

RESEARCH ARTICLE

Which of the Three Most Important Models of Business Valuation: DCF, Relatives and Options, Properly Estimate the Value of Mexican Companies?

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Abstract

This work seeks to determine which of the most important valuation models estimate the value of Mexican companies properly. This will be done, essentially, by calculating the effect that a future financial event, like a fall in income, generates on the value of companies. Initially, the article will include a general analysis of the valuation processes. Then, an explanation of the methodology used with each of the selected models. Finally, the valuations of companies of the Mexican stock market and the analysis of the results. The valuations were made on December 31, 2011. The methodology used with the DCF model was the free cash flow discounted at the WACC; with relatives, the P/E, P/B, and P/S, and with options, the real option for liquidation.

Keywords: *Business valuation, Mexican stock market Value, Valuation.*

Introduction

The most important discussion in valuation theory is, even today, which of the valuation models is the most effective to value companies. This discussion considers a key question: What determines the value of an asset: historical information, used by the relative model or future expectations, which are used by the DCF and the real option model? This article will attempt to show what models based on future expectations could reflect, in the value of Mexican public companies, financial events after the valuation date, which would make these models conceptually more accurate than those based only on historical information. Therefore, this article is aimed at those individuals who have difficulty in determining clearly the origin of value, that is, from past or future information.

Among the universe of valuation models, three models stand out from the rest, either by their theoretical basis, practicality or popularity. These models are: the discount model of cash flows, known as DCF; the relative model or multiples, and the option model. The valuation of companies in Mexico, as in other countries, is used for many important financial activities, for example: to make effective financial decisions, to manage investment portfolios, to analyze the price of stock or to determine the range of prices for a merger and acquisition operation. The Mexican financial market used the three valuation models mentioned above interchangeably. But, several

authors like Labatut [10], Adam Siade [1], and Saavedra [16] state in their research that the most used and well known in Mexico is the DCF. This article is divided into three parts. In the first part, there will be a general analysis of the valuation of companies and its usefulness and importance as a financial tool. Then, a methodological explanation of each of the models selected and the valuations made for the Mexican companies. Finally, the conclusions will be presented.

Business Valuation

The valuation of companies began to be considered as a relevant field of research after the Great Depression in the United States in 1930. Pioneering works on the subject were the *The Theory of Interest* by Irving Fisher [8] and *The Theory of Investment Value* by John Burr Williams [18]. These works allowed the first steps in the design of the different valuation models that are widely used and accepted today.

Williams argued that the actual or intrinsic value of a stock is the present value of all future dividends paid by the company. He looked for the difference between the real value and the market price. So, according to him, the analyst should not estimate the future stock price, but future profits and dividends. Others important contributions on the valuation theory were the works of David Durand [6] and Myron Gordon [9]

on the discounted cash flows models; Franco Modigliani and Merton Miller [13] on the theory of capital structure; Henry Markowitz [12] on the theory of investment portfolios; William Sharpe [17], John Lintner [11] and Jan Mossin [14] on the development of the Capital Asset Pricing Model; and Black and Scholes [2], on the model for valuing financial options.

According to Damodaran [5] all assets, real or financial, have value. The key to investing in these assets and manage them successfully is to determine their value and find the sources of this value. All assets can be valued, but some are easier than others and knowing how to value them varies in each situation.

On the other hand, for Copeland, Koller and Murrin [4], the valuation is seen as an essential tool for making financial and operational decisions. For them, the widespread belief in maximizing shareholder value should be the main goal of every company. It is the best measure of performance because when the shareholder value is maximized, the value of the other participants of the company is also maximized. Besides, if the value is not increased, the money certainly will go to other companies. Fernandez [7] explains that for all of those involved in the field of corporate finance, it is a prerequisite to understand the mechanism of the valuation of companies, and by understanding the valuation process it is also possible to identify the variables that create and destroy value.

Also, Damodaran [5], states that the practice of valuation has developed its myths, for example, if valuation models are quantitative the valuation is objective. Valuation is not a science and the quantitative models used subjective information sources. Another myth would be that a well-made valuation will not expire. The valuations change and should be adapted continuously for the periodic variations of business and market information. Another would be that a well-crafted valuation provides a precise estimate of the value. It is unrealistic to expect or demand absolute certainty in valuations, as both cash flow estimates and the discount rate are generally calculated with mistakes. Another myth is that the more quantitative the valuation model, the better. In general, the quality of the valuation depends on the time spent in obtaining the information and in understanding the operation of the company. Another is that the price market of the assets is usually wrong. The market price remains as the reference point or benchmark to compare the results of a valuation. And the last one is that the product of the valuation, the value,

is what matters, and not the process to obtain it. The process tells us which are the variables that determine the value and how they are affected.

Who Could Use a Valuation and how to Use it?

The valuation is a useful working tool for a lot of activities and the role that it plays changes depending on the activity. The use of the valuation for the passive investor is minimal, but for the active investor it is critical, since it needs to constantly look for under or overvalued assets. The analysts employ the fundamental analysis of the company, when the true value of this company is related to its financial characteristics. For the valuation process, some analysts use the discounted cash flow model (DCF) and others use the relative model such as the price-earnings (P/E) or the price-book value (P/B).

