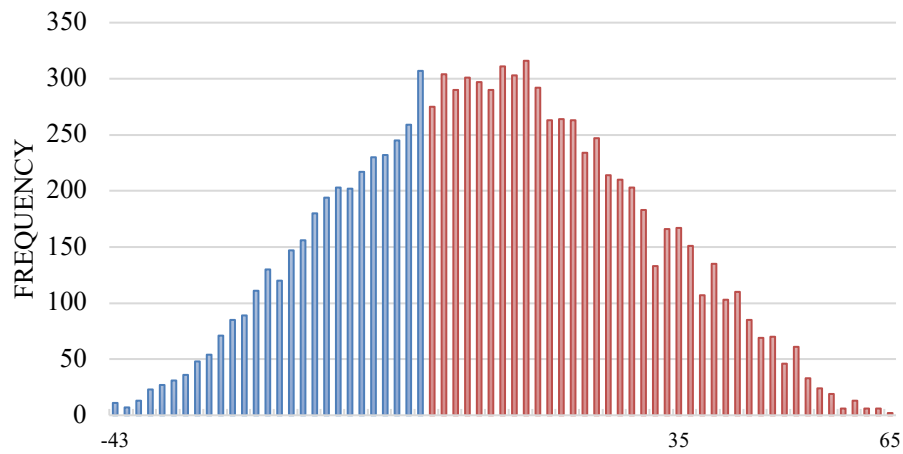
Note: Designed by the authors based on a Crystal Ball report.

Fig. 1 NPV DISTRIBUTION
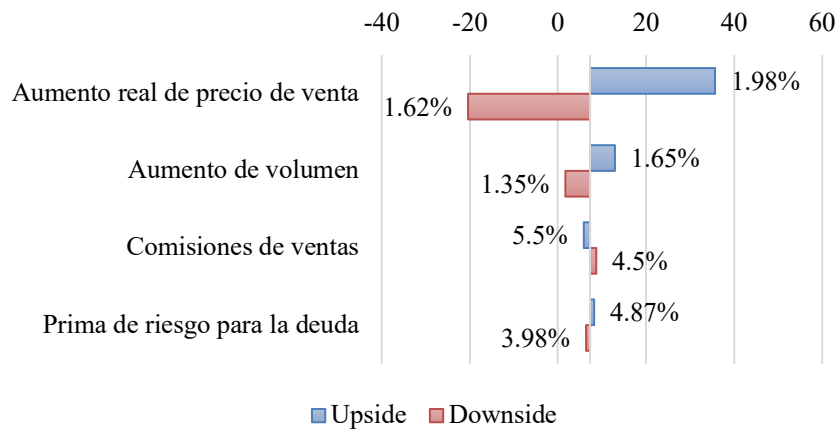
Note: Designed by the authors based on a Crystal Ball report.

Fig. 2 TORNADO DIAGRAM