Punto de vista

Analysis of the cyclically adjusted price-earnings index in the Latin American Integrated Market stock markets, 2011-2019

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Abstract

This research examines the validity of the cyclically adjusted price-earnings indicator (CAPE) in Latin American Integrated Market (MILA) countries' stocks, identifying stock market overvaluation or undervaluation 2011 - 2019. A synthetic index was created with ten stocks for each country with the highest presence 2001 - 2010 and with a correlation higher than 97% with its stock market. The representativeness of the selected stocks was verified by calculating the correlation coefficient with respect to the reference index of each market. Once the assets were selected, the PER

and CAPE of each was calculated for 2011-2019. Then, using weights, the P/E and CAPE were constructed by identifying undervaluation or overvaluation. The results indicate that these markets tend to remain overvalued, with Mexico being the most overvalued, while Peru is undervalued. Additionally, when comparing the CAPE with the returns of each market, the only one with consistency was the Peruvian market

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The subjectivity with which these markets are managed leads to making erroneous decisions when investing or operating in the stock market, hence the importance of using this type of indicators that reduce the level of uncertainty and therefore the importance of this research by contributing to the literature, practical application and usefulness of this type of financial instruments.

JEL classification

G12

F36

Keywords

Equities, equity pricing, price earnings, financial integration markets

Abbreviations

PER: Price to earnings ratio

CAPE: Cyclically Adjusted Price to Earnings

MILA: MILA Latin American Integrated Market

1.Introduction

Recessionary processes, their magnitude and global reach, are a byproduct of both crises of the world financial system and general problems related to civilization, Shavshukov (2020). On a global scale, the scope, impact, severity, and speed at which economic crises spread are increasing at an accelerated pace, Frijorek (2021). Events such as the dot-com bubble and the collapse of the American financial system in 2008, along with the subprime mortgages debacle, which reflected infection in the financial system due to excess leverage and poor-quality mortgage loans, Spatt (2020).

These situations have prompted several business adjustments in different industries such as mining, commerce and, of course, finance, in stock market negotiations due to financial globalization. In the case of Latin America, a strategic alliance emerged between the stock markets from Colombia, Chile, Peru, and Mexico, creating the Latin American Integrated Market (MILA). This led to changes in both the stock market and the companies affected by it, who tried to develop strategies that would allow them to remain competitive, Yepes (2015).

The stock market is constantly evolving due to political, social, economic, environmental, and financial (fundamental). Psychology and its relevance in relationship to human behavior with respect to financial markets, which is sometimes unfounded, may also incite change by leading to economic bubbles when there is a fear that the market may reach high and unsustainable price levels a consequence of making financial decisions under irrational exuberance and not as a product of the market psychology, which prioritizes certainty over uncertainty, Shiller (2000). However, analysis of stock forecasts can help to understand the emotions of these agents, and because of this, that irrational exuberance can be appeased, Bari (2019). Hence the importance of studying and analyzing the stock market, as research on future stock prices produces more accurate, responsible predictions with greater objectivity and certainty, Uma (2021).

This research has an important social impact since it considers stock market investors who can use the findings of this research as a basis for making decisions based on financial intelligence that will lead to positive results in terms of expected returns in accordance with their objectives. Uncertainty cannot prevail entirely in stock market negotiations and hence the importance of knowing about these financial tools that help predict the possible behavior of financial assets in an increasingly convulsed and volatile world.

There are a variety of methodologies for stock valuation; The Price earnings ratio (PER) method, is the most widely used; It compares the current price of a stock with its net income; Derived from PER, a new indicator emerged, called the Shiller P/E, commonly known as the cyclically adjusted price-to-earnings ratio (CAPE), Shiller (2000), which uses a real net income adjusted for inflation over the last ten years.

This research seeks, through the application of the CAPE, to determine if the stock markets that make up the MILA are overvalued; and, based on this, to determine whether this indicator works as a predictor of the stock price estimates that explain such overvaluation. For this purpose, the CAPE was calculated and, additionally, a synthetic index was built based on the stocks from the sample with the largest market capitalization and with presence in the stock market between January of 2001 and December of 2010.

The CAPE was then used to determine whether the analyzed stocks are overvalued and based on this, the efficiency of the model for the 2011-2019 period was evaluated, by assessing if it is indeed applicable in the valuation of MILA stocks by analyzing their behavior at moments of economic expansion and recession. As a result, it was identified that except for the Peruvian stock market, the markets that make up the MILA show a sustained tendency to overvaluation, accentuated for the case of the Mexican market. However, when evaluating the predictive capability of the CAPE it was observed that the only one that delivers consistent results is the Peruvian market.