For a buy and sell transaction, where the valuation process is fundamental, the buyer needs to know its value just before making an offer, and the seller has to know the range of possible values before accepting or refusing the offer. For corporate finance, if the main objective of the company is to maximize its value, then all decisions, whether financial or operational, should be consistent with the increase in the value. Understanding the variables that create value, their relationship, and the decisions taken because of them are the keys elements to boost the value of the company.

Copeland *et al.* [4] determines who may use the valuation

- Finance students. One of the best ways to learn how to perform a valuation is doing one.
- Corporate managers. Business leaders need to know how to value their business and its investment projects.
- Practitioners of corporate finance. Valuation, and its connection with finance and business strategies, is an important part of the performance of: CFOs, specialists in mergers and acquisitions, financial analysts and managers in general. To calculate the value of a company and to make it grow are the main responsibilities of these practitioners.
- Investors. For portfolio managers and securities analysts, value is the purest form of critical analysis.
And when it could be used
- In the valuation of companies and its investment alternatives.
- In the valuation of large financial transactions such as mergers, acquisitions, recapitalizations and separations.

- In the administration of the company focused on value-based management.
- In the communication with investors and analysts at the company.

Value and Price

The value of a company, according to Fernandez [7], is different for each buyer and seller. The value should not be confused with the price, which is the amount of money that both the seller and the buyer agree to the sale of a business. The company may have different values for different buyers, depending on: the economy of scale, the scope of the economy and the different perspectives on the company and industry.

The purchase-sale valuation shows to the buyer the maximum price paid for the company and to the seller the minimum price paid. For public companies, the valuation will be used to compare the value of the company with the market price, so the investor can decide whether to sell, buy or hold shares. The valuation process is critical to identify the variables that create the business value.

According to Pereiro [15], the value of companies depends on four factors: what, who, how, and why is valued. The specific characteristics of the company greatly affect its value, that is, by its name, location, legal status, rights, obligations, size, and control. Also, it is affected if it is a public or private company; if it is located in a developed or emerging market; if it is in a mature or emerging industry; if it is a company with years of operation or is a newly created one; and if the operation is continuous or is in the liquidation stage. The author states that it is important to know who calculates the value of the company. So, we need to understand the following terms: the intrinsic or fundamental value, the extrinsic or market value, the enterprise value and the equity value.

He explains that the intrinsic value of a company can be calculated by a professional analyst. It is an opinion on the financial status of the company, which the analyst calculates using quantitative or qualitative models. Also, the analyst evaluates the key information of the company and the variables that create its value. It is understood that the intrinsic value is the true or real value of the company.

The extrinsic value, or market value, is given by the same market. It is determined by the supply and demand forces of the market. It is not affected by a particular investor, but by all of them. In practice, he explains that the intrinsic and extrinsic values are different, because they are determined by different factors.

The enterprise value is the specific value that a particular investor calculates on a company, for a specific purpose. This investor has expectations and preferences regarding risk and return associated with the company. He uses, as a reference, both the intrinsic and the extrinsic value. The equity value is the value of the company that belongs to the shareholders and, if the company has no debt, it is the total value of the company. Regarding intrinsic and extrinsic approaches, Pereiro [15], states the following:

In intrinsic valuation, business value is determined through a precise net cash flow analysis... generated by the business over time.... Extrinsic valuation, in contrast, is a shortcut used to simplify the exercise: instead of dissecting company cash flow, a business similar to the target under valuation, and whose market value is known, is used as a reference— that is, value is computed by analogy. Extrinsic valuation uses value multiples for comparable companies quoting in the public markets, or multiples for comparable transactions that can be observed in the private market.

Also, the author explains that the nature of the buyer must be known. According to him, there are three types of buyers of companies: venture capitalists, strategic investors and financial investors. The first one uses specific valuation techniques such as relative models, with the objective to finance new investment projects that then, once in operation, try to sell to a strategic investor. The second has a specific strategic plan, such as reducing costs or increasing sales, which can be achieved with the purchase of another company in the same market. Financial investors are those companies or individuals that invest their resources in financial instruments in order to make a profit. They generally use the DCF valuation model.

Valuation in Emerging Markets

In emerging markets, it is very important to have an appropriate valuation model. These markets are less efficient than developed markets, so the usefulness of traditional valuation models is limited because these models have been created for stable and developed markets.

Pereiro [15] says that the financial efficiency of the emerging stock markets is quite questionable. Empirical evidence shows that these markets tend to be smaller, less liquid, more concentrated and more prone to manipulation than developed markets. In addition, the financial information is scarce and unreliable.

Additionally, he maintains that traditional models do not differentiate between developed

and emerging markets. It is known that they work best when they are applied to large public companies in the developed markets. Regarding the valuation of companies using real options Pereiro [15] states that its implementation is ineffective in emerging markets. Their assumptions, in practice, are not sustainable in these markets, as it is very difficult to replicate a portfolio. Also, the stock prices are unstable. So, assuming a normal distribution, as it is done by the Black-Scholes model, is very controversial.

