ACCOUNTING FOR EQUITY INVESTMENTS UNDER IFRS 13: ARE MARKET MULTIPLE EVALUATIONS ACCURATE?

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Abstract

In capital markets, the investment decision-making process is vastly influenced by accounting information. This paper addresses equity investment valuation through market multiples and its consequences in investors' financial statements under fair value accounting principles. After replicating the valuation process through the most used market multiples (price-to-forecasted earnings; market-to-book; enterprise-value-to-performance indicators), the authors analyze the distribution of the estimated-to-actual fair value ratio under the IFRS 13 perspective and the effects of a randomly selected portfolio on the balance sheet and income statement of the investor. The study's primary findings are that the market multiples tend to produce consistent results in 7 (at least) to 20 (at best) out of 100 cases, and over or underestimate the fair value in all the remaining cases without any apparent or predictable reason. The results of the paper confirm what previous literature underlined by studies conducted on older data and with a different geographical scope (Kim & Ritter, 1999; Lie & Lie, 2002; Palea & Maino, 2013). The results and the literature suggest being particularly cautious in applying the market multiples valuation method for estimating the fair value of an equity investment, given the preference that accounting principles accord to the Level 2 market-comparable methods, which also seem to be the most used ones in practice.

Keywords: Fair Value Accounting, Equity Valuation, IFRS 13, Market Multiples, Relative Valuation

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1. INTRODUCTION

Accounting practices and information have a fundamental role in enabling financial markets' functionality (Elkins & Entwistle, 2018). Analysts benefit from a better information environment, thus reducing information asymmetry among investors (Chantziaras, Koulikidou, & Leventis, 2021). The debate on fair value accounting's reliability has a long history and is still open (Mora et al., 2019). On the one hand, this accounting practice can induce procyclicality, financial instability, or

inadequacy in illiquid markets or specific business models (Marra, 2016; Mora et al., 2019). On the other hand, several research pieces show how it could reduce information asymmetry and improve information quality (Barth, Beaver, & Landsman, 2001; Georgiou, 2018; Livne & Markarian, 2018; Marra, 2016).

From a user and investor point of view, if any of the fair valuations produce estimation error, the information-processing costs increase, as well as the evaluation of risk premia and the adverse selection (Baiman & Verrecchia, 1996; Diamond & Verrecchia, 1991; Leuz & Verrecchia, 2000; Leuz & Wysocki, 2016; Roychowdhury, Shroff, & Verdi, 2019).

This paper focuses on equity investment valuation through market multiples and its consequences in investors' financial statements that use fair value accounting. Different accounting principles provide for different valuation methods for equity investments. Under an International Accounting Standard perspective, in most cases, the valuation for shares and equity financial instruments should be conducted via fair value through profit or losses (IFRS 9), albeit other methods are applicable in peculiar cases. Any valuation of an equity instrument's fair value also reflects on the company's profit and loss statement that accounts for that fair value. Profit or loss, in the meanwhile, reflects on the price valuation of the very same company.

When a fair valuation is correct, the profit/loss variation reflects an economic event on an accrual basis. On the contrary, when the fair value estimate is wrong, the variation in profit/loss reflects this valuation error in all subsequent valuations in space and time. In space, because the wrong valuation of the equity instrument modifies the price of the equity of the investor, and thus of all the investors that possess shares of the very same company; in time, because accruals report the wrong variation in fair value in the income statement and thus modifies the variations of the next years, recording and accruing profit/losses for no economic reason.

International Accounting Standards provide that the market price represents the preferable fair value estimate (IFRS 13). By itself, the price represents an amount that the market is willing to pay to acquire a share in the company's equity, thus representing the real value (market capitalization) of that company at a given point in time. Moreover, it has been proved that the market value of the firm's equity is a function of the book value, the current earnings, and current dividends (Elbakry, Nwachukwu, Abdou, & Elshandidy, 2017; Ohlson, 1995; Riahi-Belkaoui, 1999), thus being is closely related to economic fundamentals of a specific company.

Nonetheless, the market price is available for listed companies alone. For this reason, IFRS 13 provides for a range of alternative valuation methods by defining a hierarchy of preferability. When the price is not available, observable prices for identical instruments on the market can be used. When even those are not available, IFRS 13 suggests using other observable inputs on the market for similar companies to determine a company's fair value.

In finance, this practice is named "relative valuation" and is primarily adopted in the equity valuation of non-listed companies. A recent survey has demonstrated that analysts prefer relative valuation methods for estimating equity value, primarily the market multiples method (Pinto, Robinson, & Stowe, 2019). Market multiples have proved to be easy to apply and quite effective in estimating fair value. Nonetheless, several studies have outlined how this valuation method tends to produce valuation errors.

As already stated, incorrect valuation for equity instruments produces a cascade effect of replicating the error in all subsequent valuations and starts a vicious circle of misestimations. In this paper, we test the reliability of the most used market multiples in equity valuation by replicating the valuators' usual practices.

This paper's central question is to test whether the market capitalization, the "preferable" fair value under the IFRS 13 rules, is correctly estimated by the market multiples for a given company, particularly with those that prove to be the most used by practitioners.

Our analysis focuses on data from 1,817 listed companies of the European area over a 15-year-period. We analyze the replication of the relative valuation process using the market multiples that financial analysts employ most. We replicate the whole process of valuation, from peer selection to equity value calculation. The originality of this study, compared to previous ones, is to comprehensively analyze the most used Level 2, market-based, fair value measures by simulating a real-life setting to test market multiples reliability and the potential impacts on the financial statement of an investor by using Level 1 and Level 2 methods.

The study methods include both the descriptive statistics of the market multiples fair values and the results of applying the relative valuation on three different portfolios through the whole period of analysis.

With our analysis, we find market multiples introduce a wildly variable misestimation in fair values, not linked to precise economic reasons, and the valuations that fall in a range of ± 15% from the market price are just 1 out of 5 at best. Price-to-forecasted earnings multiple, which is the most used in practice (Pinto et al., 2019), shows an overall better performance than others in the balance sheet, albeit seemingly introducing greater volatility in the income statement. In contrast, the enterprise-value-to-EBITDA multiple, the second most used, has quite variable reliability in both statements, a variability that seems not to originate in economic reasons.

The rest of the paper is structured as follows. Section 2 reviews the relevant extant literature for our study, reporting the general results from previous and similar studies. Section 3 describes the research design and conducted analyses from a methodological perspective. Section 4 describes data analysis and Section 5 discusses the main results of the analyses. Section 5 sums up and concludes.

2. FAIR VALUATION AND MARKET MULTIPLES IN THE LITERATURE

2.1. Fair value estimation and IFRS 13

Accounting information in market-based economies fulfills several roles, such as valuation and stewardship, or contracting, roles (Gjesdal, 1981; Miller & Power, 2013; Mora et al., 2019). In particular, the functionality of markets in financial capitalism relies widely on the role of accounting practices. Primarily, high-quality disclosure of financial information of companies and enterprises is crucial to well-functioning capital markets (Elkins & Entwistle, 2018), for the information provided by the disclosure of financial facts and the reliability of financial statements are essential for the investors' understanding of the economics underlying the disclosure itself (Singh, 2013).

Thus, from an investor's perspective, the quality of financial statement information is pivotal for the investment decision-making process (Biddle, Hilary, & Verdi, 2009). Any accounting information measurement error aggravates the users' information-processing costs and risk premium estimation, and the investors' adverse selection. In this sense, the literature highlights how several aspects of the companies' disclosure policies affect investment decisions (Roychowdhury et al., 2019). Any reduction in financial statements' quality of information increases the capital cost to the company (Baiman & Verrecchia, 1996; Diamond & Verrecchia, 1991; Leuz & Verrecchia, 2000; Leuz & Wysocki, 2016; Roychowdhury et al., 2019). Moreover, the accounting information's reduced quality leads to a reduction in the firm's assets because of its uncertainty.

When accounting information is subjective, such as that derived from estimates, the uncertainty is even more accentuated. In these cases, managers tend to exert their decisional power and abuse discretion, which leads to biases in their valuations (Aboody, Barth, & Kasznik, 2006; Bartov, Mohanram, & Nissim, 2007; Robinson, Smith, & Valencia, 2018). When the biases are foreseeable, investors tend to predict and consider them in the firm's value estimation; when the biases are unexpected and unpredictable, the accounting information quality deteriorates, the firm's value decreases, and the investors are less capable of monitoring managerial decisions and behaviors (Bens & Monahan, 2004; Biddle & Hilary, 2006; Bushman & Smith, 2001; Hope & Thomas, 2008; Kanodia, Sapra, & Venugopalan, 2004; Siekkinen, 2016). Thus, biases tend to create a vicious circle where unreliable information gradually reduces the firm's mid and long-term value.

The debate on fair value accounting's capability of increasing accounting quality has a long history (Laux & Leuz, 2009) and is still open (Mora et al., 2019), particularly for the International Accounting Standards (Trimble, 2018). The opponents to this accounting practice primarily criticize the prospective negative impacts on markets, such as procyclicality, financial instability, or inadequacy in illiquid markets or specific business models (Marra, 2016; Mora et al., 2019). On the other hand, several research pieces show how it could reduce information asymmetry and improve information quality (Barth et al., 2001; Georgiou, 2018; Livne & Markarian, 2018; Marra, 2016).

As defined by both IFRS and SFAS accounting principles, any asset's fair value is the price that would be received to sell that asset in an orderly transaction between market participants at the measurement date.

In 2011 the IASB issued IFRS 13, "Fair value measurement", which came into effect on January 1st, 2013. The standard describes a framework for fair value measurement by outlining methodology. As pointed out by IFRS 13, the fair value must be determined on a market-based and not entity-specific measurement. Thus, the fair value represents an exit price, and its measurement relies on the usage of valuation approaches capable of observing the fair value from a market perspective. The same principle, particularly, states that when measuring financial assets' fair value, the entity should maximize the use of observable data and minimize non-observable data to estimate the reference price at current market conditions.

To support this, IFRS 13 establishes a hierarchy that classifies the inputs for fair value measurement in three categories:

- Level 1 inputs: this level represents the most reliable and observable input for fair value measurement. At the first level, thus at the highest priority, it indicates the unadjusted quoted prices of the common shares. Generally, these are represented by market capitalization. The quoted prices of identical assets on the market are considered at this level.
- Level 2 inputs: this level equates fair value to:

– quoted prices for similar assets in active markets;

– quoted prices for identical or similar assets in markets that are not active;

– inputs other than quoted prices observable for the assets, such as interest rates and yield curves observable at commonly quoted intervals, volatilities, prepayment speeds, loss severities, credit risks, and default rates;

– inputs derived from or corroborated by observable market data by correlation or other means.

- Level 3 inputs: unobservable inputs for which market data are not available. Usually, these are made up of the best information available at the moment and show up information asymmetries between preparers of financial statements (managers) and users (investors); usually, discounted cash flow and other income methods are included in this level, as they are based on internal data, projections, forecasts and estimates that are not directly observable on the market.

The extant literature highlights how the users of a financial statement prefer valuations conducted through higher input levels. As Filip et al. (2017) highlighted, "the disclosure of the FV hierarchy underlying FV estimates (vs. a situation of no disclosure) is beneficial to capital markets' participants such as investors and financial analysts. It allows them to be more precise in their valuation of a firm and in the forecasting of its future earnings" (para. 86). However, the ranking of the preferability of Level 1 over Level 2 or of Level 2 over Level 3 fair value estimates is not demonstrated clearly. Moreover, the reliability tends to be related to and conditional upon "the liquidity/riskiness of assets being measured, their complexity, and

uncertainty surrounding the measurement process and market conditions. Hence, greater details in disclosure may actually lead to some confusion in the market" (Filip et al., 2017, para. 86).

It is not usually possible for private, non-listed companies to obtain Level 1 data for fair value determination. In particular, the fair value could be sought only in market capitalization for listed identical firms in the same sector and regional area (capitalization of identical assets on the market).

In most cases, on the other hand, the "identical assets" are not available or retrievable; thus, Level 2 data (relative valuation methods) should be preferred. Nonetheless, one of the challenging issues in IFRS adoption is the complex nature of the accounting principles (Jermakowicz & Gornik-Tomaszewski, 2006), which can generate differences in interpretation and prevent accounting behavior harmonization. In the case of IFRS 13, amongst the different levels and related methods, there is no "hierarchy" of preference, and in most cases, the valuation is based on "relative" methods that link the fair value to market observable data, such as market multiples and relative valuation methods (Bancel & Mittoo, 2014; Pinto et al., 2019).

As is clear, though, private companies' performance is quite different from that of public companies. Generally, private companies show lower average economic returns (Moskowitz & Vissing-Jørgensen, 2002; Quigley & Woodward, 2003). Moreover, the economic returns distribution shows a significant asymmetry, presenting a long right tail of good and excellent economic returns (Cochrane, 2005). Determining an average value for the "peers" would thus result in the introduction of a bias, given the presence of peculiar outliers.