2. Theoretical Framework

2.1 Price-to-earnings ratio, PER (P/E)

The PER is defined as the market value of a stock, calculated through the ratio of the stock price to the earnings per share; This ratio is called the price-earnings (P/E) ratio, Goud (2020). Thus, this indicator establishes a relationship between price per share and net earnings per share. Hence, the PER indicates the number of years in which an investment in the purchase of stocks is recovered, considering the profits of the company. This indicator, by considering in its calculation both the price and the earnings per share, yields a result relative to the overvaluation or undervaluation of the company.

The formula that is used for this indicator is as follows:

PER=Price per share / Earnings (1)

According to the equation, a high value of this indicator shows that the market is willing to wait for a longer time to recover the investment, and it could potentially show signs of an overvalued asset, while a lower value indicates the opposite. The PER can indicate signs of overvaluation or undervaluation if, when calculating the mean and the standard deviation, the PER tends to revert to the mean x.

Therefore, a fundamental element of the analysis, is that it is based on the moving averages, also known as moving means. This indicator and the relevance of its applicability in the market are related to the CAPE, since it works as a moving average. In other words, the CAPE compares the behavior of the PER with its historical average adjusted for inflation, so that if the indicator increases considerably, future returns will be low. The opposite will happen with these returns if the indicator is at levels below its average.

Thus, moving averages make it possible to determine the level of correction needed for the price of a share with respect to the mean; Such indicators are of utmost importance and even more so if taken over a medium and long-term analysis timeframe; moving averages give fewer false signals on medium-term timeframes than on short-term timeframes, Nickolaevich (2020). These averages are one of the oldest indicators used for technical analysis of price prediction of different financial assets; Traditional methods, such as the simple moving average (SMA), the weighted moving average (WMA) and the exponential moving average (EMA) demonstrate their predictive power in a variety of time series data, Jeremy (2019). In this regard, there are different types of moving averages, among them, the SMA and EMA, which differ mainly in the type of data they use, since the EMA uses only the latest stock data, while the SMA uses all data, Mubarak (2020), this means that the EMA places greater importance on the more recent stock prices, and because of this, the EMA reacts more quickly to current stock price changes than the SMA.

2.2 Cyclically adjusted price-to-earnings ratio (CAPE)

In 2013, economist Robert James Shiller created a new stock market valuation index, which he called the Shiller PER ratio, also known as the Cyclically Adjusted Price to Earnings Ratio (CAPE). The big difference between CAPE and PER is the inclusion of inflation and the 10-year time horizon.

Therefore, the CAPE is one of the available mechanisms to determine the overvaluation of a stock through market multiples or market value ratios, Shiller (2000), by calculating an adjusted PER, anticipated the bursting of the dot-com bubble in the year 2000. This index is obtained by dividing the stock price chart of the S&P (Standard & Poor´s) index by the total return index (moving average of a decade), both deflated, adjusted for inflation, Schuldt (2011). The adjustment for inflation in each period makes it possible to convert the value to current prices; After performing this adjustment to the earnings of the last ten years, the average value

is calculated by adding all this values and dividing them by ten, the number of years considered for the analysis. Finally, the current price of the stock is divided by the previously calculated average value of the converted earnings to obtain the CAPE.

As can be seen, the first approach to the definition of the CAPE alludes to the existing relationship between stock price and real net earnings, it is pertinent to investigate and further explore this relationship, by analyzing the impact that profits (included in the calculation of earnings) have in the price of a stock. Naturally, the literature approaches different markets, case studies, and the use of different indicators and metrics, where, of course, the results show both positive and negative conclusions about the existence of this relationship. In this regard, Sinurat (2020) studied, on the one hand, the effect of the EVA, Return on Equity, and Earnings per Share on stock prices and, on the other hand, analyzed the role of the price-earnings ratio as a mediating variable in the relationship between said variables. According to Sinurat (2020) stated in the case of earnings per share, this has a positive and relevant impact on the stock price. Additionally, they point out that the price-earnings ratio variable does not partially or simultaneously moderate the analogy of the other variables with respect to stock prices. Likewise, Siauwijaya (2020), analyzed the price-earnings ratio for the case of banking companies listed on the Indonesian Stock Exchange, where, the obtained results indicate that bank efficiency does not influence stock returns; However, regarding net earnings per share and price-earnings ratio, they do have a positive impact on stock returns. According to Astuty (2017), furthermore, analyzed the effect of fundamental factors on the LQ45 index of the Indonesian Stock Exchange, obtaining results that indicate the existence of a relevant influence of the price-earnings ratio, earnings per share, net profit margin and systematic risk on the stock price of the companies listed on that index. Similarly, Lashgari (2016), analyzed the level of predictability of variations in long-term stock returns, and noted that the earnings growth, factors that lead to permanent adjustments in earnings per share, as well as variations in valuation multiples such as the price-earnings ratio, have, from an economic and statistical perspective, a notable effect on the returns obtained from common stock.

