GEM
Gestión y Economía Minera Ltda.

# PERSPECTIVE N°11

## *RETURN ON ASSETS IN MINING: A NEW APPROACH*

# RETURN ON ASSETS IN MINING: A NEW APPROACH

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## MOTIVATION

One of the most used financial ratios to measure and compare performance of a company is the return on assets (ROA). This ratio objectively measures the return of a company's assets not considering its level of leverage. In other words, the ROA allows measuring the efficiency of the company's assets in order to make a profit.

The ROA is widely used to compare the company's efficiency among its competitors. However, the main value underlying this indicator is its ability to explain the financial results on a period through two main factors: profitability (profit margin) and efficiency (assets turnover). In 1914 Frank Donaldson Brown, while working at DuPont Nemours & Co. (one of the main chemical companies in the world), developed a methodology to break down the ROA by separating it in Profit Margin and Assets Turnover. The "DuPont method", as it is known, is shown in ***EQUATION (1).***

$$ROA = \frac{EBIT^{1}}{Assets} = \underbrace{\frac{EBIT}{Sales}}_{\text{Profit Margin}} \times \underbrace{\frac{Sales}{Assets}}_{\text{Asset Turnover}} \qquad (1)$$

(1) Earnings before interests and taxes.

The DuPont methodology breaks ROA in two factors: the profit margin, related to the sales margin, and the assets turnover, related to the sales volume. In other words, a high ROA can be explained by a high sales volume but not necessarily with high margin, or it can be explained by a high profit margin but not necessarily with high sales volume. In the first case, the best example are wholesale companies.

This GEM|Perspective addresses the ROA analysis, and the pros and cons of using the DuPont methodology in the mining industry. This GEM|Perspective finishes with a new proposal for the ROA break down that would be more useful for the mining industry. Finally, the new methodology is shown in a case study focused on the copper industry.

*The DuPont methodology breaks ROA in two factors: the profit margin, related to the sales margin, and the assets turnover, related to the sales volume.*

# INTRODUCTION

Financial statements show the economic situation of a company. However, financial statements and the information they give are useless without the correct analysis and interpretation. One of the reasons why it is important to analyze the financial situation of a company is because it helps identify problems and supports decision making. On the other hand, financial information is commonly used by analysts and investors to establish similar behaviors among industries, and at the same time, to measure deviations within certain industry.

Numerous indicators and ratios have been developed for financial analyses. However, it is important to mention that the isolated use of these indicators can lead to wrong conclusions. Among the most used financial indicators are: Return on Equity (ROE), calculated as revenue over equity; and Return on Assets (ROA), calculated as net revenue over assets. It is important to remember that in all accounting balances the value of the assets has to be equal to the sum of liabilities and equity. Therefore, different debt policies cause changes in company's ROE, but no in company's ROA. Both ROE and ROA show the global result of the company from the shareholders' and company's point of view, respectively. These indicators are used to carry out performance comparisons between one period and the next, or among different companies. The ROA is a good measure to compare a companies' performance because it does not take into account the company's financing decisions.

Although a clear rule about what the value the ROA should be does not exist, there is an intrinsic risk of the industry which should suggest the level of profitability that the shareholders should demand. The ROA is a useful indicator to compare the profitability of companies within a specific sector. However, it is important to mention that the ROA is not enough to perform a complete analysis of a companies' financial situation. For this reason, many methodologies have been developed in order to diagnose the situation of a company. One of the most known methods is the DuPont method, which consists in breaking the ROA into two financial management indicators.

## THE DUPONT METHOD

The DuPont method breaks the ROA into two ratios: sales margin and assets turnover, as shown in ***EQUATION 1***. The sales margin is the profit created by sales. On the other hand, the assets turnover indicates the assets' capability to generate sales. The DuPont method suggests to disaggregate the factors as shown in ***FIGURE 1***. Therefore, it is also useful supporting financial management.

Commonly, among a specific industry there is a likeness on some of these factors. For example, some companies sell high volumes at a low cost, and other industries sell low volumes but with high margins. Both factors are determined by sales. This, which at a first sight should not be a problem, is a problem when the purpose of the analysis is to measure only the internal performance of a company without taking into account external factors.