Kim and Ritter (1999) tested the price-to-earnings performance, price-to-sales, enterprise-value-to-sales, and enterprise-value-to-operating cash flow ratios. The authors highlighted that the market multiples perform poorly, especially when using historical data as input for the valuation.

Lie and Lie (2002) tested the unreliability of these multiples in a more general study. They find that the most employed market multiples (price-to-earnings (P/E), enterprise-value-to-sales, enterprise-value-to-EBITDA) tend to bias the valuations by introducing estimation errors that are not influenced by the cash levels of the company but are significantly conditioned by the size of the company, its profitability, and the extent of the intangible value.

Along the same lines, Palea and Maino (2013) compared the "real" fair value of a company (the market capitalization, that is, the price paid on the market for that particular asset at the measurement moment) with the fair value determined on Level 2 inputs, namely the market and transaction EBITDA multiples. By analyzing both the "stock" normalized differences and the return yield, they point out that the use of market and transaction multiples introduces arbitrary and unrestrained estimation errors, and in particular, overvaluations. Their analysis suggests that market and transaction multiples do not catch risk-specific firm factors, thus introducing implicit measurement risk in assessing fair value. Nonetheless, practitioners and academic researchers tend to make frequent use of market and transaction multiples to assess a company's fair value, although concurring analyses over a considerable period confirm that there is no agreement on which multiple performs best.

Lastly, the authors recently conducted a seminal study on companies from four European countries (n = 1678 over 15 years) to test the reliability of market and transaction multiples' fair value measurement under the IFRS 13 assumptions (Level 2 methods). From that study, it emerged that multiples' fair value does not provide a reliable measure of a company's equity value, with a variable gap depending upon portfolios and time. In the case of observable Level 2 fair value indicators for a market, such as market multiples, the company's fair value is not consistent with the real market value. Thus, whenever Level 2 indicators are not observable, the method increases volatility and intrinsic valuation risk (Palea, Rainero, & Migliavacca, 2019).

This paper's analyses and findings expand and deepen the seminal study included in this last work by simulating a real-life setting and determining the introduction of unintended biases in relative equity valuation and the impact of this distortion extensively.

2.2. Market multiples usage by practitioners and best practices

A recent survey conducted on over 13,000 professionals showed an overwhelming, large proportion of equity analysts (circa 93%) "reported using market multiples in valuation. Ranking second and third, still with wide adoption, were present discounted value (78.8%) and asset-based approaches (61.4%). By contrast, although widely written about, a real options approach was quite infrequently used" (Pinto et al., 2019, p. 4).

Pinto et al.'s (2019) research also reports that 93% of respondents that generally use market multiples in their analyses, on average, tend to use this approach in 2 out of 3 cases (68.6%).

The most used methods include the price-to-earnings ratio, used by 88.1% of analysts in 67.2% of analyses, closely followed by enterprise-value-to-performing income measures multiples, e.g., EV-to-EBITDA, which is used by 76.7% of analysts in 61.1% of analyses. Other popular methods used by analysts include price-to-book values (used in 59% of the analysts in 44.8% of analyses).

For this reason, our analysis will focus primarily on those market multiples, and in particular on:

- Price-to-forecasted earnings ratio, selected as it is the most used amongst all the others. The practitioners responded to the survey indicating that the vastly preferred fundamental is represented by forecasted earnings (used in 2 out of 3 analyses that use this multiple) against trailing earnings (used in less than 1 out of 10).
- Market-to-book ratio (also named price-to-book), selected as it the third most used measure.
- Enterprise-value-to-performing income measures, selected as they are the second most used kind of the market multiples, and in particular:

– Enterprise-value-to-EBITDA multiples, and the most used amongst the enterprise value ones (88%).

– Enterprise-value-to-EBIT multiples selected as EBIT represents the second performing income measure used amongst the enterprise value ones (20% circa). We preferred EBIT over operating profit as the denominator to reduce formal differences in

financial statements to determine the operating profit and thus to reduce subjectivity and GAAP induced bias in the determination of the market multiple.

– Enterprise-value-to-revenues, or EV-to-sales, multiples, even though it is less used by practitioners (16%), to include a residual measure and test whether it is less relevant and reliable for valuation purposes compared to others. This multiple has been preferred to the price-to-sales one because "EV/revenue avoids the mismatch in the P/S ratio of share price in the numerator with a prefinancing income measure (sales) in the denominator" (Pinto et al., 2019, p. 6).

Empirical studies and professional best practices show that articulating the process used to calculate market multiples is pervasive on the valuation's reliability (Plenborg & Pimentel, 2016).

Three leading best practices have been identified to improve market multiples reliability:

1) The selection of peers must be consistently based. The mere association of companies by economic sector is insufficient to pursue a reliable market multiple calculations, and the best classification must also include elements from fundamentals and specificities of the companies. These results tend to be well approximated by using the industry classification of the Global Industry Classification Standard (GICS) economic sectors[1]. This classification has a demonstrated capability of improving valuation results because it adds specific elements from the companies to determine the classification (Bhojraj, Lee, & Oler, 2003; Overgaard Knudsen, Kold, & Plenborg, 2017);

2) Even if the academic research suggests that including negative company multiples in the calculation of market multiples may reduce inconsistencies and improve the valuation process, empirical research evidence supports the opposite (Sommer, Rose, & Wöhrmann, 2014). Negative multiples are determined when an element of the ratio is negative, thus when economic results are negative (negative EBITDA, negative EBIT, negative net profit, or the three concurrently);

3) The market multiple is an average measure of the company multiples. For this reason, different measures can be selected to represent the average. Typically, the most used include the simple mean and the median of the distribution, although some academic studies demonstrated that using the harmonic mean produces more consistent and reliable results (Agrrawal, Borgman, Clark, & Strong, 2010; Baker & Ruback, 1999; Liu, Nissim, & Thomas, 2002).

3. THE RESEARCH DESIGN AND METHODOLOGY

3.1. Research question and design

This paper's primary goal is to test whether the measurement methods based on market multiples can adequately estimate the company's fair value.

As highlighted previously, when using market multiples estimated by analysts such as those of FitchRatings (Palea et al., 2019; Palea & Maino, 2013), market multiples tend to overvalue the market capitalization of the company, giving inconsistent results.

The test conducted in this paper aims to replicate the practitioners' best practices in calculating market multiples by extracting data for companies operating in the European territory (including all countries geographically considered part of the European Continent).

This study analyzes whether the market multiples, as the most used equity valuation methods, produce reliable estimates for valuing the firm's market capitalization.

Thus, this paper's central question is to test whether the market capitalization, the "preferable" fair value under the IFRS 13 rules, is correctly estimated by the market multiples for a given company, particularly with those that prove to be the most used by practitioners. Previous researchers have determined the instrument's reliability in a range of misestimation not greater than 15% to the market capitalization (Gilson, Hotchkiss, & Ruback, 2000; Kaplan & Ruback, 1996; Kim & Ritter, 1999; Lie & Lie, 2002).

We answer the research question through a 5-step design:

– Step 1: Data extraction, data cleansing, and clustering;

– Step 2: Calculation of reference market multiples for each company/portfolio;

– Step 3: Calculate the Level 2 fair value for each company by using market multiples;

– Step 4: Calculation of the ratio between "Level 2" calculated fair value and Level 1 extracted fair value (market capitalization);

– Step 5: Analysis of data, both statistically and from an accounting-simulation perspective.

3.2. Dependent variables

Our analysis sample is focused on the European geographic area, comprising companies both with headquarters in the European Union or other countries of the continent. We selected all the listed companies operating in any economic sector, excluding financials. The selection of listed companies is due to the necessity of having a recorded Level 1 fair value, considered preferable under an accounting principles perspective, such as market price or market capitalization, to compare this value with the computed market-multiples-based fair value.

The analysis considers all the companies[2] with a fiscal year ending on December 31st. The reference period starts on December 31st, 2004, up to December 31st, 2018. Data refers to the end of the fiscal year, and all variables refer to that date for each year. The variables extracted from profit-and-losses statements refer to the period 01/01–12/31 of each year.

Table 1 lists the variable names, together with any assigned notation used throughout the rest of the paper, the variable type, and a brief description of the content. As highlighted in Table 1, all enterprises have been identified with the index variable *i*. Each of the companies belongs to one country only, determined based on the location of headquarters.

[1] Developed by Standard and Poor's along with MSCI, https://www.msci.com/gics

[2] Data had been extracted for the companies which showed consistent uploads on Thomson Reuters' EIKON Screener/DataStream databases, excluding those with incomplete or insufficient balance sheets and P/L report data.

Table 1. Variables list and description

Variable	*Notation*	*Type*	*Content*
idn	*i*	Categorical, panel id	The identifier for each company
year	*y*	Categorical, time series	Year number
name		String	Full name of the company
country	*c*	Categorical	Country code of the company
sec_c		Integer	GICS sector code of activity
sec_n		Nominal	GICS sector of activity
portfolio	*p*	Nominal	Generated value (sec_c + sec_n)
m_search		Categorical	Generated value (year + sec_c + dim)
m_cap		Continuous	Market capitalization
price		Continuous	Price (close)
shares		Continuous	Shares outstanding
tot_ass		Continuous	Total assets
bv		Continuous	Book value
ev		Continuous	Enterprise value
net_debt		Continuous	Net debt (Debt minus cash)
s		Continuous	Total revenues
ebitda		Continuous	EBITDA
ebit		Continuous	EBIT
earnings		Continuous	P/L of the period
eps		Continuous	Earnings per share (Earnings-to-shares ratio)
fpe	*f|pe*	Continuous	P/E forward ratio
mtb	*mtb*	Continuous	Market-to-book (Price-to-book) ratio
evs	*s*	Continuous	Enterprise-value-to-sales ratio
evda	*ebitda*	Continuous	Enterprise-value-to-EBITDA ratio
evebit	*ebit*	Continuous	Enterprise-value-to-EBIT ratio

The country of the companies is identified by the variable *c*, which can assume the values listed in Table 2.

All extracted data had been treated and cleansed to cope with severe outliers, which could conduct to biases in the computation of market multiples, being that not representative of the majority of the others.

Table 2. List of countries and distribution

Country (c)	*Frequency*	*Percent*	*Number of companies*
Austria	525	1.96	35
Belgium	949	3.54	63–64
Cyprus	30	0.11	2
Czech Republic	57	0.21	4
Denmark	860	3.21	57–58
Finland	914	3.41	60–61
France	3,833	14.29	252–258
Germany	3,799	14.16	252–255
Greece	1,605	5.98	106–108
Guernsey	53	0.20	3–4
Hungary	146	0.54	9–10
Iceland	21	0.08	0–3
Republic of Ireland	408	1.52	26–29
Isle of Man	19	0.07	0–2
Italy	1,203	4.49	77–83
Jersey	70	0.26	4–5
Luxembourg	130	0.48	7–9
Macedonia	15	0.06	1
Malta	15	0.06	1
Monaco	15	0.06	1
Netherlands	717	2.67	47–48
Norway	662	2.47	43–45
Poland	1,238	4.62	82 –83
Portugal	214	0.80	13–16
Russia	225	0.84	14–16
Slovak Republic	45	0.17	3
Slovenia	75	0.28	5
Spain	640	2.39	41–44
Sweden	1,736	6.47	114–118
Switzerland	1,480	5.52	97–100
United Kingdom	5,123	19.10	319–358
Total	**26,822**	**100.00**	**1,748–1,817**

Note: Frequency reports the absolute number of cases for the dataset. The last column reports the number of single companies extracted that repeat over the 15 years of analysis. The number of companies registered through the years varied: the lower value indicates the minimum, and the higher one indicates the maximum.

Data cleansing has been conducted by excluding from the analysis the companies which presented an excessive or insufficient number of shares or prices. Particularly, we excluded from the studies the companies that presented an extremely small or extremely high number of shares or price (highest and lowest 1%). The set of excluded firms consists of the firms that fell into the first and last percentiles of price, number of shares, and/or both (merged set). After data cleansing, the entries

from countries presenting few companies had been preserved to include as many companies as possible for each sector and thus increased the sample size.

The final sample size is 1,817 companies as shown in Table 2. The panel is unbalanced across the period of analysis, and the total number of observations is 26,822 (different financial statements).

3.3. Computation of market multiples

The process used for the computation of market multiples of each company is based on the best practices highlighted by the academic and professional literature. In brief, the calculation will be based upon the following assumptions. The portfolio of peers will be based on the industry classification of the companies. In particular, we will use the Global Industry Classification Standard economic sectors[3] because of their demonstrated ability to improve valuation results (Bhojraj et al., 2003; Overgaard Knudsen et al., 2017). Consistently with professional practice and empirical evidence (Sommer et al., 2014), we excluded from the calculation of multiples companies that presented negative economic results (only for the year of occurrence and the multiples that involved the negative result). The multiples have been determined as the median of the distribution, consistently with the best practices empirically evidenced (Agrrawal et al., 2010; Baker & Ruback, 1999; Liu et al., 2002).