Regarding the region, According to Amorim (2020), in a study on the price-earnings ratio in the Brazilian stock market, specifically in the main index of the Brazilian stock market, which is the Ibovespa, evaluated the evidence of the long-term equilibrium relationship between the stock price index and the earnings per share index, where, indeed, the time series in which the analysis was performed with these indexes showed cointegration.

On the contrary, according to Nautiyal (2018) in their study about the effect of institutional variables in the stock returns of the companies listed on the Indian NIFTY 50 benchmark index, between 1995 and 2014, indicate that unlike economic value added (EVA), which has a positive correlation with stock price performance, the earnings per share show a very cursory explanation for the variation in share prices. Likewise, Herawati (2018), in their attempt to establish the impact of fundamental factors, such as debt - equity ratio, return on assets, current ratio and price and earnings ratio, on the stock price of beverage and food industries listed on the Indonesia Stock Exchange 2012 - 2015, through the t-statistic test, determined that the debt-equity ratio, the current ratio and the price-earnings ratio have no influence on the share price of the aforementioned companies.

In order to ensure the validity of the CAPE, it is necessary to establish the applicability of the indicator in different markets and at different times. In this regard, the CAPE has been applied to the S&P 500, coinciding with different historical moments at a financial level, such as the Great Depression of 1929, the dot-com crisis of 2000 and the mortgage bubble of 2007, moments before the stock market experienced relevant neuralgic situations; These are time intervals in which the market reached historical highs, which can be an important starting point in understanding the relevance of the indicator in

situations like this. The «irrational exuberance» occurs when the CAPE exceeds 15 points, the most accentuated peaks are clearly identified, referring to 1901, 1929, 1966, 2000, and 2006 when the mortgage bubble burst, Schuldt (2011).

Thus, before the 1929 crisis, the CAPE was at a ratio of 30, which means that profit was 30 times the share price; After the infamous Black Thursday the New York Exchange plummeted 23%. Something similar occurred in the year 2000 before the tech bubble, when the indicator was at a level of 44; However, after the dot-com crisis it dropped by 49%. Lastly, before the collapse of Lehman Brothers in 2007, the CAPE was at 27.5; It maintained similar levels until March 30th of 2017. The lesson from this is that such events of excessive optimism are relatively frequent in stock markets and, sooner or later, they burst and later recover in a slow but inevitable manner, Schuldt, (2011).

It is worth noting that all these crises are always accompanied by complex economic and financial situations, hence the shock measures that countries must take to deal with them efficiently. Several studies show the consequences of these crises. A study of the Bank of England's (BoE) interest rate setting over a 16-year period, including the Great Recession of 2008 - 2009, shows that there is a greater weighting to inflationary projections, this indicates that the BoE's more pessimistic estimates of inflation bring imbedded decline in the financial outlook and its likely effect on future inflation and output, Zhua (2021).
On the other hand, 10 years after the Great Recession of 2008 - 2009 the estimates of the world economy continue to be doubtful. The economic damage as a consequence of the crisis is not yet over and its impacts continue to have deep and significant consequences in the world economic system, Yakovlev (2020).

Specifying the consequences of this financial crisis of 2008-2009 for the case of Germany, the country went through the slowdown of greater relevance of its economy since the Second World War, among other reasons, due to the dynamic decline of the GDP, Dietz, (2020).

With an emphasis on the long term, this document analyzes the PER and CAPE market forecast indicators. Consequently, conceptual criteria are stablished. In the first instance, the PER stock valuation indicator is discussed and, more importantly, the indicator on which the subject matter of this research is based is discussed as well, which, as mentioned above, is the CAPE, highlighting its benefits and limitations, in which markets it has been implemented and which results were obtained. It is worth noting that the most empirically used stock market ratio to find market overvaluations has been the PER, however, indicators such as Tobin's Q and the Dividend Yield have also been applied in different valuation models. Tobin's Q considers the relationship between the stock market price and the intrinsic value of the share (understanding this intrinsic value as the net worth over the number of shares outstanding) pointing out if it is overvalued (Tobin's Q > 1) or undervalued (Tobin's Q < 1). On the other hand, the Dividend Yield or dividend-price ratio references the return an investor obtains at the moment of receiving dividends in a given period. A further explanation of the application of stock market ratios in stock valuation and their relationship to market variables is presented below.

As for the PER, derived from this indicator the stock price target is calculated, which could be estimated as follows:

$$PT=SP*1-PER-PERm/\ PER \quad (2)$$

Where:

PT = Price target of the stock,

SP = Stock price,

PER = Price to earnings ratio,

PER_m = CAPE

A PER value higher than the CAPE in any company can be an indication that the market expects a significant increase in future profits of the business. The point from which the increase

in earnings per share (EPS) supports an above-average PER would be:

ΔEPS=PER-PERm / PERm (3)

Where:

ΔEPS = Growth rate of the EPS that supports the current PER,

PER = Price to earnings ratio,

PERm = Historical average PER of the stock.