Furthermore, the author mentions that the relative valuation models imply using similar companies to value these companies. This is highly problematic to do in small markets, where listed companies are few or non-existent. So, instead, sometimes companies from the global markets are used as comparable, which is not ideal for the differences in risk and business expectations.

Valuation of Mexican Companies

Table 1: Mexican total GDP annual growth and GDP of the Mexican mining industry, without oil, base 2003 (2007-2011)

| | 2007 | 2008 | 2009 | 2010 | 2011 | Average |
|---|-------|-------|--------|-------|-------|---------|
| Total GDP | 3.25% | 1.21% | -5.96% | 5.55% | 3.91% | 1.59% |
| GDP of the Mexican mining industry, without oil | 8.85% | 5.88% | 2.67% | 8.41% | 0.65% | 5.29% |

Source: INEGI

As mentioned earlier, the objective of this study is to verify which of the models properly estimate the value of Mexican companies. This was done by calculating the value of five companies, from the mining industry, with each of the models selected on 12/31/2011. The calculations were made twice; once including an incomes drop during the second year of operation, after the valuation date, and again without including this drop. The last step was to analyze which of the models were able to reflect this factor in the value. The mining companies chosen were: Compañía Minera

Autlan, Fresnillo PLC, Grupo México, Minera Frisco and Peñoles. These companies represent, on average, in the last three months, approximately 3.68% of the total trading volume of the Mexican Stock Exchange. In Mexico, mining-metallurgical activity was the most dynamic in the last five years among the activities of the mining industry. Its GDP grew by an average of 5.29% annually. This was higher than the economy as a whole, which grew by an average of 1.59 percent.

Methodological Application

To facilitate the practical demonstration of the models, the financial information and the variables used to value the companies were adjusted. The information used was obtained from the audited balance sheets submitted by these companies. The financial information used to project the cash flows was taken from the last three financial statements of the companies, prior to the valuation date.

Methodology Applied to the DCF Model

The procedure to obtain the final value was: first, the operating cash flows were constructed and projected, then the residual value was calculated, and finally, all the cash flows were discounted at the Weighted Average Cost of Capital (WACC).

Four elements were considered to estimate the present value

- The operating cash flows projected
- The period of the projection
- The residual value
- The discount rate (cost of capital)

The formula used to discount the cash flows was the following

$$Value = \sum_{t=1}^n \frac{CF_t}{(1+r)^t}$$

Where:

n: projection period

CF_t: projected operating cash flows

r: discount rate

A description of this formula can be seen in Brealey and Myers [3].

Operating Cash Flows

The model "Business Cash Flow", described by Damodaran [5], was used to calculate the operating cash flow

$$\begin{aligned}
 &+ \text{EBIT} (1 - \text{effective tax rate}) \\
 &+ \text{Depreciation and amortization} \\
 &- \text{Difference of working capital} \\
 &- \text{Capital expenditures} \\
 &= \text{Operating Cash Flow}
 \end{aligned}$$

The tax benefit of the interest payments was not estimated, because it was included in the WACC. Also, the expected inflation was incorporated in the cash flows; therefore the flows were nominal and were discounted at a nominal rate. As for the

growth rate of the cash flows, Copelan *et al.* [4] mentioned that in the long term, few companies can grow faster than the economy overall. The best growth rate to estimate the flows is the expected growth rate of the industrial products in the long-term.

The growth rate used in this work was the growth rate of the industry average income over the last five years. The average margin of the variable costs was maintained steadily in relation to revenue growth. Both the fixed costs and the capital investments were held constant. Therefore, it was estimated that the fixed costs and the capital investment absorbed the sales growth during the forecast period. As for the working capital, the average accounts payable and receivable days of the last three years were used to calculate each account. Finally, the inventory was maintained constant.

Projection Period

Copelan *et al.* [4] explain that the number of years of the projection period should be the total years necessary until the moment the company reaches stability; that is, until the moment that the company gets a stable rate of return for its old and new capital investments. The authors recommend using a period of not less than seven years. This work used these seven years as the projection period.

Residual Value

When performing a valuation of an asset with an indefinite useful life, Damodaran [5] states that it is necessary to estimate the residual value of an asset, after the projection period. This value is usually a very important part of the total value of the asset, thus, its estimation is a key activity in the valuation process. This work estimated that after the projection period there will be no growth, therefore the perpetuity formula was used to calculate the residual value.

$$\text{Residual value} = \frac{FCF_{t+1}}{WACC}$$

Where

FCF_{t+1}: cash flow in the first year after the regular period of projection

WACC: weighted average cost of capital

Discount Rate

The discount rate used was the WACC that represents the weighted average cost of capital:

$$WACC = \frac{D}{V} * [k_d * (1 - T)] + \frac{E}{V} * k_e$$

Where:

D: debt

V: equity + debt

T: effective tax rate

E: equity

k_d: cost of debt

k_e: expected return of capital

It was assumed that the book value of the unpaid balance of financial debt was equal to its market value, so that the cost of debt (k_d) was equal to the effective interest rate paid annually for the debts. In addition, the cost of debt remained constant throughout the projection period. Also, a standard capital structure, or optimal, that remained constant throughout the projection period was estimated. In order to maintain the capital structure, the accrued incomes were totally distributed. The “Hybrid Adjusted CAPM” was used to calculate the expected return of capital (k_e), since it incorporates both sovereign risk and global factors. It is understood that this model is best suited for emerging countries with some financial stability and without barriers to global markets. A U.S. treasury note was used to estimate the global risk free rate. The rates published by JP Morgan were used to estimate the country risk premium. Then, this premium was added to the global risk free rate to estimate the local risk free rate. Like Pereiro [15] a 5.5% was used as the global risk premium.

$$k_e = r_{FL} + \beta_{CIS} * \beta_{GS} * (R_{mG} - r_{FG}) * (1 - R^2); \quad r_{FL} = r_{FS} + r_c$$

Where

r_{FL}: local risk free rate

β_{CIS}: slope of the regression (beta) between the local stock market index and the global market index

β_{GS}: average beta of comparable companies in the global market

R_{mG}: global risk premium

r_{FG}: global risk free rate

r_c: county risk

R²: coefficient of determination of the regression between the volatility of the local stock market and the change in country risk

For the calculation of the betas, Fernandez [7] suggests that betas calculated from historical data should not be used, but rather those obtained on the basis of the analyst’s common sense and experience. According to him, the betas depend on the risk that analysts determine from the cash flows of the companies. He also explains that a beta of one has given better results than the betas calculated individually for the companies. In this work, betas of one and a 0.69 for the (1 - R²) of Mexico, provided by Pereiro [15], p.168, were used.

Methodology Applied to the Relative Model

With this model the procedure was the following: three formulas were used as multiples, the P/E, P/B and P/S. Where, (P) represents the market share price of the company; (E) the earning of the company; (B) the equity book value of the company; and (S) total sales. The share price used was the closing price published by the Mexican stock market on the last day of December 2011. The earnings, the equity, and the total sales used were the average amount of the last three years (2009, 2010 and 2011) divided by the total shares of the company. A total average index was calculated for each multiple. Then, to get the final value, the resulting index was applied to the average amount of the earnings, equity and total sales of each company. It is important to remember that some authors, in order to incorporate future expectations to this model, implement a projection of the information to a certain point in the future. So, this procedure has two consequences. First, if the projected information is not updated, it will have practical value only in the future. Second, if the data is updated, the model would be transformed into a discounted flows model.

Methodology Applied to Options

Pereiro [15] explains that the direct application of the Black-Scholes formula is a bit problematic. Instead, he uses a procedure-Pereiro [15], p. 484– derived from this formula, which permits the calculation of the approximate value of a European call option. The procedure includes the use of a table that shows, horizontally, the maturity of the option and the standard deviation of the industry, represented by: $\sigma * T_e^{1/2}$. And, vertically, the rest of the variables, with the

following formula: present value of assets / present value of the exercise price. For the present value of the exercise price, the book value of the financial debt was used at the date of the valuation. The standard deviation used was 7.15%, which is the standard deviation of the industry's GDP. To obtain the final value, the following steps were taken. First: the present value of the projected cash flows for the seven years was calculated. Then, the value of a real option of liquidation was calculated using the procedure explained above. Finally, the two values were added. Like the case of the DCF model, two values were calculated for each company; one without considering the income drop and the other considering the drop.

Valuation of Companies

Information Used with the DCF Model

The revenue growth rate used was the average growth rate of the industry, which was 5.29% (Table 1). In the case of the income drop, a fifty percent decrease of the sales was estimated for the second year of the projection period. The following year the sales were normalized according to the amount sold in the year 2012. For the rest of the period, the sales grew at the rate stipulated before. The direct costs were calculated according to the average annual percentage of the last three years. The interest rate of the financial debt used was the effective rate paid in 2011. The rate of the income tax used was the average of the effective rates paid annually during the last three years. The expected return of capital rate used was 7.66% annually.

Table 2: Valuation of Autlan, 12/31/2011 (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|--------|
| WACC | | 5.87% | 5.87% | 5.87% | 5.87% | 5.87% | 5.87% | 5.87% |
| kd (1 - T) | | 2.59% | 2.59% | 2.59% | 2.59% | 2.59% | 2.59% | 2.59% |
| Financial debt | | 1,893 | 1,893 | 1,893 | 1,893 | 1,893 | 1,893 | 1,893 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 3,497 | 3,497 | 3,497 | 3,497 | 3,497 | 3,497 | 3,497 |
| OCF | | 654 | 711 | 752 | 796 | 842 | 890 | 941 |
| Residualvalue | | | | | | | | 16,024 |
| Total value | 15,161 | 15,398 | 15,591 | 15,755 | 15,885 | 15,976 | 16,024 | |