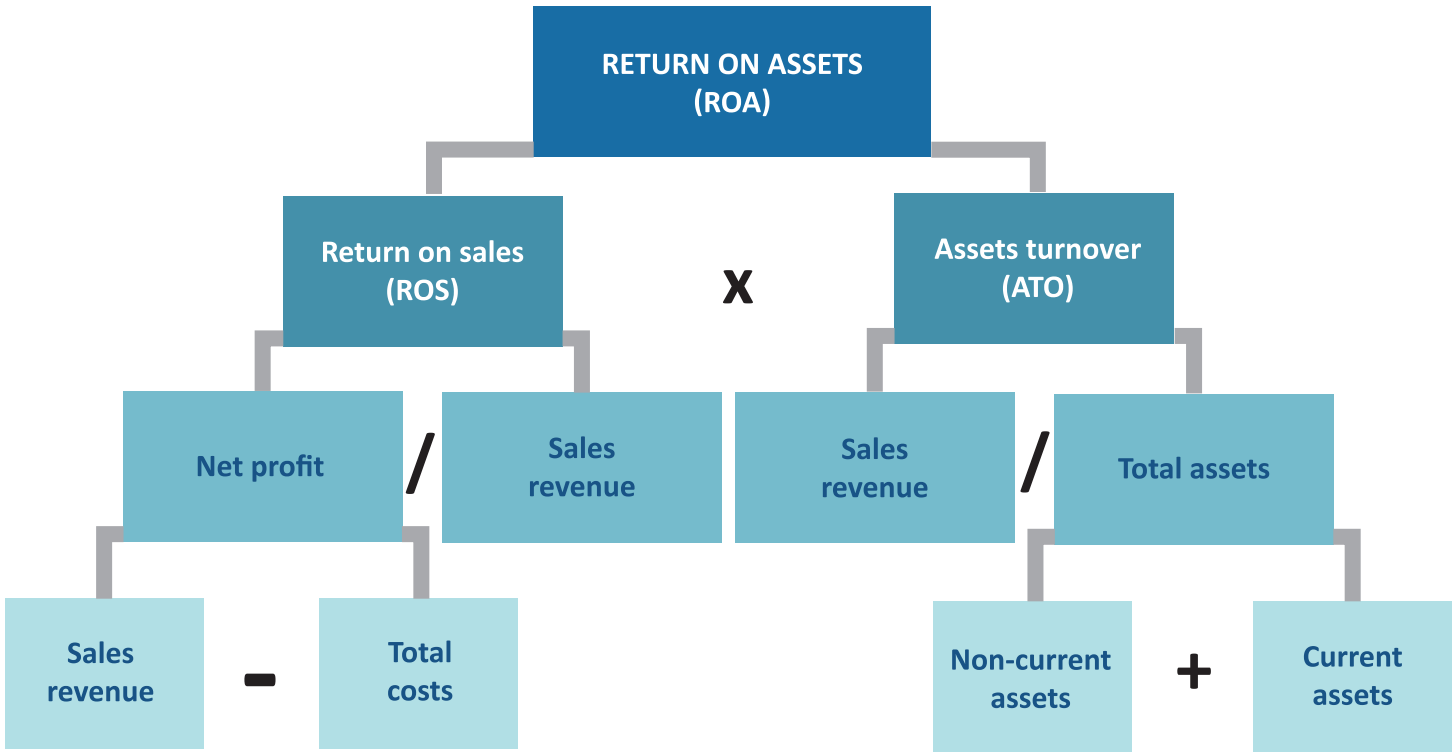
## DUPONT METHOD ANALYSIS

The DuPont method aims to find the sources that determine a company's profit: sales margin, sales volume or both. Each industry has its own characteristics that explain parts of its profits, and it is possible to compare companies in order to evaluate performance. However, the two factors that characterize the DuPont method consider both internal and external aspects. This means variations among periods may be only due to external factors and therefore, differences might be observed while the company's internal performance remains constant.

Given this situation, it is valid to ask: is it possible to isolate or separate the internal elements of the company that affect profit by only using the DuPont method? The answer is no. Because of that, a new ROA breakdown becomes necessary, looking to isolate the internal factors from the external ones, allowing this way to compare internal performance among companies or periods.