For example, if a company has a PER of 69.76 and a CAPE of 34.25, the following result would be obtained:

ΔEPS = 69,76 - 34,25 / 34,25 =103,67% (4)

In other words, for the stock price of this simulated company to sustain its current PER, it would require a growth in earnings per share in subsequent periods of 103.67%.

However, this indicator, like any other, presents flaws, particularly in what is called value traps, where the impression is given that a company is overvalued when in reality it is undervalued and vice versa; This is accentuated because the PER is calculated for a very limited time period, for example, one day, one month, or one quarter. For this reason, it does not take into account a series of anomalies that can occur in the long term and that can alter the valuations calculated with this indicator. Thus, as is logical, these alterations must be considered in the long-term calculation; By doing so, this shortcoming of the PER can be improved by the CAPE.

2.3 Latin American Integrated Market (MILA)

The Latin American Integrated Market (MILA) is an agreement made between the Stock Exchanges of Chile, Colombia and Perú, in its inception 2009, and later with Mexico in 2014, with the aim of creating a regional market for equity assets (shares) where investors in these countries can buy the assets of the other participating countries through this platform without unifying the stock exchanges. As a result, each one continues to operate individually and under the criteria and supervision that existed prior to the signing of the agreement.

In general terms, MILA has had both positive and negative aspects. In Muñoz (2020), it is said that MILA has benefited the markets by promoting stock market activity, reducing risk, creating a margin for diversification, and limiting risk contagion among them; Another study concludes that in an integration process such as MILA, in which stock market members differ in terms of stock market development, the markets will initially benefit from integration, however, in the long run those benefits dissipate, Espinosa (2017). On the other hand, the MILA has not had a great development due, in part, to the fact that there is no unification in the legislation regarding these markets and, in addition, to the non-standardization of accounting information of the companies listed on these exchanges, especially in Colombia, which at the beginning did not have the application of the IFRS standards. Additionally, integration tests based on conventional statistical methodologies do not detect a long-run stationary relationships among its four members; This result was found after performing a cointegration of Johansen's test to explore a long-run equilibrium relationship, where, it is reiterated; No evidence of significant cointegration was found for the four markets, Álamos (2020). Furthermore, the exchange rate risk remains, since each stock exchange trades in its local currency, none of which has the characteristics of an international currency; This means that on paper they could present a very volatile behavior.

This market arose in a global economic context of excess liquidity due to the monetary policies of the central banks of the developed world. One of the consequences of this phenomenon is the profitability achieved by the stock markets of the countries that comprise it during the last decade, which may imply the existence of an overvaluation of the MILA. Proof of this is that,

at the local level, during the period covered by this study, the General Index of the Colombian Stock Exchange, IGBC, has had an accumulated positive variation of 712.62%, higher than that achieved by the main stock indexes of the world, which indicates an overvalued stock market. In fact, and drawing a parallel with the MILA countries, in 2011 the International Monetary Fund, in its report on the economic outlook for the Americas, warned that the stock markets of Chile, Colombia and Peru were overvalued. This situation is due to the behavior of the stock market, in which its tendencies are generated not by an objective calculation of stock value, but by psychological aspects of the investors; That is to say it is a temporary event, called a "speculative bubble", in which share prices remain high as a consequence of the enthusiasm of the investors but not because of a coherent estimate of the real value of the stock, Shiller (2000).

This overvaluation persists and calls for a price correction in the medium term to avoid potential financial bubbles. Faced with these situations, stock market analysts must provide a permanent response, and to this end, they make constant use of a series of fundamental and technical tools in order to make forecasts that allow them to glimpse to a certain extent the future behavior of the market, deal with any anomalies that may arise, generate certainty and reduce risk levels.

The MILA is an example of the strategies used to appease the evident failures in the crisis presented in 2007 - 2009 as a type of international financial integration that accentuates the transfer of capital flows. The exceptional high levels of capital flows towards emerging economies have been frequently associated with financial crises; Identifying these events is essential to understand their origin, Dhar (2021), brings to the forefront a current characteristic of the global economic development such as the expansion of financial and economic integration between developed and emerging countries; This greater interdependence in recent decades has brought on an increase in international mobility of capital flows. Thus, in the first and early second decades of the 21st century, emerging economies showed an increase in capital flows coming from advanced economies due to their growth prospects and improved macroeconomic indicators; For example, in the Colombian case, during this time interval the inflow of capital presented an upward trend, which explains the surplus in the balance of payments or capital account, this panorama reiterates the cause mentioned above regarding the economic crisis, it should be noted that the effects of capital flows at the end of this period were set in the context of the international financial crisis, Gómez (2012). In addition, capital flows have a cyclical behavior and depend on uncertainty and risk aversion in the international financial markets, Lampa (2020), however, this inflow of capital flows can have negative impacts on the region because financial and business cycles are driven by monetary decisions in developed countries. Capital inflows to the region after 2008 reflect a potential risk rather than an opportunity, generating financial crises, Lampa (2020), such as the one Argentina experienced in 2018.