Table 3: Valuation of Autlan, 12/31/2011, with incomes drop (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|------|-------|-------|-------|-------|-------|-------|--------|
| WACC | | 5.87% | 5.87% | 5.87% | 5.87% | 5.87% | 5.87% | 5.87% |
| kd (1 - T) | | 2.59% | 2.59% | 2.59% | 2.59% | 2.59% | 2.59% | 2.59% |
| Financial debt | | 1,893 | 1,893 | 1,893 | 1,893 | 1,893 | 1,893 | 1,893 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 3,497 | 3,497 | 3,497 | 3,497 | 3,497 | 3,497 | 3,497 |
| OCF | | 654 | 591 | 422 | 711 | 752 | 796 | 842 |
| Residual value | | | | | | | | 14,333 |

| | | | | | | | |
|-------------|--------|--------|--------|--------|--------|--------|--------|
| Total value | 13,372 | 13,504 | 13,706 | 14,090 | 14,207 | 14,289 | 14,333 |
|-------------|--------|--------|--------|--------|--------|--------|--------|

Table 4: Valuation of Fresnillo, 12/31/2011 (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|---------|---------|---------|---------|---------|---------|---------|---------|
| WACC | | 6.92% | 6.92% | 6.92% | 6.92% | 6.92% | 6.92% | 6.92% |
| kd (1 - T) | | 1.57% | 1.57% | 1.57% | 1.57% | 1.57% | 1.57% | 1.57% |
| Financial debt | | 5,853 | 5,853 | 5,853 | 5,853 | 5,853 | 5,853 | 5,853 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 42,383 | 42,383 | 42,383 | 42,383 | 42,383 | 42,383 | 42,383 |
| OCF | | 14,792 | 15,547 | 16,445 | 17,390 | 18,385 | 19,433 | 20,537 |
| Residual value | | | | | | | | 296,902 |
| Total value | 279,128 | 283,643 | 287,716 | 291,173 | 293,924 | 295,870 | 296,902 | |

Table 5: Valuation of Fresnillo, 12/31/2011, with incomes drop (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|---------|---------|---------|---------|---------|---------|---------|---------|
| WACC | | 6.92% | 6.92% | 6.92% | 6.92% | 6.92% | 6.92% | 6.92% |
| kd (1 - T) | | 1.57% | 1.57% | 1.57% | 1.57% | 1.57% | 1.57% | 1.57% |
| Financial debt | | 5,853 | 5,853 | 5,853 | 5,853 | 5,853 | 5,853 | 5,853 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 42,383 | 42,383 | 42,383 | 42,383 | 42,383 | 42,383 | 42,383 |
| OCF | | 14,792 | 8,325 | 13,245 | 15,547 | 16,445 | 17,390 | 18,385 |
| Residual value | | | | | | | | 265,797 |
| Total value | 245,202 | 247,371 | 256,156 | 260,630 | 263,111 | 264,866 | 265,797 | |

Table 6: Valuation of Frisco, 12/31/2011 (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| WACC | | 9.08% | 9.08% | 9.08% | 9.08% | 9.08% | 9.08% | 9.08% |
| kd (1 - T) | | 17.07% | 17.07% | 17.07% | 17.07% | 17.07% | 17.07% | 17.07% |
| Financial debt | | 2,589 | 2,589 | 2,589 | 2,589 | 2,589 | 2,589 | 2,589 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 14,511 | 14,511 | 14,511 | 14,511 | 14,511 | 14,511 | 14,511 |
| OCF | | 4,316 | 3,441 | 3,622 | 3,812 | 4,013 | 4,223 | 4,446 |
| Residual value | | | | | | | | 48,956 |
| Total value | 46,499 | 46,405 | 47,178 | 47,840 | 48,372 | 48,752 | 48,956 | |

Table 7. Valuation of Frisco, 12/31/2011, with incomes drop (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| WACC | | 9.08% | 9.08% | 9.08% | 9.08% | 9.08% | 9.08% | 9.08% |
| kd (1 - T) | | 17.07% | 17.07% | 17.07% | 17.07% | 17.07% | 17.07% | 17.07% |
| Financial debt | | 2,589 | 2,589 | 2,589 | 2,589 | 2,589 | 2,589 | 2,589 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 14,511 | 14,511 | 14,511 | 14,511 | 14,511 | 14,511 | 14,511 |
| OCF | | 4,316 | 2,477 | 2,560 | 3,441 | 3,622 | 3,812 | 4,013 |
| Residual value | | | | | | | | 44,187 |
| Total value | 41,280 | 40,713 | 41,933 | 43,181 | 43,661 | 44,004 | 44,187 | |

Table 8: Valuation of Grupo México, 12/31/2011 (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| WACC | | 6.49% | 6.49% | 6.49% | 6.49% | 6.49% | 6.49% | 6.49% |
| kd (1 - T) | | 3.57% | 3.57% | 3.57% | 3.57% | 3.57% | 3.57% | 3.57% |
| Financial debt | | 71,996 | 71,996 | 71,996 | 71,996 | 71,996 | 71,996 | 71,996 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 180,906 | 180,906 | 180,906 | 180,906 | 180,906 | 180,906 | 180,906 |
| OCF | | 48,222 | 54,359 | 57,749 | 61,319 | 65,077 | 69,034 | 73,200 |
| Residual value | | | | | | | | 1,127,771 |
| Total value | 1,056,879 | 1,077,257 | 1,092,819 | 1,106,001 | 1,116,469 | 1,123,859 | 1,127,771 | |