In the mining industry, the DuPont method is highly affected by commodity prices. This is because both the sales margin and assets turnover have total sales as a factor. Thus, the two factors that the DuPont method uses in order to break down the ROA are modified period by period by elements external to the company. This makes it impossible to carry out a complete analysis of the internal performance of the company. Because of this, it would be useful to develop a new disaggregation of the ROA for the mining industry, where the internal performance of the company could be analyzed and specific elements of the industry could be taken into consideration (such as the quality of the deposit, stripping ratio, ore grades and mine and plant design among others).

## FIGURE 1. DUPONT DECOMPOSITION OF ROA




Source: Ross, S. et al. (2012)

## PROPOSED METHOD

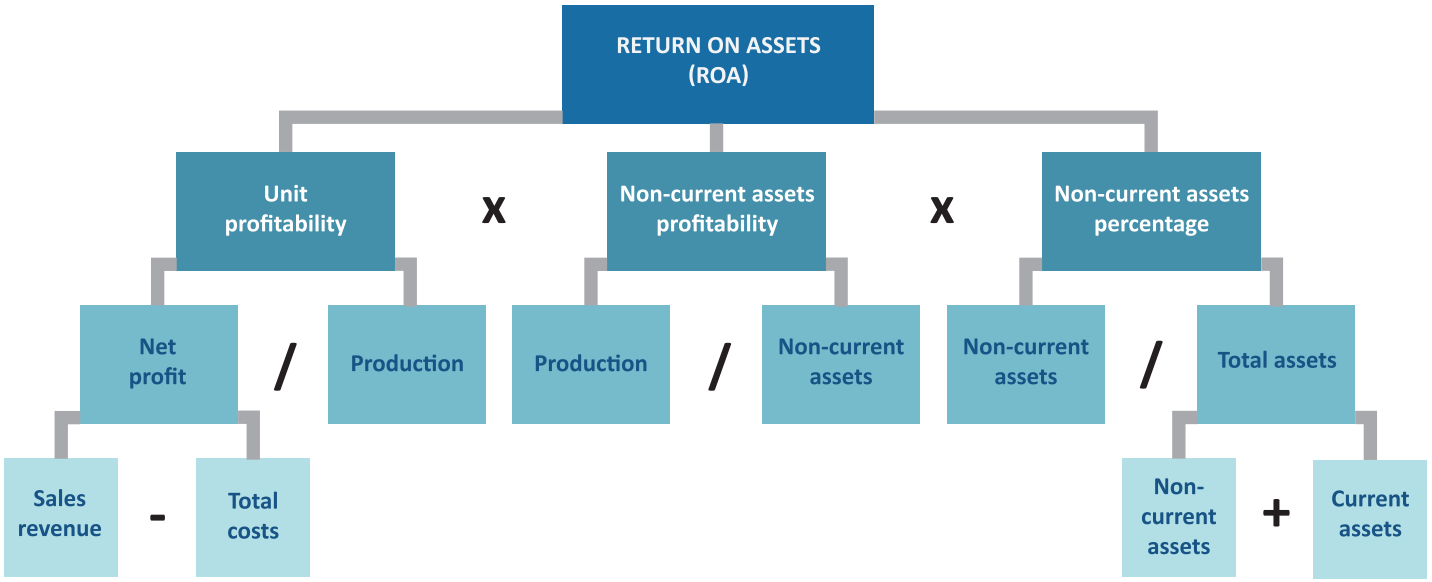
GEM has adapted the DuPont method in order to complement the financial analysis with particular elements of the mining industry, bringing financial analysis closer to mining professionals. If the proposed method is applied, the financial analysis of mining companies can be done with factors that take into account key elements of the operation.