More precisely, the countries belonging to the MILA presented the following participation in terms of FDI as a percentage of GDP:

Tabla 1. Foreign direct investment (% of GDP)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Chile	6,24	5,92	3,66	5,32	6,85	6,07	4,90	7,76	10,28	8,04	7,33	10,14
Colombia	2,44	2,59	2,18	1,82	2,66	7,03	4,18	4,31	4,36	3,46	2,24	4,37
México	2,60	3,97	3,12	2,50	3,19	2,97	2,13	3,14	2,91	2,13	1,97	2,09
Perú	1,56	2,20	3,94	2,27	2,39	3,39	3,91	5,37	5,74	5,32	5,73	4,47

Source: Own elaboration based on World Bank data (n.d.)

Regarding the dynamics of the markets belonging to MILA, the effects of this integration process have been tested in relation to the efficiency in terms of the reaction of stocks to the estimated earnings; It was concluded that the MILA reflects isolated gains with respect to the reaction to corporate earnings appreciations, which translates into tenuous improvements in the efficiency of this market, however, it is evident that MILA benefited cointegration, Hardy (2018); Likewise, according to Santillán-Salgado (2017), studied the success of one of the objectives of the MILA, related to the enhancement of the integration of Latin American financial markets, evidencing an increase in the linear correlations between countries and thus its linear causal relationship with an improvement in the financial integration process in the region.

Furthermore, there are several studies on the integration of stock markets worldwide and the implications that this has brought with it. In relation to this, one of these studies references the integration of the stock markets of Central and Eastern European Countries with those of developed countries such as Germany, the USA, and the UK, in it, through two types of analysis, static and dynamic, it was evident that the markets of the European Economic Community (EEC) present long-term cointegration with the three counterparts considered, Boțoc (2020).

According to Tilfani, et al, (2020), studied the importance of stock market integration, they evaluated the evolution of this integration for the case of Central and Eastern Europe, and highlighted that the stock markets of the Czech Republic, Hungary, Croatia, Poland, and Romania are more integrated than those of Bosnia, Montenegro, Serbia, and Slovakia. The authors also evaluate the degree of integration depending on the current economic situation, where they find that during crises, market integration levels increased, while Brexit apparently had the opposite effect. Finally, they highlight the usefulness of these studies of stock market integrations for different agents, for example, for investors, for the construction of investment portfolios, and for authorities, with the purpose of identifying possible falls in prices.

Another example of integration is the BRICS, a group of countries formed by Brazil, Russia, India, China, and South Africa, which is characterized by strong relationships in terms of economic growth, competitiveness, macroeconomic infrastructure, and economic development, Rinto, (2024).

Metodología

In order to identify the overvaluation or undervaluation of the markets comprising the MILA based on the CAPE, a quantitative analysis of the data on each of the markets comprising the MILA (Colombia, Chile, Mexico and Peru) was carried out.

The first step was to create a synthetic index for each market, both for the PER and for the stock market performance. This synthetic index is constructed as is done with a normal stock market index such as the Colcap, Dow Jones or S&P 500, i.e., each stock is given a percentage weight and based on this, its relative contribution within the index is determined. For this purpose, the ten stocks of each country that had presence and registered the largest trading volume during the period between 2001 and 2010, and that, also, registered trading throughout this period were analyzed. The reason for choosing this range of data is that, as mentioned above, the CAPE is calculated based on historical information of the last ten years. In order to verify that the stocks selected for each synthetic index were representative of each market, the correlation coefficient was calculated with respect to the benchmark index of each market. In the case of the Colombian market, the IGBC index was taken as a reference because the COLCAP was created only until 2008.

Table 2: Correlation coefficient of each sample with respect to the benchmark index.

	IGBC	IPSA	IPC	S&P Lima
Synthetic Index	97,74%	97,33%	98,26%	96,62%

Source: Own elaboration based on (Economatica, 2020).

To assign the participation percentage to each of the stocks on the synthetic indexes created for each country, the trading volume of each asset during 2010 was taken into account; As a function of the volume, the participation percentage was assigned so that in total it would add up to 100%. The selected assets and their participation in their respective indexes are shown below:

Table 3: Trading participation of each stock in its respective market.