3.3.1. Selection of peers

The first step consists of creating consistent and homogeneous portfolios based on the economic sector's code. We used the Global Industry Classification Standard (GICS), developed from MSCI and S&P Dow Jones[4], extracted from the database and assigned from the analysts. This classification is preferred to other industry classification systems (such as NAICS or NACE) because of its demonstrated ability to identify a company's peers better than other systems and is based on a classification that is not only qualitative but also quantitative. Nonetheless, the multiples had been calculated based on the Level 1 GICS code, regarding the economic sector of operations, being unfeasible to use industry levels (2–4) because of the limited number of companies included in the analysis.

Each of the companies had been assigned to one of the 10 GICS sectors, where p is the categorical variable that identifies the portfolio as follows.

Table 3. Sectors of activity for portfolio determination

p	*GICS Code*	*GICS description*
1	10	Energy
2	15	Materials
3	20	Industrials
4	25	Consumer Discretionary
5	30	Consumer Staples
6	35	Health Care
7	45	Information Technology
8	50	Communication Services
9	55	Utilities
10	60	Real Estate

3.3.2. Calculation of company and market multiples

For each portfolio, we assigned[5] the extracted company multiples to the variables $m_{i,y}^{x}$, where,
m^x is the considered multiple;
i identifies the company;
y identifies the year considered;
x identifies the multiple, as indicated in Table 4.

Table 4. Multiples description a base of calculation

x	*Multiple descriptions*	*Base (b^x)*	*Source*
fpe	Price-to-forecasted earnings	Forecasted earnings per share	Extracted*
mtb	Market-to-book	Book value	Extracted*
s	Enterprise-value-to-sales	Sales revenues	Extracted*
$ebitda$	Enterprise-value-to-EBITDA	EBITDA	Extracted*
$ebit$	Enterprise-value-to-EBIT	EBIT	Extracted*

*Note: * Multiples have been double-checked by recalculating them for each firm based on financial statements' data.*

For each portfolio, identified by the variable p, for each year, we calculated the single market multiples as the median of the multiples of the companies included. The formula used for computation of the market multiples is equation (1):

$$\mu_{p,y}^{x} = Me\left(m_{i,y}^{x}\right); p = 1, \dots, 10 \quad (1)$$

where,
μ^xidentifies the market multiples, similarly as m^x, with the x identifying it as in Table 4;
p identifies the sector of activity as previously defined;
y identifies the year of the multiple;
i identifies the company;
y is the year;
i is the identification index of the company.

3.4. Fair value estimation via market multiples

After determining the market multiples for each portfolio, we can estimate the fair value of the company. The fair value calculation is computed using equation (2a) for the price-to-earnings and market-to-book multiples and using equation (2b) for the EV-to-sales-EBITDA, and -EBIT multiples.

[3] Developed by Standard and Poor's along with MSCI, https://www.msci.com/gics

[4] As reported on the MSCI website (https://www.msci.com/gics), "— GICS is a common global classification standard used by thousands of market participants across all major groups involved in the investment process: asset managers, brokers (institutional and retail), custodians, consultants, research teams and stock exchanges. — Standardized industry definitions are applied to companies globally. — The structure precisely reflects the current state of industries in global investment markets. — The classification consists of four levels of analysis, ranging from the most general sector to the most specialized sub-industry. — Annual reviews are conducted by MSCI and S&P Dow Jones Indices to ensure that the structure remains fully representative of today's global markets".

[5] The multiples had been checked for consistency by calculating the multiple with the other extracted variables (i.e., in the case of pe, the extracted multiple had been compared to the ratio between the extracted prices and earnings per share of each company, and so on).

$$FV_{i,y}^{x} = b_{i,y}^{x} \cdot \mu_{p,y}^{x} \quad (2a)$$

$$FV_{i,y}^{x} = b_{i,y}^{x} \cdot \mu_{p,y}^{x} - ND_i \quad (2b)$$

where:
$b_{i,y}^{x}$ is the basis of calculation of multiple x, as identified in Table 4;
$\mu_{p,y}^{x}$ is calculated via equation (1);
ND_i is the net debt of the company.

Based on the computed fair value, we then computed the difference between the fair value $FV_{i,y}^{x}$ and the market capitalization $MC_{i,y}$. The differences had been computed both as absolute (Euros) difference, equation (3) and as a ratio, equation (4).

$$\delta_{i,y}^{x} = FV_{i,y}^{x} - MC_{i,y} \quad (3)$$

$$r_{i,y}^{x} = FV_{i,y}^{x} / MC_{i,y} \quad (4)$$

Remarkably, the ratio determined in equation (4) defines "correctly estimated" fair values when the value is between 0.85 and 1.15 (± 15% from the market capitalization).

3.5. Analyses outline

Based on the calculated fair values and ratios, we conducted three different analyses:

1) Descriptive statistics and analysis of the statistical distribution of the ratios.

2) Analysis of the correlation between the price of shares and the fair value per share determined on the several FV^{x}.

3) Simulation of the effects on an investor's balance sheet and income statement using different market multiples for estimating the (Level 2) fair value of a portfolio of companies compared to (Level 1) market capitalization.

In the next paragraphs, we outline the methods used for each analysis and the tested hypotheses.

3.5.1. Descriptive statistics and analysis of the statistical distribution of the ratios

This analysis has been conducted to test whether any estimated fair value is likely to fall between a ± 15% range from the same company's price value. In this case, the ratio calculated via equation (4) can be considered equal to ratio = 1 ± evaluation error, where a value of ratio =1 ± 0 (no valuation error) means that the estimated fair value equals the market capitalization. The multiple reliability is assumed when the error falls within the 15% range consistently with the measure used in previous analyses.

For this reason, we assume that the distribution of ratios r^{x} comprises a range from 15% less than the market capitalization (0.85, or 85%) to 15% more (1.15, or 115%). To test this hypothesis, we used descriptive statistics.

On the one hand, we simply analyze the moments of the statistical distribution of the ratios r^{x} and particularly the mean, standard deviation, the percentiles of the distribution, the skewness, and the distribution's kurtosis.

On the other hand, we analyze the cumulative frequency of the ratios falling inside or outside the reliability range. We highlighted the frequency of cases with a ratio of estimated fair value that falls in the range of ± 5% and ± 15% and greater or equal to ± 50% compared with market capitalization.

3.5.2. Simulating financial statement impact of market multiples evaluation

This analysis consists in simulating the effect of applying IFRS 13 by using the Level 2 market multiples valuation method on the balance sheet and income statement of an investor compared to the use of the Level 1 price (market capitalization) method if he/she invested in a portfolio of companies.

To simulate a real-life setting and to avoid introducing undesired variations in our simulation due to companies' absence of data, we selected three different random portfolios: Portfolio S, including 50 randomly selected companies; Portfolio M, including 100 randomly selected companies; Portfolio L, including 250 randomly selected companies. For each portfolio, we assume that the investor possesses the totality of the shares of the company.

The portfolios are extracted by randomly selecting companies from the dataset. The selection process only considers the companies for which it was possible to calculate the different fair values every year. The three portfolios are independent, and the smaller ones do not represent sub-groups of the larger ones. Besides, some companies could be present in two or more portfolios because the selection process allows repetition.

The three portfolios were then assessed regarding the effect on the balance sheet and the income statement.

1) To test the impact of market multiples valuation on the balance sheet, we calculated each portfolio's total asset value with each different valuation method. The different portfolio values equate to the sum of all the fair values for each company included in each portfolio, as computed with equation (2a) or (2b). More formally,

$$L2_{y}^{x} = \sum_{i} FV_{i,y}^{x} \quad (5a)$$

where, $L2_{y}^{x}$ represents the Level 2 portfolio fair value for each market multiple x for each year y. The sum of the market capitalizations gives the benchmark value with which to compare the fair value that represents the Level 1 fair value for each year.

$$L1_{y} = \sum_{i} MC_{i,y} \quad (5b)$$

For accounting purposes, both *L1* and *L2*s represent the fair value that the portfolio reports in the assets of the balance sheet under different valuation methods. For this reason, a difference between the Level 1 and Level 2 methods represents an undesired effect of under or overvaluation on the balance sheet because it is due just to the different valuation methods chosen and not to actual economic reasons.

The larger this difference is, the greater the misestimation and the valuation bias induced by valuation method choice.

We then summed all the differences between the years $\delta_{i,y}^{x}$ as determined with equation (3) for each company included in the portfolios, given that $L2_y^x - L1_y = \sum_i FV_{i,y}^x - \sum_i MC_{i,y} = \sum_i \delta_{i,y}^x$.

The amount of "effect" on the balance sheet (*EBS*) represents, for each market multiple *x* and year *y*, the impact on the balance sheet of the valuation method on the balance sheet, thus the induced and undesired under or overvaluation.

$$EBS_y^x = L2_y^x - L1_y \tag{6a}$$

The relative per one hundred effect represents the relative impact of the under or overvaluation effect on the balance sheet for each year, compared with the benchmark Level 1 value.

$$EBS\%_y^x = \frac{L2_y^x}{L1_y}\% - 1 = \frac{EBS_y^x}{L1_y}\% \tag{6b}$$

2) To test the impact of market multiples valuation on the income statement, we calculated the portfolio value variation between two subsequent years under each different valuation method. The asset is assumedly valued at fair value through profit and losses (FVPL) (cf. IFRS 9, 2016, §5.2.1.c) thus we consider the whole variation in fair value between two years for the portfolio reported in profit/losses affecting the net income.

For this reason, the variation between two years in Level 1 fair values is the benchmark value, thus representing the correct variation of fair value in the income statement on an accrual basis. When the variation between two years in Level 2 fair values is higher than the benchmark, there is an extra profit that is accounted in the net profit of the year for the sole reason of using a different market multiple. Vice versa, when the variation between Level 2 is lower than the benchmark, there is an extra-loss that is accounted for in the net profit that has no economic justification.

We thus compute the effect on income statement as follows

$$\begin{aligned} EIS_y^x &= \left(L2_y^x - L2_{y-1}^x\right) - \left(L1_y - L1_{y-1}\right) \\ &= EBS_y^x - EBS_{y-1}^x \end{aligned} \tag{7a}$$

which represents the extra profit or loss due to the application of a different valuation method and reported in the investor's income statement, and

$$EIS\%_y^x = \frac{\left(L2_y^x - L2_{y-1}^x\right) - \left(L1_y - L1_{y-1}\right)}{\left|L1_y - L1_{y-1}\right|} = \frac{EIS_y^x}{\left|L1_y - L1_{y-1}\right|} \tag{7b}$$

which represents the relative effect on the income statement compared with the benchmark Level 1 variation.

4. DATA ANALYSIS

4.1. Analysis of the frequency of ratios

Before conducting statistical analysis, it is interesting to first glance at the distribution of the ratios calculated via equation (4). Consistently with the extant literature, we consider a valuation method "reliable" when it estimates a fair value that is in a range of ± 15% from the Level 1 fair value (Gilson et al., 2000; Kaplan & Ruback, 1996; Kim & Ritter, 1999; Lie & Lie, 2002), that in our case is represented by market capitalization.

The ratios' distribution graphical analysis shows us that the market multiples valuation method produces inconsistent results. Under or overestimations are far more likely to happen than "correct" estimations that fall in the range of ± 15% from the market capitalization.

Figure 1 represents the trend of the cumulated frequencies for the ranges through the years. Each bar's lower and upper sections (gridded) represent under or overestimations greater than ± 50%. The second to last lower and upper sections (striped) represent under or overestimations smaller than ± 50% but greater than ±85 %. The central sections of each bar (full color) represent the "excellent" estimates, where the darker color identifies the valuations that fall in a range of ± 5% and the lighter color identifies the valuations that fall in a range of ± 15%.