Table 9. Valuation of Grupo México, 12/31/2011, with incomes drop (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|------------------|-----------|
| WACC | | 6.49% | 6.49% | 6.49% | 6.49% | 6.49% | 6.49% | 6.49% |
| kd (1 - T) | | 3.57% | 3.57% | 3.57% | 3.57% | 3.57% | 3.57% | 3.57% |
| Financial debt | | 71,996 | 71,996 | 71,996 | 71,996 | 71,996 | 71,996 | 71,996 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 180,906 | 180,906 | 180,906 | 180,906 | 180,906 | 180,906 | 180,906 |
| OCF | | 48,222 | 26,568 | 46,121 | 54,359 | 57,749 | 61,319 | 65,077 |
| Residual value | | | | | | | | 1,002,619 |
| Total value | 920,875 | 932,425 | 966,378 | 982,981 | 992,424 | 999,090 | 1,002,619 | |

Table 10. Valuation of Peñoles, 12/31/2011 (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| WACC | | 6.52% | 6.52% | 6.52% | 6.52% | 6.52% | 6.52% | 6.52% |
| kd (1 - T) | | 2.61% | 2.61% | 2.61% | 2.61% | 2.61% | 2.61% | 2.61% |
| Financial debt | | 20,322 | 20,322 | 20,322 | 20,322 | 20,322 | 20,322 | 20,322 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 70,395 | 70,395 | 70,395 | 70,395 | 70,395 | 70,395 | 70,395 |
| OCF | | 22,237 | 23,979 | 25,251 | 26,589 | 27,999 | 29,483 | 31,045 |
| Residual value | | | | | | | | 475,808 |
| Total value | 449,767 | 456,876 | 462,707 | 467,648 | 471,571 | 474,342 | 475,808 | |

Table 11. Valuation of Peñoles, 12/31/2011, with incomes drop (millions of Mexican pesos)

| Concepts | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------|
| WACC | | 6.52% | 6.52% | 6.52% | 6.52% | 6.52% | 6.52% | 6.52% |
| kd (1 - T) | | 2.61% | 2.61% | 2.61% | 2.61% | 2.61% | 2.61% | 2.61% |
| Financial debt | | 20,322 | 20,322 | 20,322 | 20,322 | 20,322 | 20,322 | 20,322 |
| ke | | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% | 7.66% |
| Equity | | 70,395 | 70,395 | 70,395 | 70,395 | 70,395 | 70,395 | 70,395 |
| OCF | | 22,237 | 12,325 | 21,943 | 23,979 | 25,251 | 26,589 | 27,999 |
| Residual value | | | | | | | | 429,114 |
| Total value | 398,793 | 402,576 | 416,519 | 421,753 | 425,292 | 427,791 | 429,114 | |

Information Used with the Relative Model

The share price used was that published by the Mexican Stock Market on the last day of operation in December, 2011. The total number of shares used was that shown by the company in its

balance sheets on December 31, 2011. An industrial average rate was used for the valuation of the companies, which was normalized in the event of extreme results.

With P/E

Table 12: Calculation of the average P/E, 12/31/2011 (millions of shares and Mexican pesos, except share price and P/E)

| Concepts | Autlan | Fresnillo | Frisco* | Grupo México | Peñoles | Average |
|----------------------|--------|-----------|---------|--------------|---------|---------|
| Share price 12/2011 | 15.75 | 345.00 | 59.27 | 41.49 | 103.89 | - |
| Average total shares | 272.1 | 798.9 | 3,041.1 | 9,566.1 | 553.5 | - |
| Earnings 12/31/2011 | 245 | 14,501 | 669 | 37,403 | 17,763 | - |
| P/E | 17.5 | 19.0 | 134.7 | 10.6 | 3.2 | 37.0 |

* Normalize P/E

Table 13: Companies' values with P/E, 12/31/2011 (millions of Mexican pesos, except P/E)

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles |
|------------------------|--------|-----------|--------|--------------|---------|
| Average P/E | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 |
| Earnings 12/31/2011 | 245 | 14,501 | 669 | 37,403 | 17,763 |
| Total value 12/31/2011 | 9,067 | 536,676 | 24,759 | 1,384,268 | 657,401 |

*With P/B***Table 14: Calculation of the average P/B, 12/31/2011 (millions of shares and Mexican pesos, except share price and P/B)**

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles | Average |
|----------------------|--------|-----------|---------|--------------|---------|---------|
| Share price 12/2011 | 15.75 | 345.00 | 59.27 | 41.49 | 103.89 | - |
| Average total shares | 272.1 | 798.9 | 3,041.1 | 9,566.1 | 553.5 | - |
| Equity 12/31/2011 | 3,090 | 30,022 | 12,003 | 139,126 | 52,214 | - |
| P/B | 1.4 | 9.2 | 15.0 | 2.9 | 1.1 | 5.9 |