Asset	Colombia		Chile		México		Perú	
	Asset	**%**	**Asset**	**%**	**Asset**	**%**	**Asset**	**%**
Asset 1	PFBCOLOM	32,52%	LAN	18,35%	WALMEX	19,13%	VOLCABC1	19,74%
Asset 2	GRUPOSURA	16,20%	FALABELLA	13,38%	GFNORTEO	15,33%	TELEFBC1	16,07%
Asset 3	EXITO	11,50%	SQM -B	10,79%	CEMEXCPO	14,74%	FERREYC1	11,16%
Asset 4	CEMARGOS	9,80%	ENELAM	10,67%	GMEXICOB	14%	AENZAC1	10,60%
Asset 5	GRUPOARGOS	9,33%	BSANTANDER	9,38%	FEMSAUB	9,58%	ALICORI1	10,50%
Asset 6	NUTRESA	7,15%	ENELGXCH	9,29%	TELEVISACPO	8,22%	BAP	9,31%
Asset 7	CORFICOLCF	5,59%	COPEC	8,30%	ALFAA	7,07%	BBVAC1	6,15%
Asset 8	CELSIA	3,37%	CHILE	7,75%	ORBIA	5,06%	MINSURI1	6,13%
Asset 9	BOGOTÁ	2,85%	ENTEL	6,24%	ELEKTRA	3,46%	CVERDEC1	5,78%
Asset 10	GRUPOAVAL	1,67%	CAP	5,84%	BSMXB	3,41%	CPACASC1	4,55%

Source: Own elaboration based on (Economatica, 2020).

With the selection of the assets made, the PER and CAPE were calculated for each asset between 2011-2019, and then, based on the weightings presented in Table 3; These indicators were constructed for each market. In this way, it is possible to identify year by year whether the MILA stock markets are undervalued or overvalued, from the perspective of the CAPE. Then, the performance of each one of the stock markets were compared, based on the CAPE results.

Finally, the tools for measuring forecast error are used to identify the level of adjustment of the PER of each market with respect to the CAPE, under the assumption that the PER should always tend to revert to its average adjusted for inflation. The analysis is mainly done with the Mean Absolute Percentage Error (MAPE) and the tracking signal (TS), so that it can be established to what extent it can serve as a tool to forecast the future behavior of the stock markets that are part of the MILA.

The Mean Absolute Percentage Error measures the error in a series of data with respect to its forecast and expresses it in the form of a percentage; This indicator is calculated using the following formula:

$$MAPE=100/N \sum_{k=1}^{n} ((xi-fi) / xi)) \quad (5)$$

Where, for the purpose of this investigation, the following would apply:

Xi = The PER for each period

Fi = The CAPE for each period

N = Number of data in the series

This indicator identifies the average percentage variation of the PER with respect to the CAPE.
The tracking signal (TS) measures the cumulative variations between the PER and the CAPE with respect to the average absolute error of the data series. An acceptable range of results for this indicator could be between 4 and -4, since it would be covering most values within the normal distribution. Results outside this range would imply a low predictive power of the CAPE with respect to the PER. On the other hand, a positive tracking signal would show that the market has a greater tendency to be overvalued relative to CAPE and a negative tracking signal would show the opposite.

The formula for calculating the tracking signal (TS) is as follows:

$$TS= \sum_{t=1}^{n} (xi-fi) / (xi-fi) \quad (6)$$

Where,

xi = The PER for each period

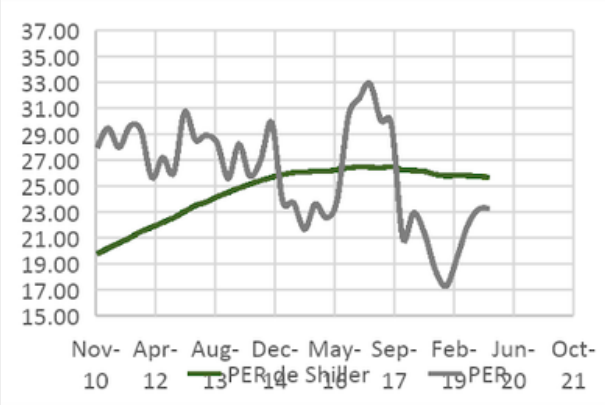
fi = The CAPE for each period

N = Number of data in the series

3. Results

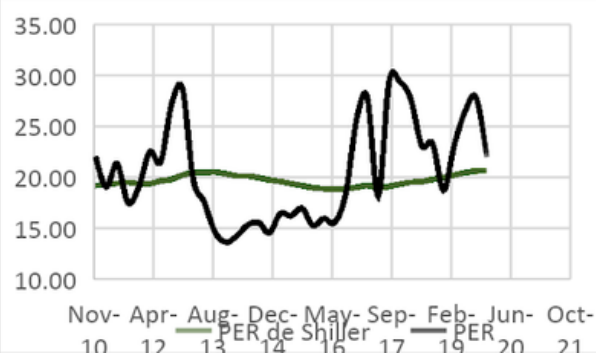
This research presents an analysis regarding the application of the CAPE index to the stocks of the countries that make up the MILA, in order to evidence overvaluation or undervaluation in the period between 2011 and 2019. In this context, it is examined whether there are similar behavior parameters in these markets during some periods within the selected time horizon or, on the contrary, whether it is established that each country operates autonomously. Based on that, the individual results obtained for each country under study are shown below.