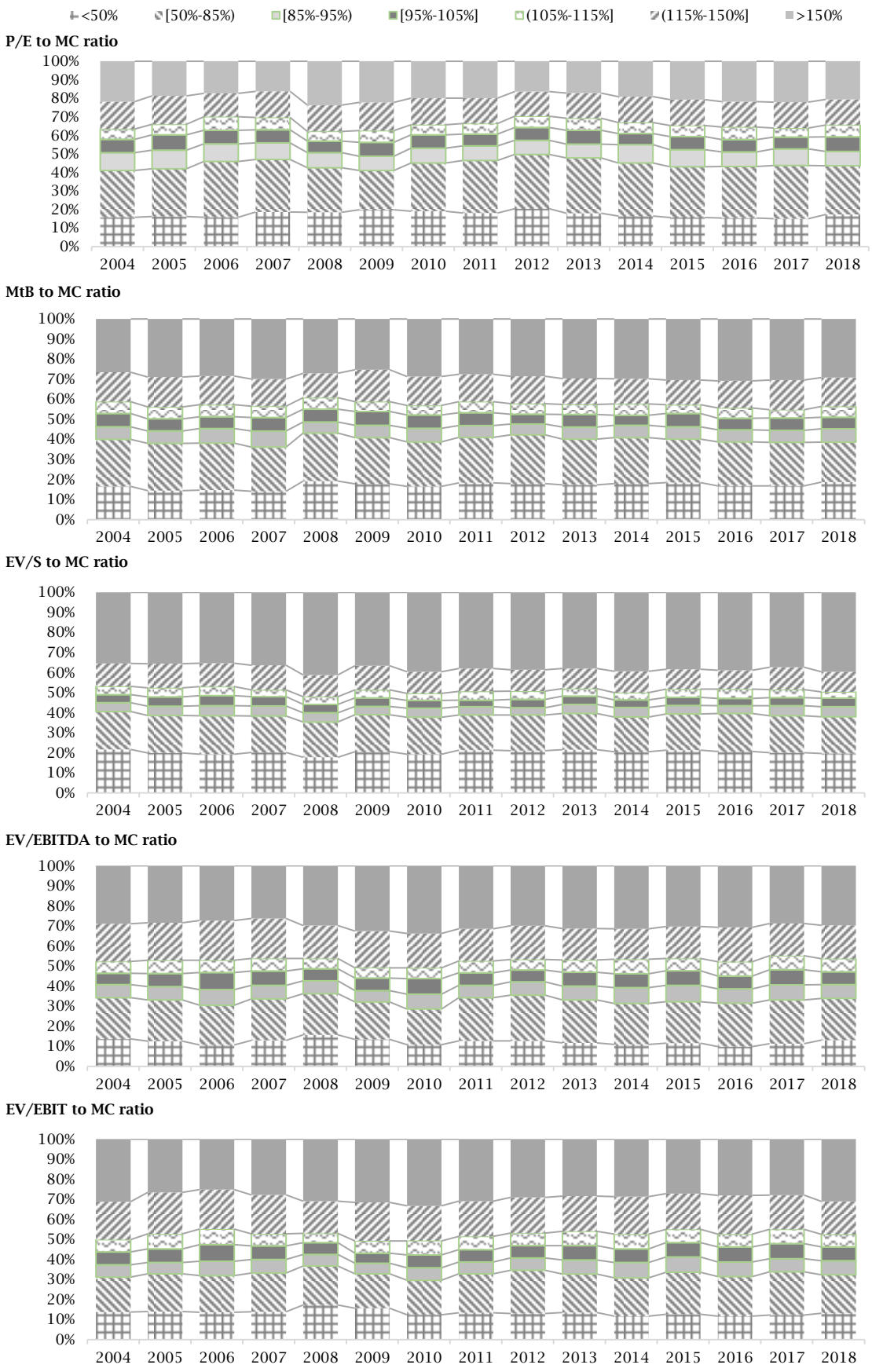
It is to be noted that the central area of the bars is almost invariant. The P/E multiple produces correct results (in the range of ± 15%) in 20%–24% of cases; the market-to-book multiple in 15.5%–20.5% of cases; the EV/S multiple in 12%–14% of cases; the EV/EBITDA multiple in 17.5%–22.5% of cases, and the EV/EBIT multiple in 16%–22% of cases.

Table 5 shows the cumulated frequency for the whole period, given that there are small differences in the "reliability" frequency in the different years. The overall best performer is the price-to-earnings multiple that produces "correct" valuations in 21.7% of the cases, while the worst performer is enterprise-value-to-sales, which produces correct valuations in just 12.6% of cases. Generally, less than half of those "correct" valuations are in a range of 5% from the market capitalization, representing at best 7 out of 100 cases.

Table 5. Cumulated frequencies for specific ranges of variable value

Variable	*50% or lower*	*85% to 115%*	*95% to 105%*	*150% or greater*
r^{fpe}	17.3%	21.7%	7.0%	19.8%
r^{mtb}	17.0%	17.8%	6.2%	28.8%
r^{s}	20.3%	12.6%	4.1%	37.9%
r^{ebitda}	12.2%	19.9%	6.8%	30.0%
r^{ebit}	13.4%	19.9%	6.7%	29.1%

Figure 1. Trend of the cumulated frequencies in the period of analysis



Also, the P/E multiple tends to produce the lowest percentage of "extreme" overvaluation (greater than 150% of the market capitalization), while the EV-to-EBITDA multiple tends to produce the lowest number of extreme undervaluation (lower than 50% of market capitalization).

The analysis of cumulated frequencies shows that the most used market multiples (P/E and EV/S) tend to produce, more or less, 7 out of 100 correct (in a range of 5%) and circa 20% of "acceptable" (in a range of 15%) estimations of the fair value, at the cost of wildly misvaluing equity in more or less 40% of cases.

4.2. Descriptive statistics and analysis of the statistical distribution of the ratios

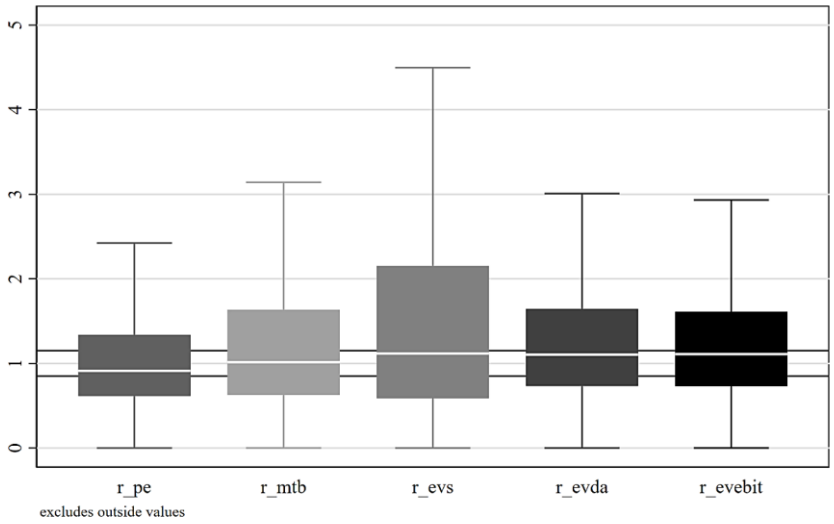
This section analyzes the descriptive statistics to test whether the differences between estimated fair values and market capitalization are statistically significant, and thus if the market multiples can produce "reliable" valuations.

As already pointed out, we consider a valuation method "reliable" when it estimates a fair value in a range of ± 15% from the market capitalization (Level 1 fair value). Therefore, we expect that the distribution of ratios between estimated fair value and price is concentrated in the range that goes from $r^x = 0.85$ (estimated value is 85% of the market capitalization) to a maximum of $r^x = 1.15$ (estimated value is 115% of market cap).

This hypothesis is tested by analyzing the distribution of the ratios r^x, focusing mainly on the descriptive statistics of the distribution (mean, standard deviation, percentiles, median, skewness, kurtosis).

The following figure shows the box plot of the distribution graphically representing the ratios' statistical distribution for the different multiples.

Figure 2. Box plot of ratios distribution



Note: The two horizontal lines show the "reliability range" of ± 15% from the market capitalization, represented by the constant value of 1.

In Table 6, we report the general descriptive statistics for the distribution of the market multiples-to-capitalization ratios. As reported in Table 6, the mean of the distribution of all ratios falls in the range that goes from $m_{r^x} = 1.245$ to $m_{r^x} = 2.364$, with standard deviations in the magnitude of $s_{r^x} \cong 3$ up to of $s_{r^x} \cong 19$. This means that the values are somewhat dispersed around the mean, influenced by a long right tail of extreme results and outliers.

Table 6. Descriptive statistics of the r^x distribution

Variable	*Mean*	*Std. Dev.*	*Percentiles*			*Skewness*	*Kurtosis*
			1st	*50th*	*99th*		
r^{fpe}	1.245	3.064	0.046	0.913	6.478	54.344	4324
r^{mtb}	1.499	4.230	0.130	1.015	8.237	71.824	7873
r^{s}	2.364	19.446	0.039	1.117	18.246	131.480	19505
r^{ebitda}	1.650	18.600	0.066	1.104	8.493	146.824	22138
r^{ebit}	1.472	3.212	0.051	1.111	7.344	38.104	2098

The value of skewness and kurtosis of the ratios' distributions confirm the outlier trends (for all the values, see Table 6). Moreover, the considerable value of these distribution moments shows that the market multiples methods produce an astounding number of outliers, with a long and thin right tail, compared to a normal distribution (with skewness of 0 and kurtosis of 3 for definition).

To reinforce our analysis, we furtherly analyzed the statistical significance of the estimated value. Due to the long right tail extreme results, we used the Wilcoxon signed-rank test to determine whether the difference between the estimated value and the market capitalization is statistically significant.

The results are reported in Table 7. The test suggests that in most cases, the difference is statistically significant throughout the years.

Table 7. Wilcoxon sign-rank test (paired multiple to market capitalization difference) — p-values

Year	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2004	< 0.001***	0.0097***	0.016**	< 0.001***	< 0.001***
2005	< 0.001***	0.115	0.004***	< 0.001***	< 0.001***
2006	< 0.001***	0.033**	0.002***	< 0.001***	< 0.001***
2007	< 0.001***	0.467	0.002***	< 0.001***	< 0.001***
2008	< 0.001***	< 0.001***	< 0.001***	0.002***	< 0.001***
2009	< 0.001***	< 0.001***	0.007***	< 0.001***	< 0.001***
2010	< 0.001***	0.001***	< 0.001***	< 0.001***	< 0.001***
2011	< 0.001***	< 0.001***	0.003***	< 0.001***	< 0.001***
2012	< 0.001***	< 0.001***	0.015**	0.012**	< 0.001***
2013	< 0.001***	< 0.001***	0.152	< 0.001***	< 0.001***
2014	< 0.001***	< 0.001***	0.065*	< 0.001***	< 0.001***
2015	< 0.001***	< 0.001***	0.923	0.011**	0.013**
2016	< 0.001***	< 0.001***	0.879	0.001***	< 0.001***
2017	< 0.001***	< 0.001***	0.587	0.042**	0.004***
2018	< 0.001***	< 0.001***	0.071*	0.006***	< 0.001***
Total	**< 0.001*** **	**< 0.001*** **	**< 0.001*** **	**< 0.001*** **	**< 0.001*** **

*Note: * p < 5%, ** p < 1%, *** p < 0.1%.*

Thus, the analysis results reported in this section make us reject our central hypothesis that the estimated fair value consistently falls in the market capitalization vicinity. The statistical significance of the difference between estimated fair value and market capitalization suggests that under or overestimations happen far more by chance than for actual economic reasons.

Moreover, the differences can vary randomly from very large underestimations to very large overestimations for no apparent reason.

These differences represent a subjectivity bias in the fair value determination process due to the valuation method's choice, considering that all reported ones are equally accepted in accounting principles and valuation practices.

4.3. Financial statement effects simulation

With this part of the analysis, we will assess and simulate the bias's impact on a hypothetical investor's financial statement.

We test and simulate the effect of under or overestimations on the fundamentals of both the balance sheet and income statement regarding the portfolios' accounting equity value.

As reported in the methodology section, we constructed three randomly selected portfolios under the assumption that the investor possesses the entirety of their shares.

The random selection of companies included in each portfolio is carried out only on the companies that presented a calculable value of fair value under each different method for the whole 15-year-period. Each portfolio includes a different randomized selection of companies. A single company can be included in one or more portfolios, depending on the selection process, but the smaller portfolios are not intended to be sub-groups of larger ones.

We first assess the overall effect on the balance sheet and the income statement. The last section reports the relative effect of applying Level 2 valuation methods to using Level 1 market capitalization.

4.3.1. Effect on the balance sheet

In the following tables, we report the calculated fair value to record in the balance sheet under the different possible values. In Table 8, it is possible to retrieve the values for Portfolio L; in Table 9, the values for Portfolio M, and in Table 10, the values for Portfolio S.

In the first graph, the two horizontal lines are two benchmarks. The light grey dash reports the cumulated book value of the companies' equity included in the portfolio. This value is the "equity method" accounting value of the portfolio, net of initial recognition differences. The black dash reports the cumulated market capitalization, thus the Level 1 fair value of the portfolio, which is the benchmark of our analysis as calculated in equation (5b), as described in this paper's methodology section. The bars report the cumulated Level 2 fair values calculated in equation (5a), as described in this paper's methodology section.

In the second graph, we represented the trend of the relative extra effect on the balance sheet for each multiple $\left(EBS\%_{y}^{x}\right)$ as calculated in equation (6b). The dashed line at + 0% represents the trend of the market capitalization.

In general, we can assert that almost none of the market multiples' fair value is regularly similar to the market capitalization fair value. Fair value calculated via P/E (forecasted earnings) produces the most consistent and less variating difference to the three portfolios' market capitalization.

A portfolio "dimension" is present and increases the apparent "reliability" of the multiple in larger portfolios, with larger fluctuations in the smaller ones. This effect is predictable because it is well known that diversification tends to reduce risk and thus compensate and level out firm-level differences.

There is a little time-related effect, signaling that P/E multiple is more capable of absorbing general market trends and, particularly in the larger portfolios, there are no crises-related plunges in 2007–2008 and 2011–2012.