GEM's breakdown of the ROA takes into account the production of one commodity at a time. The identity is shown in the ***EQUATION 2.***

The GEM method takes into account economic and operational elements of the mining industry by using three factors: unit profitability, non-current assets productivity and non-current assets percentage. The GEM method to breakdown the ROA is shown in ***FIGURE 2.***

$$\text{ROA} = \frac{\text{EBIT}}{\text{Assets}} = \underbrace{\frac{\text{EBIT}}{\text{Production}}}_{\text{Unit profitability}} \times \underbrace{\frac{\text{Production}}{\text{Non-current assets}}}_{\text{Non-current assets productivity}} \times \underbrace{\frac{\text{Non-current assets}}{\text{Assets}}}_{\text{Non-current assets percentage}} \quad \textbf{(2)}$$

## FIGURE 2. GEM DECOMPOSITION OF ROA




Source: GEM (2015)

### GEM METHOD FACTORS

The GEM method breaks down the ROA into three factors: unit profitability, non-current assets productivity and non-current assets percentage.

Unit profitability is calculated as profit (EBIT) over the production of the commodity under analysis. This factor is highly related to the business' profitability. It measures the benefit that each unit of production creates, before taxes. This factor is mainly determined by the commodity price and operational costs. It is important to mention that commodity prices are highly related to market conditions, which at the same time affect production costs. Therefore, there is a relation between them (for more details go to GEM, 2015).

Non-current assets productivity is calculated as the production of the commodity under study over the book value of non-current assets, indicating the physical ability of a company to produce the commodity from its invested capital (in particular, capital invested in mining properties, processing plants and equipment). This indicator is not affected by market conditions (at least not directly). It measures how efficient is the mining company in its core business, which is ore extraction and processing. Using this indicator it is possible to measure the effect of the intrinsic characteristic of the operations and deposits (ore grades, recovery, stripping ratio, technology measured by capital expenditures, etc.) on the company's return.

The non-current assets ratio is calculated as the book value of non-current assets over the book value of total assets, and it measures the capital intensity of use. This factor isolates non-current assets from current assets, which is important because, in productive industries such as mining, production requires mostly non-current assets, and a high proportion of current assets may indicate performance problems that require deeper analysis.

### GEM METHOD LIMITATIONS

The GEM method is useful to compare mining companies as well as analysing particular operations. Nevertheless, it is important to take into account that this new methodology is only valid for a single commodity analysis at a time. Therefore, it is necessary to have access to Financial Statements broken down by business areas. For example, in the case of Rio Tinto – a multinational commodity diversified company – if the analysis is being done for the copper industry, it will be necessary to determine the percentage of EBIT, current assets and non-current assets related to Rio Tinto's copper business. This information could be difficult

to obtain for some companies. Fortunately, in Chile, most mining operations constitute a different company which reports theirs own Financial Statements.

## CASE OF STUDY: COPPER INDUSTRY

In order to compare both methodologies presented in this GEM|Perspective (DuPont and GEM), a performance comparison during 2014 of some major copper mining companies, as well as individual Chilean operations, will be carried out.

***TABLE 1*** and ***TABLE 2*** show the ROA of 12 Chilean copper mines for the year 2014, disaggregated according to the DuPont method and the GEM method respectively. ***TABLE 3*** and ***TABLE 4*** show the ROA of three copper companies for the year 2014, broken down by the DuPont method and the GEM method respectively.

DuPont analysis for the 12 mines under study reflects that the average net profit margin and asset turnover are 25% and 60%, respectively. Within this group, Michilla (AMSA) and Salvador (CODELCO) are the only ones with a negative net profit margin, and therefore a negative ROA. This is because both are old mines, and they are in closing stage. Regarding the asset turnover, Michilla has the highest ratio (184%). This means that given its total assets, it has the higher sales. On the other hand, Ministro Hales (CODELCO) has the lowest assets turnover ratio (14%).

*The GEM method takes into account economic and operational elements of the mining industry by using three factors: unit profitability, non-current assets productivity and non-current assets percentage.*