Table 15: Companies' values with P/B, 12/31/2011 (millions of Mexican pesos, except P/B)

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles |
|------------------------|--------|-----------|--------|--------------|---------|
| Average P/B | 5.9 | 5.9 | 5.9 | 5.9 | 5.9 |
| Equity 12/31/2011 | 3,090 | 30,022 | 12,003 | 139,126 | 52,214 |
| Total value 12/31/2011 | 18,255 | 177,360 | 70,910 | 821,911 | 308,463 |

*With P/S***Table 16: Calculation of the average P/S, 12/31/2011 (millions of shares and Mexican pesos, except share price and P/S)**

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles | Average |
|----------------------|--------|-----------|---------|--------------|---------|---------|
| Share price 12/2011 | 15.75 | 345.00 | 59.27 | 41.49 | 103.89 | - |
| Average total shares | 272.1 | 798.9 | 3,041.1 | 9,566.1 | 553.5 | - |
| Sales 12/31/2011 | 3,872 | 30,636 | 8,545 | 129,663 | 96,864 | - |
| P/S | 1.1 | 9.0 | 21.1 | 3.1 | 0.6 | 7.0 |

Table 17: Companies' values with P/S, 12/31/2011 (millions of Mexican pesos, except P/S)

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles |
|------------------------|--------|-----------|--------|--------------|---------|
| Average P/S | 7.0 | 7.0 | 7.0 | 7.0 | 7.0 |
| Sales 12/31/2011 | 3,872 | 30,636 | 8,545 | 129,663 | 96,864 |
| Total value 12/31/2011 | 26,989 | 213,544 | 59,562 | 903,798 | 675,177 |

Information Used with the Option Model

The operating cash flows calculated with the DCF model was used as the cash flows for the projected period, without the residual value (assets value). The present value of the exercise price used was the book value of the financial debt on December

31, 2011. The value of the liquidation option was calculated by multiplying the percentage found in the table –Pereiro [15], p. 484– and the present value of the asset. Two values were calculated for each company, one without considering the income drop and the other considering the drop.

Table 18: Valuation of Autlan, 12/31/2011, with liquidation option (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 4,416 |
| Present value of the exercise price | 2,427 |
| Value calculated | 1.82 |
| Percentage of the table | 42.9% |
| Value of the liquidation option | 1,894 |
| Total value of the company | 6,310 |

Table 19: Valuation of Autlan, 12/31/2011, with liquidation option and incomes drop (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 3,761 |

| | |
|-------------------------------------|--------------|
| Present value of the exercise price | 2,427 |
| Value calculated | 1.55 |
| Percentage of the table | 33.5% |
| Value of the liquidation option | 1,260 |
| Total value of the company | 5,021 |

Table 20: Valuation of Fresnillo, 12/31/2011, with liquidation option (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 93,226 |
| Present value of the exercise price | 9,918 |
| Value calculated | 9.40 |
| Percentage of the table | 60.0% |
| Value of the liquidation option | 55,936 |
| Total value of the company | 149,162 |

Table 21. Valuation of Fresnillo, 12/31/2011, with liquidation option and incomes drop (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 78,776 |
| Present value of the exercise price | 9,918 |
| Value calculated | 7.94 |
| Percentage of the table | 60.0% |
| Value of the liquidation option | 47,266 |
| Total value of the company | 126,042 |

Table 22: Valuation of Frisco, 12/31/2011, with liquidation option (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 19,857 |
| Present value of the exercise price | 12,300 |
| Value calculated | 1.61 |
| Percentage of the table | 33.5% |
| Value of the liquidation option | 6,652 |
| Total value of the company | 26,509 |

Table 23: Valuation of Frisco, 12/31/2011, with liquidation option and incomes drop (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 17,233 |
| Present value of the exercise price | 12,300 |
| Value calculated | 1.40 |
| Percentage of the table | 28.9% |
| Value of the liquidation option | 4,980 |
| Total value of the company | 22,214 |

Table 24: Valuation of Grupo México, 12/31/2011, with liquidation option (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 330,708 |

| | |
|-------------------------------------|----------------|
| Present value of the exercise price | 93,566 |
| Value calculated | 3.53 |
| Percentage of the table | 60.0% |
| Value of the liquidation option | 198,425 |
| Total value of the company | 529,132 |

Table 25: Valuation of Grupo México, 12/31/2011, with liquidation option and incomes drop (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 275,289 |
| Present value of the exercise price | 93,566 |
| Value calculated | 2.94 |
| Percentage of the table | 60.0% |
| Value of the liquidation option | 165,173 |
| Total value of the company | 440,462 |

Table 26: Valuation of Peñoles, 12/31/2011, with liquidation option (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 144,080 |
| Present value of the exercise price | 28,517 |
| Value calculated | 5.05 |
| Percentage of the table | 60.0% |
| Value of the liquidation option | 86,448 |
| Total value of the company | 230,528 |