This effect is probably due to diversification, as it is possible to note by analyzing Portfolio S, which had a large drop in value in 2008.

On the contrary, in each portfolio, the market-to-book multiple tends to produce the most inconsistent results by inducing a considerable underestimation comprised in a range of -20% to -40% from the market capitalization. Also, even in Portfolio L, there is a plummet in 2008 that even worsens this undervaluation.

On the other hand, the enterprise value to performance multiples tends to overestimate the fair

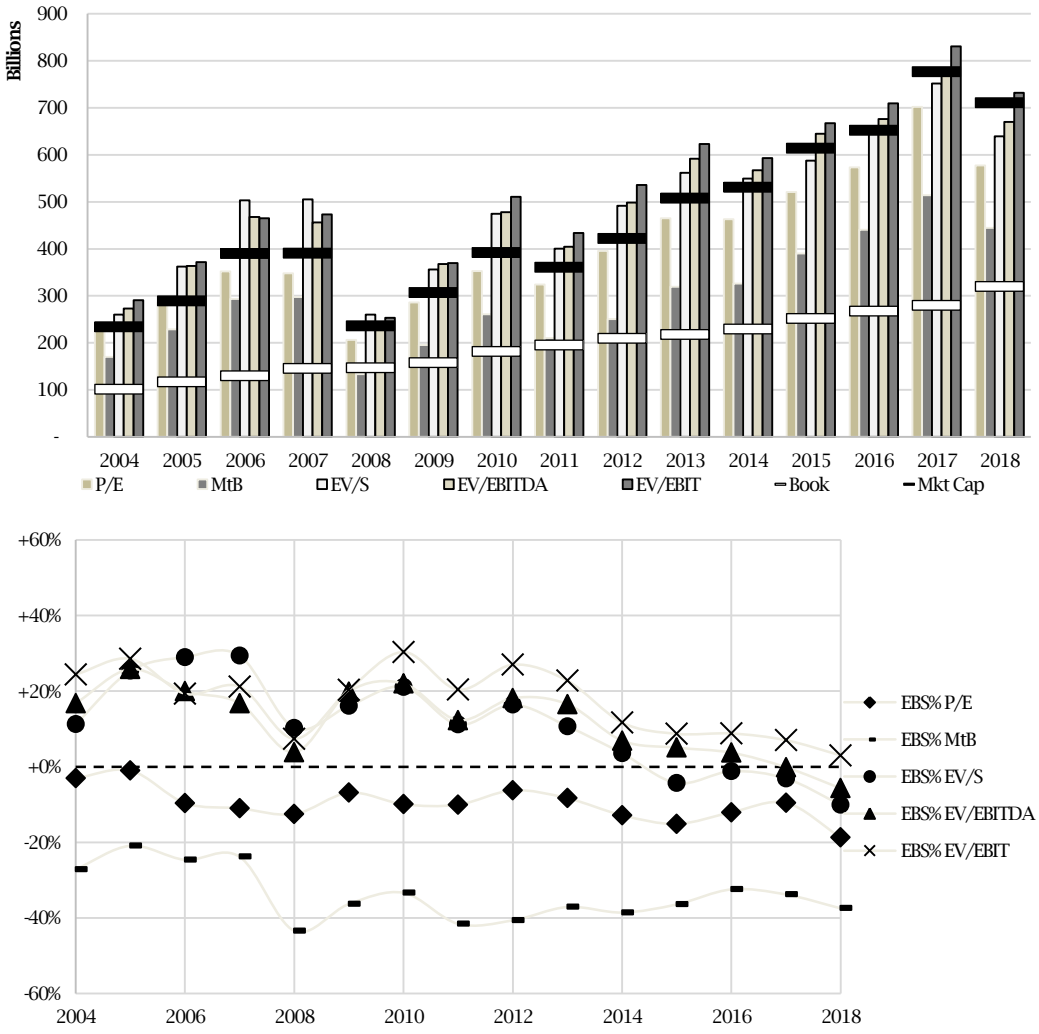
value in the first period of analysis, with slopes in 2008 and 2011 and then decreasing in the "recovery" period.

Generally speaking, EV/S is the most variable of the three, achieving both the larger overvaluations during the initial period and some undervaluation during the last period. EV/EBITDA has a slightly better and less variable trend, while EV/EBIT tends to be less variable but mostly prone to overestimation if compared to its sibling.

The relative percentages and trends are reported in the last paragraph of this section that analyses the market multiples' general reliability and the portfolio dimension's diversification effect.

Table 8. Balance sheet Portfolio L values

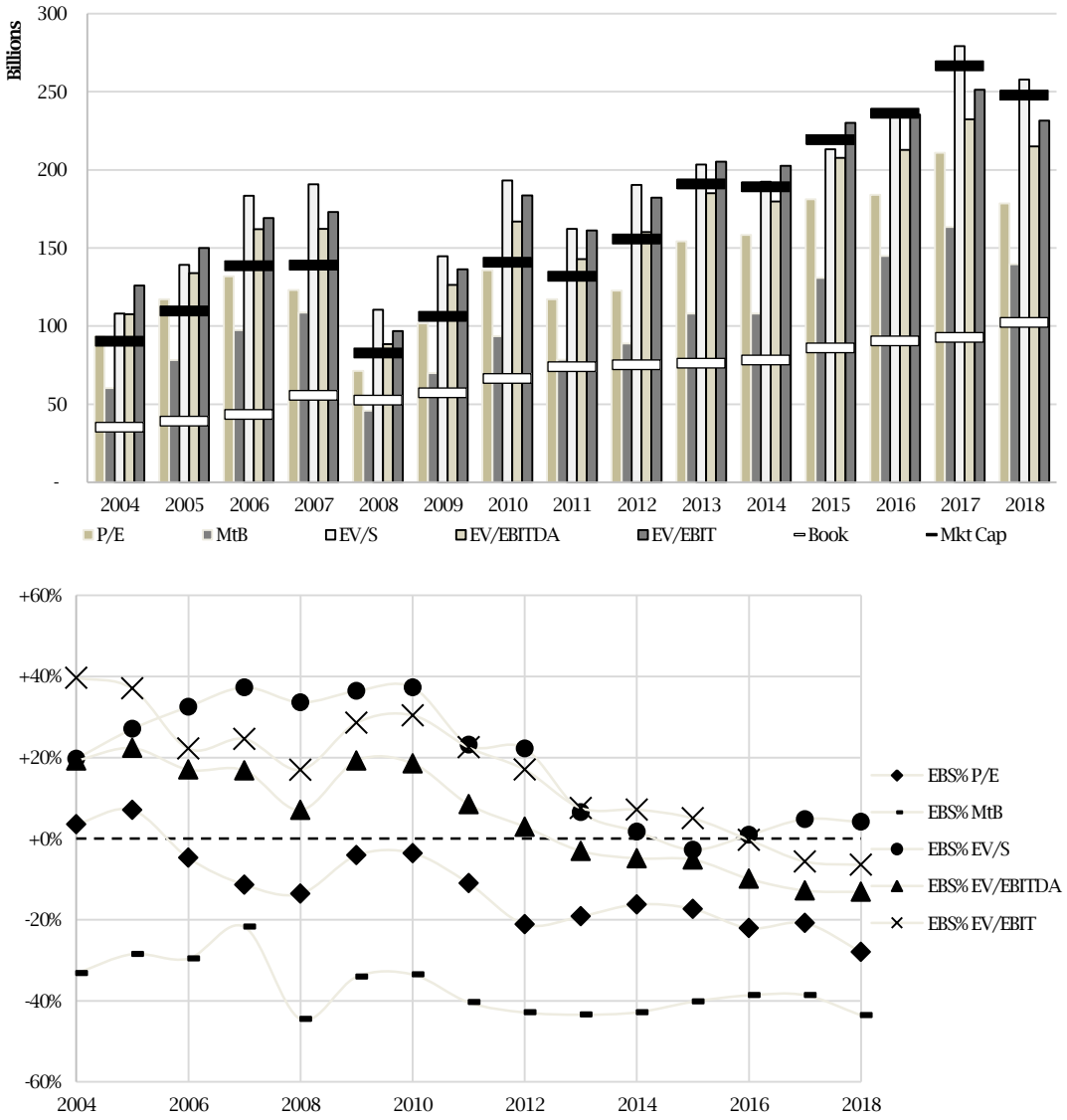
Year	*Book*	*Mkt Cap*	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2004	100,991	233,713	226,587	170,257	260,059	272,911	290,720
2005	116,658	289,140	286,241	228,636	362,503	363,824	371,687
2006	129,461	389,815	352,326	293,778	502,826	467,578	465,082
2007	145,214	390,740	347,789	297,625	505,532	456,356	473,449
2008	146,720	235,651	206,100	133,340	259,860	244,601	253,111
2009	157,772	306,940	285,815	195,436	356,337	367,870	369,461
2010	181,291	391,768	352,857	261,082	474,552	477,934	510,668
2011	195,369	360,214	324,025	210,443	400,378	404,561	433,718
2012	209,341	422,052	395,689	250,452	491,250	498,544	535,986
2013	217,562	507,482	465,189	319,165	561,690	591,412	622,903
2014	228,922	530,849	462,729	326,072	549,753	567,465	592,942
2015	251,314	613,968	521,098	390,256	587,480	644,968	667,414
2016	267,541	651,878	573,233	440,272	644,088	676,112	709,246
2017	279,483	776,188	701,964	513,879	751,910	775,024	830,632
2018	319,980	710,601	577,579	444,365	639,055	670,040	731,992



Note: The table values are in Euros/million. The grouped bar graph reports the same values as the table in a graphical way. The curves in the second graph report the relative $(EBS\%_y^x)$ *as calculated in equation (6b).*

Table 9. Balance sheet Portfolio M values

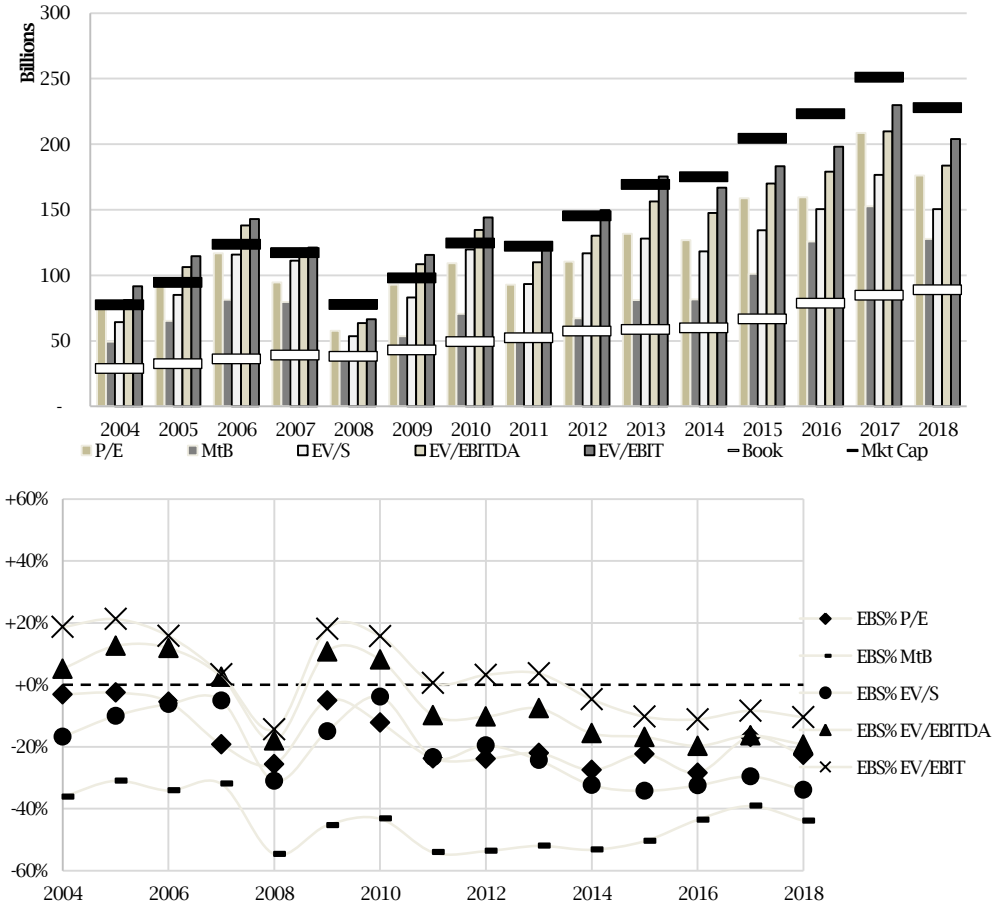
Year	*Book*	*Mkt Cap*	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2004	35,128	90,188	93,370	60,210	107,942	107,511	125,959
2005	39,049	109,469	117,179	78,271	139,080	133,902	149,984
2006	43,183	138,403	131,806	97,421	183,398	161,913	169,090
2007	55,524	138,879	123,061	108,620	190,655	162,235	173,022
2008	52,391	82,656	71,401	45,835	110,429	88,467	96,676
2009	57,093	105,993	101,597	69,841	144,585	126,359	136,264
2010	66,252	140,762	135,696	93,568	193,270	166,851	183,561
2011	73,815	131,670	117,141	78,462	162,101	142,772	161,267
2012	75,005	155,668	122,710	88,892	190,275	160,200	182,120
2013	76,178	190,887	154,252	107,958	203,334	185,039	205,283
2014	78,206	189,047	158,341	108,003	192,338	179,810	202,554
2015	85,801	219,111	181,077	130,904	213,080	207,721	230,047
2016	90,272	236,166	183,943	144,876	238,258	212,690	235,446
2017	92,613	266,412	210,810	163,506	279,189	232,231	251,310
2018	102,107	247,631	178,418	139,653	257,812	215,047	231,561