**TABLE 1. DUPONT DECOMPOSITION FOR CHILEAN COPPER MINES**

| MINE | ROA [%] | Net profit margin [%] | Asset turnover [%] | EBIT [MMUS$] | Sales revenue [MMUS$] | Total costs [MMUS$] | Total assets [MMUS$] | Non-current assets [MMUS$] | Current assets [MMUS$] |
|---|---|---|---|---|---|---|---|---|---|
| Pelambres | 36% | 50% | 72% | 1,338 | 2,663 | 1,325 | 3,680 | 2,968 | 712 |
| Centinela | 9% | 23% | 39% | 464 | 1,986 | 1,522 | 5,153 | 4,295 | 858 |
| Michilla | -16% | -9% | 184% | -29 | 335 | 364 | 182 | 48 | 134 |
| Chuquicamata | 12% | 28% | 42% | 612 | 2,154 | 1,542 | 5,177 | 4,211 | 966 |
| Radomiro Tomic | 26% | 32% | 82% | 659 | 2,087 | 1,428 | 2,544 | 1,846 | 698 |
| Salvador | -7% | -15% | 50% | -96 | 642 | 738 | 1,293 | 957 | 336 |
| Andina | 8% | 25% | 32% | 350 | 1,396 | 1,046 | 4,390 | 3,965 | 425 |
| El Teniente | 24% | 45% | 53% | 1,316 | 2,935 | 1,619 | 5,547 | 4,719 | 828 |
| Gaby | 11% | 22% | 51% | 182 | 830 | 648 | 1,629 | 1,197 | 432 |
| Ministro Hales | 2% | 13% | 14% | 81 | 635 | 554 | 4,460 | 3,879 | 581 |
| Collahuasi | 19% | 38% | 50% | 1,122 | 2,980 | 1,858 | 5,994 | 4,918 | 1,076 |
| Escondida | 24% | 43% | 55% | 3,422 | 8,051 | 4,629 | 14,514 | 12,088 | 2,426 |
| AVERAGE | 12% | 25% | 60% | 785 | 2,225 | 1,439 | 4,547 | 3,758 | 789 |

Source: Companies' Financial Statements (2014)

**TABLE 2. GEM DECOMPOSITION FOR CHILEAN COPPER MINES**

| MINE | ROA [%] | Unit profitability [US$/lb] | Non-current assets productivity [lb/US$] | Non-current assets ratio[%] | EBIT [MMUS$] | Copper production [kt] | Sales revenue [MMUS$] | Total cost [MMUS$] | Non-current assets [MMUS$] | Total assets [MMUS$] | Current assets [MMUS$] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelambres | 36% | 1.55 | 0.29 | 81% | 1,338 | 391 | 2,663 | 1,325 | 2,968 | 3,680 | 712 |
| Centinela | 9% | 0.79 | 0.14 | 83% | 464 | 267 | 1,986 | 1,522 | 4,295 | 5,153 | 858 |
| Michilla | -16% | -0.28 | 2.16 | 26% | -29 | 47 | 335 | 364 | 48 | 182 | 134 |
| Chuquicamata | 12% | 0.82 | 0.18 | 81% | 612 | 340 | 2,154 | 1,542 | 4,211 | 5,177 | 966 |
| Radomiro Tomic | 26% | 0.91 | 0.39 | 73% | 659 | 327 | 2,087 | 1,428 | 1,846 | 2,544 | 698 |
| Salvador | -7% | -0.81 | 0.12 | 74% | -96 | 54 | 642 | 738 | 957 | 1,293 | 336 |
| Andina | 8% | 0.68 | 0.13 | 90% | 350 | 232 | 1,396 | 1,046 | 3,965 | 4,390 | 425 |
| El Teniente | 24% | 1.31 | 0.21 | 85% | 1,316 | 455 | 2,935 | 1,619 | 4,719 | 5,547 | 828 |
| Gaby | 11% | 0.68 | 0.22 | 73% | 182 | 121 | 830 | 648 | 1,197 | 1,629 | 432 |
| Ministro Hales | 2% | 0.26 | 0.08 | 87% | 81 | 141 | 635 | 554 | 3,879 | 4,460 | 581 |
| Collahuasi | 19% | 1.08 | 0.21 | 82% | 1,122 | 470 | 2,980 | 1,858 | 4,918 | 5,994 | 1,076 |
| Escondida | 24% | 1.32 | 0.21 | 83% | 3,422 | 1,172 | 8,051 | 4,629 | 12,088 | 14,514 | 2,426 |
| PROMEDIO | 12% | 0.69 | 0.36 | 77% | 785 | 335 | 2,225 | 1,439 | 3,758 | 4,547 | 789 |

Source: Companies' Financial Statements (2014)

By using GEM's proposed method of the ROA decomposition, it is possible to figure out the source of the highest value of Pelambres's ROA, which is mainly because of its high unit profitability. On the other hand, the second highest ROA of the group under analysis is Radomiro Tomic's. In this case, the value is mostly explained by the non-current assets profitability.