Figure 1. CAPE Colombia 2011-2019



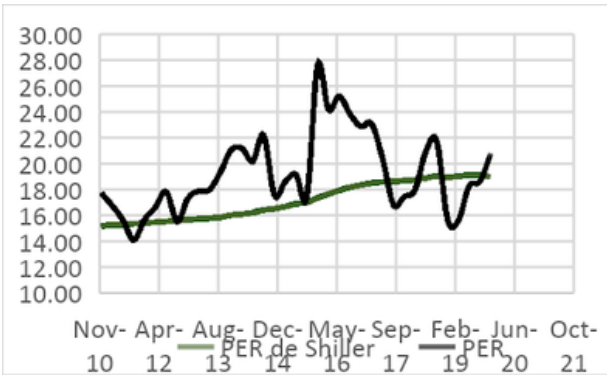
Note. Calculated from data obtained from (Economatica, 2020)

Figure 2. CAPE Chile 2011-2019



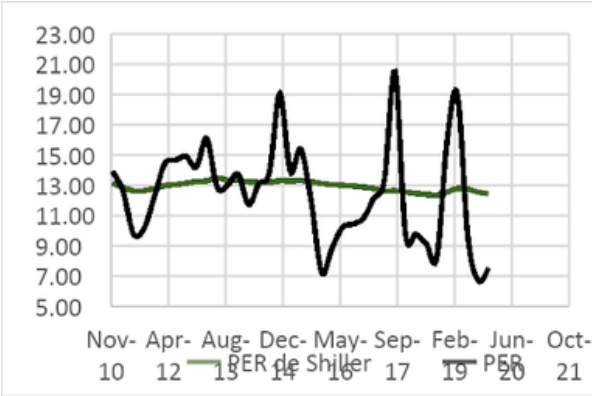
Note. Calculated from data obtained from (Economatica, 2020)

Figure 3. CAPE México 2011-2019



Note. Calculated from data obtained from (Economatica, 2020)

Figure 4. CAPE Perú 2011-2019



Note. Calculated from data obtained from (Economatica, 2020)

As shown in the figures above, all markets started 2011 overvalued and have since fluctuated around the CAPE, however, in the case of the Colombian stock market the PER only crosses the CAPE on three occasions, which could show a low predictive power of the CAPE for the Colombian stock market. At the end of 2019, prior to the onset of the COVID-19 pandemic, the valuation of the stock markets analyzed was mixed, while the Colombian and Peruvian markets started the pandemic undervalued, the Chilean and Mexican markets started the pandemic overvalued. Table 4 shows the status of the valuation, performed for each year between 2011 and 2019.

Table 4: Valuation of the MILA stock markets from 2011 - 2019.

	Colombia	Chile	Mexico	Peru
2010	Overvalued	Overvalued	Overvalued	Overvalued
2011	Overvalued	Undervalued	Overvalued	Undervalued
2012	Overvalued	Overvalued	Overvalued	Overvalued
2013	Overvalued	Undervalued	Overvalued	Overvalued
2014	Overvalued	Undervalued	Overvalued	Overvalued
2015	Undervalued	Undervalued	Overvalued	Undervalued
2016	Overvalued	Overvalued	Overvalued	Undervalued
2017	Undervalued	Overvalued	Undervalued	Undervalued
2018	Undervalued	Undervalued	Undervalued	Overvalued
2019	Undervalued	Overvalued	Overvalued	Undervalued

Source: Own elaboration.

This table shows that throughout the analyzed period, the Peruvian and Chilean stock markets showed a balance between periods of overvaluation and undervaluation, while the Colombian and Mexican markets were mainly overvalued, with the Mexican stock market being overvalued in 80% of the years under analysis.

To validate whether the CAPE has any predictive capacity, the valuation presented in Table 4 was validated with respect to the expected behavior of the stock market the following year, so that if there is predictive power in an overvalued or undervalued market, the following year should show the opposite performance. To characterize the behavior obtained, with respect to the expected behavior, the table assigns values of 1 and 0, 1 if the expected effect occurred, and 0 if an adverse result was obtained.

A review of the results in Table 5 shows that the only market in which there was a high level of coincidence (89%) between the result of the valuation and the performance of the following period was the Peruvian market. For the other markets, the predictive capacity of the CAPE is below 50%.

As for the forecast error indicators, the mean absolute percentage error (MAPE) shows that the greatest discrepancy between the PER and the CAPE is found in both the Chilean and Peruvian stock markets. On the other hand, the Mexican stock market, with a MAPE of 16.29%, is the one with the lowest gap between the PER and the CAPE.