Note: The table values are in Euros/million. The grouped bar graph reports the same values as the table in a graphical way. The curves in the second graph report the relative $(EBS\%_y^x)$ *as calculated in equation (6b).*

Table 10. Balance sheet Portfolio S values

Year	*Book*	*Mkt Cap*	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2004	28,845	77,335	74,916	49,285	64,332	81,267	91,733
2005	32,551	94,558	92,123	65,232	85,064	106,399	114,617
2006	36,152	123,487	116,683	81,291	115,753	138,128	142,950
2007	39,114	117,228	94,596	79,706	111,183	120,219	121,145
2008	38,092	77,697	57,779	35,181	53,564	63,648	66,469
2009	43,017	97,854	92,858	53,454	83,159	108,377	115,506
2010	49,364	124,507	109,238	70,641	119,651	134,591	144,041
2011	52,104	121,933	92,928	55,952	93,337	109,915	122,675
2012	57,246	145,157	110,360	67,146	116,716	130,234	149,764
2013	58,675	169,158	131,809	81,157	127,959	156,255	175,305
2014	59,775	174,967	126,756	81,739	118,241	147,535	166,732
2015	66,585	204,377	158,706	101,131	134,376	169,928	183,321
2016	78,470	223,041	159,621	125,748	150,456	178,962	198,115
2017	84,603	250,990	208,649	152,690	176,654	209,827	229,960
2018	88,823	227,791	176,198	127,721	150,447	183,775	203,892



Note: The table values are in Euros/million. The grouped bar graph reports the same values as the table in a graphical way. The curves in the second graph report the relative $(EBS\%_y^x)$ *as calculated in equation (6b).*

4.3.2. Effect on the income statement

In this paragraph, we report the value of the variation to record in the income statement under each different market multiple. Table 11 presents the results for Portfolio L, in Table 12, the results for Portfolio M, and in Table 13, the results for Portfolio S.

In the first graph, the black dash reports the cumulated variation in market capitalization between two years, thus the Level 1 fair value of the portfolio, which is our analysis benchmark. The bars report the cumulated variation in Level 2 fair values between years.

In the second graph, we represented the trend of the relative extra effect on the income statement for each multiple $(EIS\%_y^x)$ as calculated in equation (7b). The dashed line at + 0% represents the trend of the market capitalization. The calculated extra effect is a relative measure; a positive value represents a recorded Level 2 profit greater than the recorded Level 1 profit, or a Level 2 profit instead of a Level 1 loss. On the other hand, a negative value represents a recorded Level 2 loss larger than the recorded Level 1 loss, or a Level 2 loss instead of a Level 1 profit.

Being the effect on each market's income statement multiple due to the variation of the fair value between two years, the general trend that can be caught is the same as for the balance sheet.

The data to focus on is the relative extra-effect that the market multiples introduce into the income statements compared with the market capitalization. In a few cases, we point out that market multiples' profit or loss is akin to the profit or loss generated by market capitalization. The portfolio size seems not to neutralize the trend of difference and thus plays a smaller role in this case.

We highlight a time-related effect, especially during crises, where the market multiples induce relatively enormous differences in the profits or losses: in these years, market capitalization tends to decrease compared to previous years.

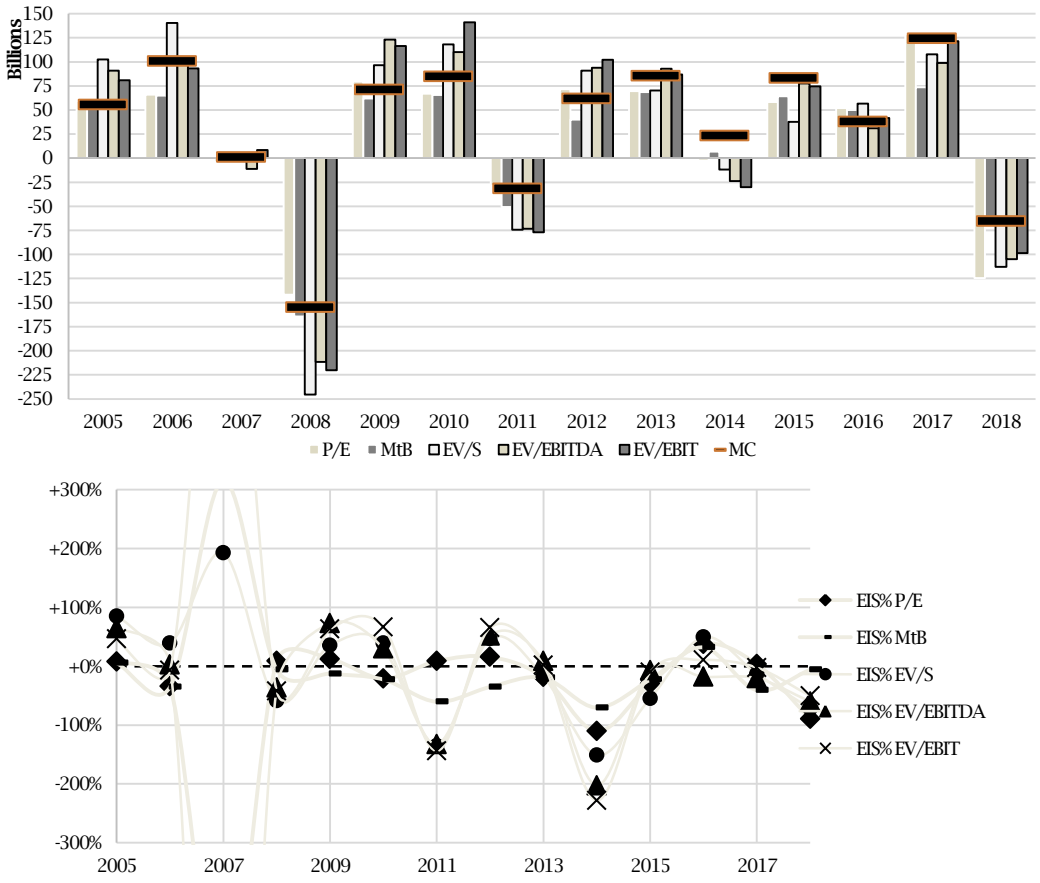
Looking at the years 2007, 2011, and 2018, the market capitalization in almost all the portfolios records a loss. We can notice that in the same years, for almost all the market multiples and across the portfolios, the loss is amplified and is highly severe or even inverted by recorded profits.

These amplifications/inversions introduce a bias in the income statement and a procyclical effect during crises that can reduce companies' net results and thus worsen the crisis for a mere valuation choice that does not reflect an economic reason. Moreover, the differences can unpredictably vary from large underestimations to large overestimations.

The difference is not due to firm-specific risks, nor leverage risks, nor systematic ones. On the contrary, this difference is recorded in the income statement because the sole reason for adopting a different valuation method is accepted by the accounting standards (and in some cases preferred, mainly where no market capitalization or price is available).

Table 11. Income statement Portfolio L values

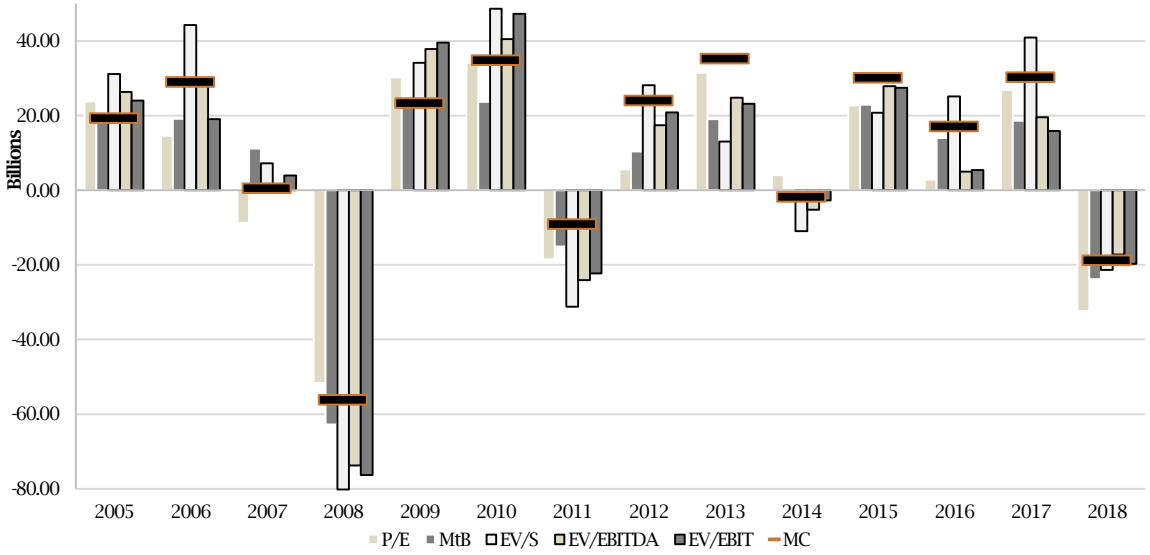
Year	*MC*	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2005	55,427	59,654	58,379	102,443	90,913	80,967
2006	100,675	66,085	65,141	140,323	103,755	93,394
2007	925	-4,537	3,847	2,706	-11,223	8,367
2008	-155,089	-141,688	-164,284	-245,671	-211,755	-220,337
2009	71,289	79,714	62,096	96,477	123,269	116,350
2010	84,827	67,043	65,645	118,215	110,065	141,207
2011	-31,553	-28,833	-50,639	-74,175	-73,373	-76,951
2012	61,838	71,664	40,009	90,872	93,982	102,269
2013	85,430	69,500	68,713	70,440	92,869	86,917
2014	23,367	-2,461	6,908	-11,938	-23,947	-29,961
2015	83,119	58,369	64,184	37,727	77,503	74,472
2016	37,910	52,135	50,016	56,608	31,144	41,832
2017	124,310	128,731	73,607	107,822	98,912	121,386
2018	-65,587	-124,385	-69,514	-112,855	-104,984	-98,640

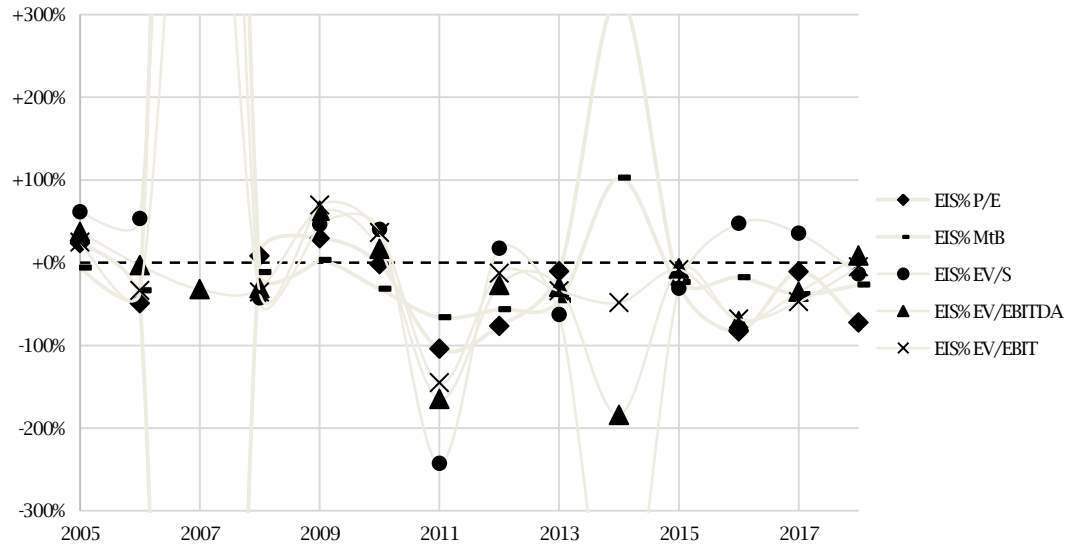


Note: The table values are in Euros/million. The grouped bar graph reports the same values as the table in a graphical way. The curves in the graph report the relative $(EIS\%_y^x)$ *as calculated in equation (7b).*