Table 27: Valuation of Peñoles, 12/31/2011, with liquidation option and incomes drop (millions of Mexican pesos, except value calculated)

| Concepts | Data |
|---|---|
| Calculation of the first formula: | $\sigma * T_e^{1/2} = 0.0715 * 7^{1/2} = 0.19$ |
| Calculation of the second formula: | present value of assets / present value of the exercise price |
| Present value of assets, without residual value | 123,105 |
| Present value of the exercise price | 28,517 |
| Value calculated | 4.32 |
| Percentage of the table | 60.0% |
| Value of the liquidation option | 73,863 |
| Total value of the company | 196,969 |

Results Analysis

The following table shows the effect that the income drop had on the valuation of the companies with the DCF model. On average this

decline represented 11.9%, which shows that the model is sensitive to events that occurred after the valuation date.

Table 28: Valuations of the companies with DCF, 12/31/2011, with and without incomes drop (millions of Mexican pesos)

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles | Average |
|---------------------------------------|--------|-----------|--------|--------------|---------|---------|
| Values with DCF, without incomes drop | 15,161 | 279,128 | 46,499 | 1,056,879 | 449,767 | - |
| Values with DCF, with incomes drop | 13,372 | 245,202 | 41,280 | 920,875 | 398,793 | - |
| Difference | 1,789 | 33,926 | 5,219 | 136,004 | 50,974 | 45,582 |
| Decline percentage | -11.8% | -12.2% | -11.2% | -12.9% | -11.3% | -11.9% |

Also, as with the DCF, the valuations of the companies with the real option model, were sensitive to events that occurred after the valuation date. In this case, the average decline

was 16.7%. On the other hand, the results show that, with this model, the amounts of the valuations obtained were lower than those obtained with DCF.

Table 29: Valuations of the companies with real options, 12/31/2011, with and without incomes drop (millions of Mexican pesos)

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles | Average |
|--|--------|-----------|--------|--------------|---------|---------|
| Value with options, without incomes drop | 6,310 | 149,162 | 26,509 | 529,132 | 230,528 | - |
| Value with options, with incomes drop | 5,021 | 126,042 | 22,214 | 440,462 | 196,969 | - |
| Difference | 1,289 | 23,120 | 4,295 | 88,670 | 33,560 | 30,187 |
| Decline percentage | -20.4% | -15.5% | -16.2% | -16.8% | -14.6% | -16.7% |

The following table shows the values calculated for each company, with the three multiples selected. In this case, the values were calculated

without taking into account the income drop because, as was explained, the model uses historical information only.

Table 30: Valuations of the companies with relative, 12/31/2011 (millions of Mexican pesos)

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles |
|-----------------|--------|-----------|--------|--------------|---------|
| Values with P/E | 9,067 | 536,676 | 24,759 | 1,384,268 | 657,401 |
| Values with P/B | 18,255 | 177,360 | 70,910 | 821,911 | 308,463 |
| Values with P/S | 26,989 | 213,544 | 59,562 | 903,798 | 675,177 |

Tables 31 and 32 show the average difference between the values obtained with the relative model and the ones obtained with the DCF and the option models without considering the income drop. Also, the tables show that with respect to

the DCF model, the biggest difference was observed with the P/S multiple and the lowest with the P/B. This is also observed with the option model, but with higher percentages.

Table 31: Difference between the relative model and the DCF, without incomes drop

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles | Average |
|--------------------------------|--------|-----------|--------|--------------|---------|--------------|
| Difference between P/E and DCF | -40.2% | 92.3% | -46.8% | 31.0% | 46.2% | 16.5% |
| Difference between P/B and DCF | 20.4% | -36.5% | 52.5% | -22.2% | -31.4% | -3.4% |
| Difference between P/S and DCF | 78.0% | -23.5% | 28.1% | -14.5% | 50.1% | 23.6% |

Table 32: Difference between the relative model and the option, without incomes drop

| Concepts | Autlan | Fresnillo | Frisco | Grupo México | Peñoles | Average |
|-----------------------------------|--------|-----------|--------|--------------|---------|--------------|
| Difference between P/E and option | 43.7% | 92.3% | -46.8% | 31.0% | 46.2% | 33.3% |
| Difference between P/B and option | 189.3% | -36.5% | 52.5% | -22.2% | -31.4% | 30.3% |
| Difference between P/S and option | 327.7% | -23.5% | 28.1% | -14.5% | 50.1% | 73.6% |

Conclusions

This work included, first, a general analysis of the business valuation. Then, an explanation of the methodology used with the three valuation models chosen for the analysis. Finally, the valuations of the five public companies selected from the mining industry and the analysis of the results obtained. The decline of the value of the

companies, considering the effect of the income drop, was on average 11.9% with the DCF model and 16.7% with the option model. Therefore, it can be stated that models based on future expectations can reflect the financial events of the company after the valuation date. This makes these models conceptually more accurate than the relative models and therefore the most suitable.

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