On the other hand, the tracking signal expresses in terms of standard deviations the differences between the PER and the CAPE, which is why the values closer to zero reflect a greater convergence between the PER and the CAPE. In this respect, there is a contrast between the Mexican and the Peruvian markets, where in the former the tracking signal is significantly far from zero; In the Peruvian market this indicator is the closest to zero of the four markets analyzed. Moreover, the sign of the tracking signal shows that while the Peruvian market was mainly undervalued throughout the analyzed period, the Colombian, Mexican and Chilean markets were mainly overvalued, a result that coincides with that shown in Table 4.

Table 5: Comparison between the performed valuation vs. real stock market profit.

	Colombia		Chile		Mexico		Peru	
2011	17.06%	0	-8.61%	1	41%	0	-14%	1
2012	45.63%	0	-5.96%	0	-8%	1	30%	1
2013	-5.50%	1	-62.39%	1	-3%	1	-11%	1
2014	31.68%	0	-0.85%	0	13%	0	14%	0
2015	-27.10%	1	-51.13%	0	12%	0	-38%	1
2016	21.58%	1	127.53%	1	-9%	1	62%	1
2017	21.81%	0	206.41%	0	25%	0	44%	1
2018	-30.13%	0	-38.21%	1	-9%	0	4%	1
2019	19.07%	1	-15.64%	0	19%	1	-1%	1
		44%		44%		44%		89%

Source: Own elaboration.

Table 6: Forecast error indicators as of December 2019.

	Colombia	Chile	Mexico	Peru
MAPE	19.29%	21.14%	16.29%	19.36%
TS	10.34	8.15	27.53	-7.06

Source: Own elaboration.

4. Discussion

The CAPE is a stock market index that, due to the ease of its calculation and interpretation, has been the basis for several studies and applications in different markets. However, the results have been heterogeneous with respect to its effectiveness. From the different studies about the price-earnings ratio of stocks, as elements immersed in the CAPE, and regarding the MILA market, the obtained results are more associated with that said by Nautiyal (2018) and Herawati, (2018); They state that those variables do not have a marked influence on stock market behavior; There is no evidence of a causal relationship; This, it is worth noting, is because there is a considerable difference between the economic, financial and legal aspects of the countries that are part of this study. Thus, the results obtained between 2011 and 2019, the period in which the MILA market evolves, show that the markets still function independently and that the results obtained are more associated with the economic and political conditions in each country.

The market integration process has been progressing smoothly, and specific products have been created for the MILA market, however, the conditions in each country determine the behavior of the markets and there is no direct contagion effect among them, although they all have similar behaviors in the face of global economic events and international stock markets.

Despite the various studies in which the CAPE or similar models that incorporate earnings per share in their estimates have been applied, it was observed that there are very few studies on the subject in Latin America; In this context, analyzing the Latin American Integrated Market makes sense, considering that it groups together four of the largest economies in the continent.

The results validate the positive and negative aspects that have occurred in previous studies and that were previously reported.

From the beginning of the time horizon in which this research was carried out, the markets corresponding to the MILA were located around the CAPE, which is consistent with the predictive level of this indicator when estimating stock behavior, Sinurat, (2020).

Likewise, the Peruvian market presented the highest level of similarity between its valuation and returns; this is consistent with, Lashgari, (2016), who stated that the price-earnings ratio has an important impact on stock returns.

The Colombian market presents a distant behavior with respect to the CAPE throughout the period under study, which indicates a low level of predictability of the indicator, at least for this market; in relation to this, Nautiyal, (2018), indicates that the CAPE slightly estimates the shareholder behavior.

Just as the Peruvian market was the one with the highest coincidence regarding the CAPE, the prediction of the indicator with the other markets that integrate the MILA was low; this agrees with, Herawati, (2018), when mentioning that the price-earnings ratio on which the CAPE is based has no impact on the stock behavior.

Conclusions

From the results found, it is relevant that the markets were overvalued in most of the observation period, except for the Peruvian market; In the pre-pandemic period, the Colombian and Peruvian stock markets were undervalued, while the Chilean and Mexican stock markets were overvalued.

Despite the findings above, it was found that the predictive power of the CAPE for the stock markets that are part of the MILA is limited; In fact, it was found that the only market in which a relationship between the valuation made and the performance of the stock market existed was the Peruvian market, both by the measurements made by comparison and by the results yielded by the tracking signal, which for this market

yielded a value of -7.06. In either case, it can be determined that the tracking signal ratifies the fact that the CAPE is not a valid method as a predictor for the analyzed markets, since all the TS values are outside the generally accepted range.

For future research, it is worth exploring the reasons why the CAPE is not effectively applicable to the MILA markets; Moreover, a study of the CAPE of individual stocks may be interesting in each of the markets to corroborate the results of this study.

Additionally, it is interesting to analyze the following years after the one studied in this research, referring to the pandemic and post-pandemic period due to the economic and financial repercussions brought about by this social health phenomenon worldwide.

It is also important to test the efficiency of the indicator in other markets or to associate it with stocks that are part of reference indexes such as the Dow Jones or the S&P 500.

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