Table 12. Income statement Portfolio M values

Year	*MC*	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2005	19,281	23,810	18,060	31,138	26,391	24,025
2006	28,934	14,627	19,150	44,318	28,011	19,105
2007	476	-8,745	11,200	7,257	322	3,933
2008	-56,223	-51,660	-62,785	-80,226	-73,768	-76,347
2009	23,337	30,195	24,007	34,156	37,892	39,588
2010	34,769	34,099	23,727	48,685	40,492	47,297
2011	-9,092	-18,554	-15,106	-31,169	-24,079	-22,294
2012	23,998	5,568	10,430	28,174	17,428	20,853
2013	35,219	31,543	19,066	13,059	24,839	23,164
2014	-1,840	4,089	45	-10,996	-5,228	-2,729
2015	30,063	22,736	22,901	20,742	27,911	27,493
2016	17,055	2,866	13,972	25,178	4,969	5,399
2017	30,247	26,867	18,630	40,931	19,541	15,864
2018	-18,782	-32,392	-23,853	-21,378	-17,184	-19,750

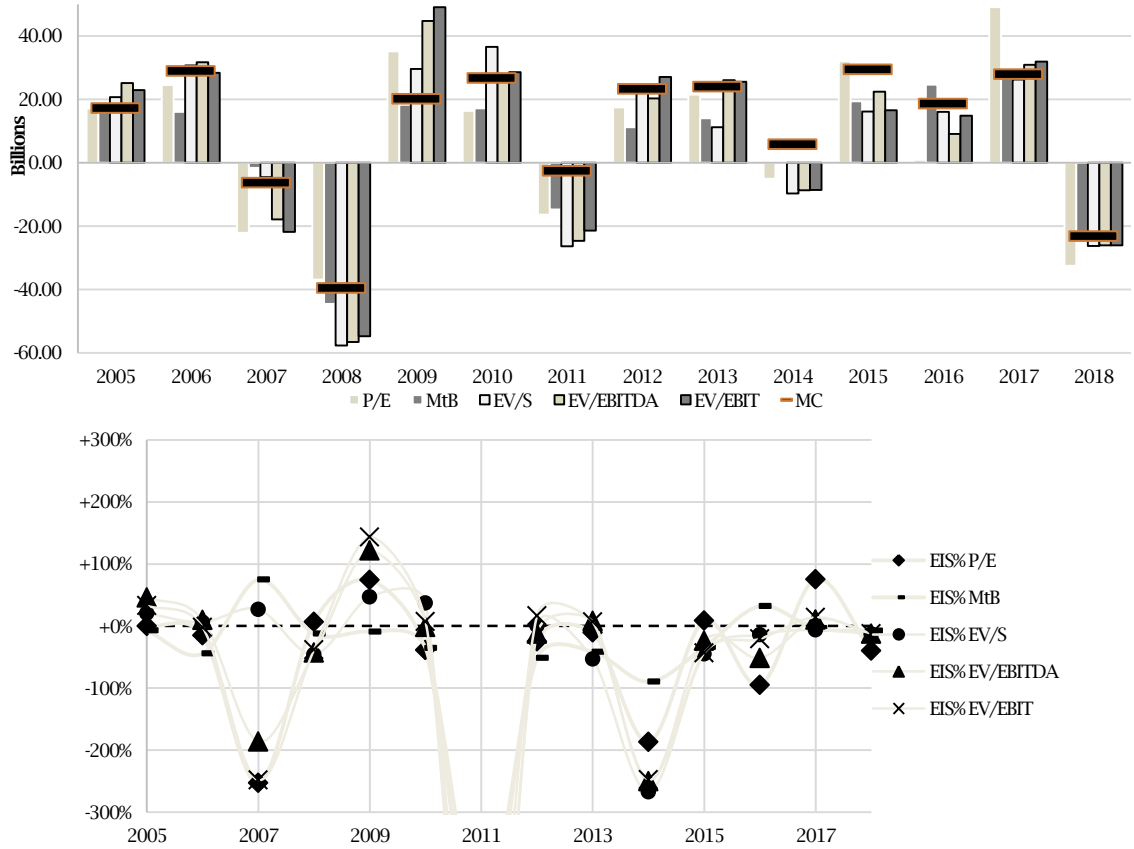




Note: The table values are in Euros/million. The grouped bar graph reports the same values as the table in a graphical way. The curves in the graph report the relative $(EIS\%_y^x)$ as calculated in equation (7b).

Table 13. Income statement Portfolio S values

Year	*MC*	*P/E*	*MtB*	*EV/S*	*EV/EBITDA*	*EV/EBIT*
2005	17,224	17,208	15,947	20,732	25,132	22,884
2006	28,929	24,559	16,059	30,689	31,730	28,333
2007	-6,259	-22,086	-1,585	-4,570	-17,909	-21,806
2008	-39,531	-36,817	-44,525	-57,619	-56,571	-54,676
2009	20,158	35,079	18,272	29,595	44,729	49,037
2010	26,653	16,381	17,187	36,491	26,214	28,536
2011	-2,574	-16,311	-14,689	-26,313	-24,676	-21,366
2012	23,223	17,433	11,195	23,379	20,319	27,089
2013	24,001	21,449	14,010	11,243	26,020	25,540
2014	5,809	-5,053	582	-9,718	-8,719	-8,573
2015	29,410	31,951	19,392	16,135	22,393	16,589
2016	18,664	915	24,617	16,079	9,034	14,794
2017	27,950	49,028	26,942	26,198	30,865	31,845
2018	-23,199	-32,451	-24,969	-26,206	-26,051	-26,068



Note: The table values are in Euros/million. The grouped bar graph reports the same values as the table in a graphical way. The curves in the graph report the relative $(EIS\%_y^x)$ *as calculated in equation (7b).*

4.3.3. Overall effect and reliability of the market multiples

In this section, we compare the relative $EBS\%_y^x$ and $EIS\%_y^x$ across the years and the different market multiples, to summarize the overall reliability of the market multiples fair values and outline the presence of time-related and portfolio effects.

Table 14 reports the relative effect of each of the different market multiples on both the balance sheet and the income statement, in percentages. A difference of up to ± 5% means that the market multiples fair value is very close to the market capitalization, and thus the valuation is reliable. A difference of up to ± 15% is still acceptable in theory.

A difference of more than ± 15% means that the estimated Level 2 fair value is not close to Level 1 fair value and thus should not be accepted to avoid introducing values not linked to economic justifications into financial statements.

We highlight that the effect on income statements is sometimes abnormal (years 2007, 2011, 2014, and 2018), since in those years, as reported in the previous paragraph, the variation of market capitalization is small. For this reason, the ratio has a number at the denominator that is far lower than the numerator, generating high percentages.

As already pointed out in the previous paragraphs, the balance sheet's effect is influenced by time and portfolio size, while the income statement's effect seems to be influenced only by the year.

Price-to-forecasted earnings are the market multiple that produces the highest number of "acceptable" measurements in the balance sheet (14 out of 15 in Portfolio L), and it is affected by portfolio size (8 out of 15 in M and 5 out of 14 in S).

For this reason, the mean value of the *EBS%* is acceptable, with a low standard deviation.

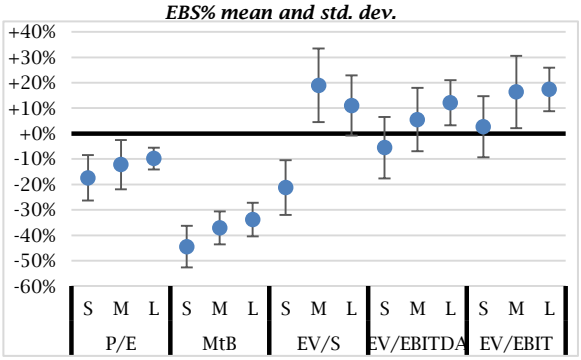
However, the P/E multiple introduces large volatility in the economic returns: the "reliability" shown for the balance sheet does not reflect on the income statement, which is in many cases severely under or overvalued, amplifying crises by introducing considerable losses in the income statements. The mean value of the *EIS%* is also affected by the portfolio's composition, and the standard deviation is quite pronounced.

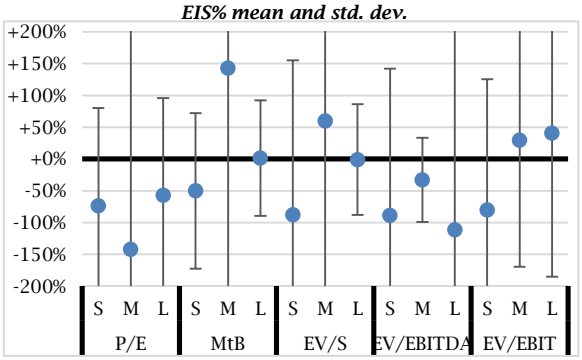
On the other hand, the market-to-book multiple does not produce any "acceptable" balance sheet value by frequently producing underestimated fair values with a low standard deviation. In the meantime, the income statement's effect is just as pronounced as the other multiples; in Portfolio L, it is, on average, relatively small and with an acceptable standard deviation. This market multiple, thus, tends to produce underestimations that are, on the other hand, less volatile than the market capitalization.

Lastly, the enterprise value to performance multiples produces an "acceptable" fair value in fewer cases than price-to-earnings, particularly by overestimating it (almost all the mean *EBS%* are greater than + 0%). The enterprise value multiples seem to overestimate more in larger portfolios and to produce better results in smaller ones. EV/S tends to undervalue smaller portfolios. However, all three EV-to-performance multiples behavior seem to be quite unpredictable. The descriptive statistics of the extracted general sample (reported in Sub-section 4.2) returned high values of kurtosis and skewness of the distribution, suggesting the generation of many outliers. The next figures serve as an immediate vehicle to represent the different market multiples' overall reliability.

Table 14. Relative $EBS\%_y^x$ as calculated in equation (6b)