Regarding unit profitability, the highest value is reported by Pelambres, with 1.55 US$/lb. On the other hand, Salvador has the lowest value with -0.81 US$/lb. The high value of Pelambres can be due to its molybdenum production, which includes all of AMSA's (Pelambres' controlling shareholder) molybdenum coming from other mining operations. Salvador's value is related to lower ore grades and higher costs, which affect its results.

Regarding non-current assets percentage, it is interesting that all mines under analysis, except Michilla, have values between 70% and 90%. Andina has the highest value with 90%, while Gaby, Radomiro Tomic and Salvador are in the lower limit with 73%, 73% and 74%, respectively. On the other hand, Michilla has a 26% of non-current assets percentage, which can be attributed to the fact that the mine is in its closing stage.

Finally, regarding non-current assets productivity, most of the mines under analysis have values between 0.08 lb/US$ and 0.39 lb/US$. Michilla is the only one that has a value outside this range reaching 2.16 lb/US$, which could be explained by its latest sale of inventory. Radomiro Tomic has a high non-current assets productivity value, which could be because the operation uses Chuquicamata's

*By using the decomposition proposed by GEM, it is possible to go further and establish that Radomiro Tomic is a mine with a high productivity of non-current assets, capable of producing an important amount of copper in relation with its facilities.*

**TABLE 3. DUPONT DECOMPOSITION FOR SELECTED COPPER COMPANIES**

| COMPANY | ROA [%] | Net profit margin [%] | Asset turnover [%] | EBIT [MMUS$] | Sales revenue [MMUS$] | Total costs [MMUS$] | Total assets [MMUS$] | Non-current assets [MMUS$] | Current assets [MMUS$] |
|---|---|---|---|---|---|---|---|---|---|
| Anglo American Sur | 12% | 24% | 49% | 678 | 2,791 | 2,113 | 5,704 | 4,746 | 9,58 |
| CODELCO | 9% | 29% | 30% | 3,059 | 10,721 | 7,662 | 35,256 | 29,099 | 6,157 |
| KGHM | 11% | 21% | 53% | 3,545 | 17,206 | 13,661 | 32,312 | 27,439 | 4,873 |
| AVERAGE | 11% | 24% | 44% | 2,427 | 10,239 | 7,812 | 24,424 | 20,428 | 3,996 |

Source: Companies' Financial Statements (2014)

facilities to process sulphide ores. The mine with the lowest productivity of non-current assets is Ministro Hales. This may be because, in order to produce copper, this mine uses a roaster (to reduce arsenic levels in its concentrate) which increases the non-current assets of the operation.

Within the group of mines under analysis, three of them have a very similar ROA: Radomiro Tomic, Escondida and El Teniente. Using DuPont decomposition of ROA, it can be said that while for Escondida and El Teniente a similar share of their value comes sales margin and non-current assets turnover, for Radomiro Tomic the main contribution comes from its assets turnover. Therefore, it is possible to determine that even though the operation has a lower margin, given its asset turnover it is possible to achieve ROA values at the level of the other two mines. On the other hand, by using the decomposition proposed by GEM, it is possible to go further and establish that Radomiro Tomic is a mine with a high productivity of non-current assets, capable of producing an important amount of copper in relation with its facilities. This last operational-mining element is the one that allows the mine to get good results. Both decompositions, DuPont's and GEM's, provide information that explains the ROA of each mine. However, as shown above, it is possible to determine specific operational-mining causes through the decomposition proposed by GEM.

An important element to be mentioned is the case of mines that have a negative ROA. In ***TABLE 2*** it was shown that Salvador and Michilla had a ROA of -7% and -16%, respectively. At first glance, this suggests that the performance of Michilla is much worse than Salvador's performance. However, further analysis is needed. Using the GEM decomposition, it is possible to see that even though both are negative, Michilla's profitability is higher than Salvador's. At the same time, Michilla's productivity, measured as pounds of copper over dollars of non-current assets, is greater than Salvador's productivity. Therefore, given the construction of the indicator, although Michilla has a higher profitability and productivity, the value of its ROA is worse. These results demonstrate the necessity of further analysis in mines with negative ROA. Moreover, given that a negative EBIT and a high profitability usually leads to a more negative ROA, it is always necessary to break it down and analyze the sources of the numbers used to avoid reaching wrong conclusions.