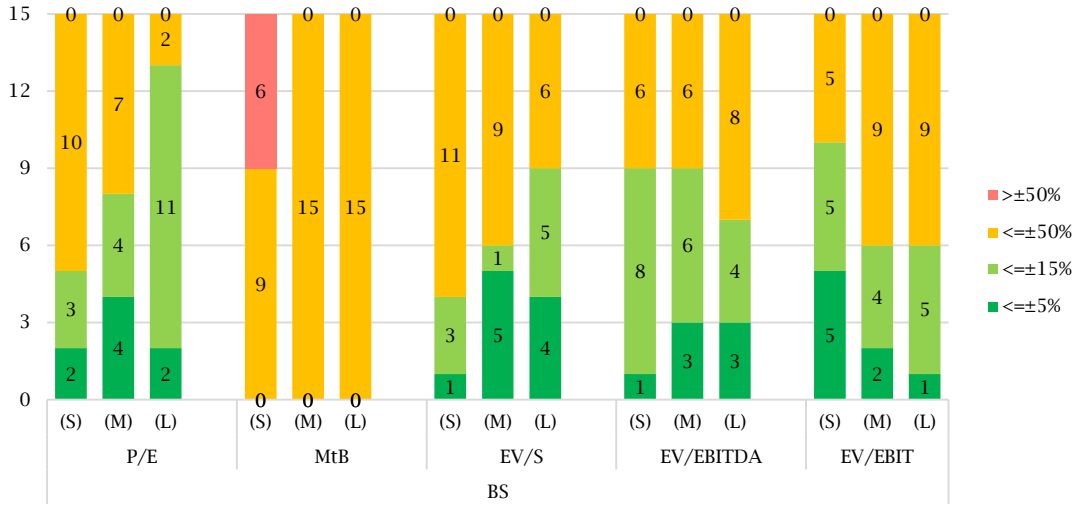
		'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18
Price-to-earnings																
S	*EBS%*	**-3**	**-3**	**-6**	-19	-26	**-5**	**-12**	-24	-24	-22	-28	-22	-28	-17	-23
	EIS%		**-0**	**-15**	-253	**+7**	+74	-39	-534	-25	**-11**	-187	**+9**	-95	+75	-40
M	*EBS%*	**+4**	**+7**	**-5**	**-11**	**-14**	**-4**	**-4**	**-11**	-21	-19	-16	-17	-22	-21	-28
	EIS%		+23	-49	-1939	**+8**	+29	**-2**	-104	-77	**-10**	+322	-24	-83	**-11**	-72
L	*EBS%*	**-3**	**-1**	**-10**	**-11**	**-13**	**-7**	**-10**	**-10**	**-6**	**-8**	**-13**	**-15**	**-12**	**-10**	-19
	EIS%		**+8**	-34	-591	**+9**	**+12**	-21	**+9**	**+16**	-19	-111	-30	+38	**+4**	-90
Market-to-book																
S	*EBS%*	-36	-31	-34	-32	-55	-45	-43	-54	-54	-52	-53	-51	-44	-39	-44
	EIS%		**-7**	-44	+75	**-13**	**-9**	-36	-471	-52	-42	-90	-34	+32	**-4**	**-8**
M	*EBS%*	-33	-28	-30	-22	-45	-34	-34	-40	-43	-43	-43	-40	-39	-39	-44
	EIS%		**-6**	-34	+2255	**-12**	**+3**	-32	-66	-57	-46	+102	-24	-18	-38	-27
L	*EBS%*	-27	-21	-25	-24	-43	-36	-33	-42	-41	-37	-39	-36	-32	-34	-37
	EIS%		**+5**	-35	+316	**-6**	**-13**	-23	-60	-35	-20	-70	-23	+32	-41	**-6**
EV-to-sales																
S	*EBS%*	-17	**-10**	**-6**	**-5**	-31	**-15**	**-4**	-23	-20	-24	-32	-34	-33	-30	-34
	EIS%		+20	**+6**	+27	-46	+47	+37	-922	**+1**	-53	-267	-45	**-14**	**-6**	**-13**
M	*EBS%*	+20	+27	+33	+37	+34	+36	+37	+23	+22	**+7**	**+2**	**-3**	**+1**	**+5**	**+4**
	EIS%		+61	+53	+1426	-43	+46	+40	-243	+17	-63	-498	-31	+48	+35	**-14**
L	*EBS%*	**+11**	+25	+29	+29	**+10**	+16	+21	**+11**	+16	**+11**	**+4**	**-4**	**-1**	**-3**	**-10**
	EIS%		+85	+39	+193	-58	+35	+39	-135	+47	-18	-151	-55	+49	**-13**	-72
EV-to-EBITDA																
S	*EBS%*	**+5**	**+13**	**+12**	**+3**	-18	**+11**	**+8**	**-10**	**-10**	**-8**	**-16**	-17	-20	-16	-19
	EIS%		+46	**+10**	-186	-43	+122	**-2**	-859	**-13**	**+8**	-250	-24	-52	**+10**	**-12**
M	*EBS%*	+19	+22	+17	+17	**+7**	+19	+19	**+8**	**+3**	**-3**	**-5**	**-5**	**-10**	**-13**	**-13**
	EIS%		+37	**-3**	-32	-31	+62	+16	-165	-27	-29	-184	**-7**	-71	-35	**+9**
L	*EBS%*	+17	+26	+20	+17	**+4**	+20	+22	**+12**	+18	+17	**+7**	**+5**	**+4**	**-0**	**-6**
	EIS%		+64	**+3**	-1313	-37	+73	+30	-133	+52	**+9**	-202	**-7**	-18	-20	-60
EV-to-EBIT																
S	*EBS%*	+19	+21	**+16**	**+3**	**-14**	+18	**+16**	**+1**	**+3**	**+4**	**-5**	**-10**	**-11**	**-8**	**-10**
	EIS%		+33	**-2**	-248	-38	+143	**+7**	-730	+17	**+6**	-248	-44	-21	**+14**	**-12**
M	*EBS%*	+40	+37	+22	+25	+17	+29	+30	+22	+17	**+8**	**+7**	**+5**	**-0**	**-6**	**-6**
	EIS%		+25	-34	+727	-36	+70	+36	-145	**-13**	-34	-48	**-9**	-68	-48	**-5**
L	*EBS%*	+24	+29	+19	+21	**+7**	+20	+30	+20	+27	+23	**+12**	**+9**	**+9**	**+7**	**+3**
	EIS%		+46	**-7**	+805	-42	+63	+66	-144	+65	**+2**	-228	**-10**	**+10**	**-2**	-50





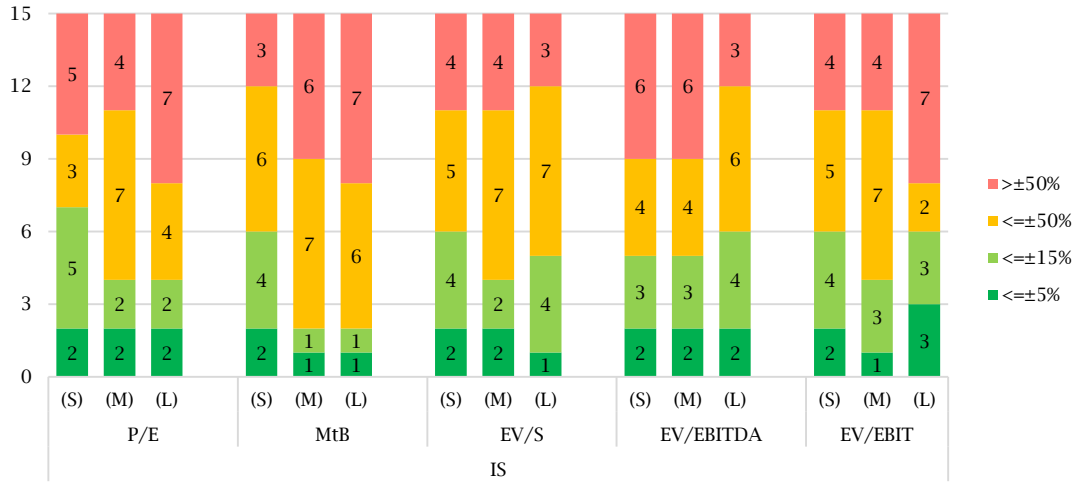
Note: $EIS\%_y^x$ as calculated in equation (7b) for each multiple, in the different portfolios, by year. The numbers are percentages; the % symbol has been removed for clarity.

Figure 3. Number of years in which the (absolute) value of the portfolio in the balance sheet falls in the specified *EBS%* range.



Note: The larger ranges exclude the smaller ones.

Figure 4. Number of years in which the (absolute) value of the portfolio variation reported in the income statement falls in the specified *EIS%* range



Note: The larger ranges exclude the smaller ones.

5. MAIN RESULTS AND DISCUSSION

Previous studies on the accounting effect of relative valuation highlighted that multiples' fair value seems not to provide a reliable measure of a company's equity value, with a gap that varies depending upon portfolios and time.

This paper's analyses and findings expand and deepen the seminal study included in previous work (Palea et al., 2019) by simulating a real-life setting and extensively determine the introduction of unintended biases in relative equity valuation and the impact of this distortion.

We replicated the whole valuation process, from peer selection to equity value calculation with the most employed multiples, based on data from listed companies of the European area over a 15-year-period. Consistently with the extant literature, we consider a valuation method "reliable" when it estimates a fair value in a range of ± 15% from the Level 1 fair value (market capitalization).

By analyzing the cumulated frequencies, the first impression is that the most used market multiples (P/E and EV/S) tend to estimate, by-and-large, 7 out of 100 correct (in a range of 5%) and circa 20% of "acceptable" (in a range of 15%) fair value estimations, at the cost of significantly "misrepresenting" the equity value in more or less 40% of cases. The distribution of estimated value to market cap ratios is somewhat dispersed around the mean, with a long right tail of extreme results and many outliers. There is a statistically significant difference between estimated fair value and market capitalization.

This difference suggests that under or overestimations happen far more by chance than for actual economic reasons. Moreover, the differences can unpredictably vary from large underestimations to large overestimations.

This result is consistent with that of Lie and Lie (2002) and Kim and Ritter (1999), who found that the most employed market multiples (price-to-

earnings (P/E), enterprise-value-to-sales, enterprise-value-to-EBIT(DA)) tend to bias the valuations by introducing estimation errors that are not influenced by the cash levels of the company. They also pointed out that the estimation errors are significantly conditioned by the size of the company, its profitability, and the extent of the intangible value.

The simulation of portfolio values highlights that almost no fair values determined with market multiples return similar results to the price-based fair value. The P/E fair value (based on forecasted earnings) produces the most consistent and less variating difference to the market capitalization in all three portfolios from a balance sheet perspective. This result confirms what Kim and Ritter (1999) highlighted about the poor performance of market multiples based on historical data as input for the valuation.

A portfolio size effect increases the apparent "reliability" of the multiple in larger portfolios, with larger fluctuations in the smaller ones. This effect is predictable because it is well known that diversification tends to reduce risk and thus compensate and level out firm-level differences. On the contrary, there is a little time-related effect, signaling that P/E multiple is more capable of absorbing general market trends and, particularly in the larger portfolios, there are no crises-related plunges in 2007–2008 and 2011–2012.

The market-to-book multiple tends to produce the most inconsistent results by inducing a considerable underestimation comprised in a range of -20% to -40% from the market capitalization. Also, even in Portfolio L, there is a plummet in 2008 that even worsens this underestimation. The enterprise value to performance multiples tends to overestimate the fair value in the first period of analysis, with slopes in 2008 and 2011 and a decreasing trend in the "recovery" period. EV/S is the most variable of the three that achieves both the larger overestimations during the initial period and some underestimations during the last period. EV/EBITDA has a slightly better and less variable trend, while EV/EBIT tends to be less variable but mostly prone to overestimation if compared to its sibling.

On the income statement, on the other hand, we highlight a time-related effect, especially during crises, where the market multiples induce relatively enormous differences in the profits or losses since the variation in market capitalization is relatively small. In some cases, there is also an "inversion" of sign from profit to loss and vice versa. These amplifications/ inversions introduce a bias in the income statement and a procyclical effect during crises that can reduce companies' net results and thus worsen the crisis for a mere valuation choice that does not reflect an economic reason. For effect on income statements in the years 2007, 2011, 2014, and 2018, the relative under or overestimation is abnormal. In those years, as reported in the previous paragraph, the variation of market capitalization is small, and thus the ratio has a number at the denominator that is far lower than the numerator, generating high percentages.

Price-to-forecasted earnings are the market multiple that produces the highest number of "acceptable" fair value estimates in the balance sheet, and it is affected by portfolio size. For this reason, the mean value of the relative effect on the balance sheet is acceptable, with a low standard deviation. The "reliability" does not reflect on the income statement, which is in many cases severely or overvalued, amplifying crises by introducing considerable losses in the income statements. The mean value of the relative effect on the income statement is also affected by the portfolio's composition, and the standard deviation is quite pronounced.

On the other hand, the market-to-book multiple does not estimate any "acceptable" balance sheet value by regularly producing underestimated fair values with a low standard deviation. In the meantime, this market multiple tends to produce (under)valuations that are less volatile than market capitalization.

Eventually, all the three EV-to-performance multiples seem to be quite unpredictable in their behavior, seemingly overvaluing more in larger portfolios and producing better results in smaller ones, while EV/S tends to undervalue smaller portfolios.

In practical terms, consistently with what Palea and Maino (2013) highlighted, the results of this research suggest that the measurement of fair value based on market multiples fails to take into account company-specific risk factors, generating values that are inconsistent with the market price and apparently not based on real economic reasons.

6. CONCLUSION

The main results of the research conducted by replicating the practitioners' most employed relative valuation methods point out that the estimation of Level 2 fair values can unpredictably produce any possible result: in some cases, one out of five, the market multiples correctly estimate the fair value; in other cases, there is a slight under or overvaluation; in several cases, the misestimation is large.

The overall most used multiple (price to forecasted earnings) produces reliable portfolio fair values in the balance sheet on a portfolio basis. However, it fails to represent the variation, introducing elements of volatility in the income statement related solely to a different valuation method's choice.

For valuation purposes, thus, market multiples seem to have both pros and cons. On the one hand, they produce quick and easy valuations, particularly when adopting multiples extracted from analysts' bulletins and reports, such as FitchRatings or other ones. Moreover, market multiples and relative valuation are preferred under an International Accounting Standards perspective.

On the other hand, market multiples (particularly the most used ones) tend to produce misestimations derived from several different reasons, such as the peers' selection process, intrinsic market volatility and systemic risks, and economic fundamentals of the company, the market multiple calculation process. Moreover, the market multiples are an average measure (usually, simple mean or median) that flatten the peers' different peculiarities and exclude the firm's specific fundamentals and value indicators.

The originality of this study, compared to previous ones, is to comprehensively analyze the most used Level 2, market-based, fair value measures by simulating a real-life setting to test market multiples reliability and the potential

impacts on the financial statement of an investor by using Level 1 and Level 2 methods. Consistently with the extant literature, we consider a valuation method "reliable" when it estimates a fair value in a range of ± 15% from the Level 1 fair value (market capitalization).

This study's practical implication is to be cautious in applying the market multiples valuation method in estimating the fair value of equity investment; this is particularly important considering the preference that accounting principles accord to the Level 2 market-comparable methods, which also seems to be the most used ones in practice.

The main limitation of this study is that the behavior of the valuation instrument is studied, but the underlying reasons for the distortions caused by the market multiples method have not been determined, and the financial statement and management variables of the company that tends to have the most significant influence have not been studied. In addition, the market multiples method tends to be the "preferred" valuation criterion for unlisted companies, which have different characteristics than public companies, and which were not considered in depth in this study.

Further studies on this topic should address the problem under several different perspectives to test and highlight both the misestimation drivers and how to correct them, enhancing the multiples method to better represent the market price by introducing corrections. In addition, further studies could focus on exchanges and acquisitions of unlisted companies, in order to test the correctness of the market multiples method with respect to the actual transaction price.

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