The DuPont analysis for three copper companies shows

**TABLE 4. GEM DECOMPOSITION FOR SELECTED COPPER COMPANIES**

| COMPANY | ROA [%] | Unit profitability [US$/lb] | Non-current assets productivity [lb/US$] | Non-current assets ratio[%] | EBIT [MMUS$] | Copper production [kt] | Sales revenue [MMUS$] | Total cost [MMUS$] | Non-current assets [MMUS$] | Total assets [MMUS$] | Current assets [MMUS$] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Anglo American Sur | 12% | 0.70 | 0.20 | 83% | 678 | 437 | 2,791 | 2,113 | 4,746 | 5,704 | 958 |
| CODELCO | 9% | 0.75 | 0.14 | 83% | 3.059 | 1,841 | 10,721 | 7,662 | 29,099 | 35,256 | 6,157 |
| KGHM | 11% | 2.79 | 0.05 | 85% | 3.545 | 577 | 17,206 | 13,661 | 27,439 | 32,312 | 4,873 |
| AVERAGE | 11% | 1.41 | 0.06 | 84% | 2,427 | 952 | 10,239 | 7,812 | 20,428 | 24,424 | 3,996 |

Source: Companies' Financial Statements (2014)

that ROA and net profit margin are very similar among them. Nevertheless, CODELCO's asset turnover ratio is clearly lower than Anglo American Sur's and KGHM´s, which suggests that in relation to its total assets, CODELCO's sales revenues were lower than those of the other two companies in 2014.

Using the GEM decomposition, it is possible to highlight that the unit profit of KGHM is higher than that of Anglo American Sur and CODELCO. This indicates that the net profit per copper pound produced by KGHM is higher than that of the other two companies. It is necessary to take into account that by-products or other activities may have a considerable impact in the unit profit ratio of mining companies.

Regarding non-current asset productivity, Anglo American Sur has presented the highest value (0.20 lb/US$), while KGHM has presented the lowest value (0.05 lb/US$). Based on this, it is possible to say that although KGHM has presented a high unit profitability, it has used a higher proportion of non-current assets to achieve its production, which shows a low efficiency in the use of those assets.

## CONCLUSIONS

Financial analysis is an important tool for the decision making process within a company, since it allows investors and other stakeholders to get a sense of where the company is and how it might behave in the future, as well as to identify its strengths and weaknesses.

The main indicators used in financial analysis are ROE and ROA, which measure the profitability of the company. In particular, the ROA measures profitability regardless of financial structure. Besides indicating the company's profitability, it allows for a comparison between past and current performance within the same company, as well as between the company itself and other firms among the same industry.

For the copper business, the main driver of profitability is the efficiency of capturing profits with low costs. However, there are significant differences in the companies' efficiency to extract and produce copper from its non-current assets. The DuPont method breaks the ROA down into two management factors related to economics; on the other hand, the GEM method allows for a deeper analysis considering factors specific to the mining industry. While DuPont only analyses whether sales margin or assets turnover is the main driver of the ROA, the proposed method allows the analyst to go further and determine operative-mining sources that explain the ROA. Therefore, it is possible to analyse how the ROA of each mine or mining company is constructed by taking into account elements of the mining operation, which means the ROA can be used to compare performance between different mining operation.

Through a case study, which included 12 mining operations and 3 mining companies, it was possible to show the advantages of the GEM method for ROA analysis over DuPont method. The proposed method gives specific information and makes it easier to establish possible reasons, both operational and market related, that result in the ROA of each mine or company.

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## ACLARACIÓN



El presente reporte ha sido elaborado utilizando la Nueva Ortografía de la Lengua Española (RAE, 2010).

Este servicio ha sido entregado bajo los controles establecidos por un Sistema de Gestión de la Calidad aprobado por Bureau Veritas Certification conforme con ISO 9001. Número de Certificado: 8309

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