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Assessment ofeconomic-financial andenvironmental performance in wood, paperandcellulosecompanieslistedontheBrazilian stock exchange

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Abstract
The environmental, economic and financial performance is always questioned among researchers. The present paper assessed the existing relation between environmental performance and economic-financial performance in companies of wood, paper and cellulose segments, present in the Brazilian stock exchange sustainability indexes (B3)considering the period from 2014 to 2018. To this end, we selected the ROA, ROE, EPS and LR economic-financial indicators obtained from financial statements provided by companies, and from the Economática database. For assessing environmental performance we used the IPAT-e indicator, which is capable of measuring the impact caused by companies on the environment. Via relational test between economic-financial indicators and IPAT-e, in which Pearson correlation test and OLS multiple linear regression were applied for data analysis, we selected Model 1 with OLS (Ordinary Least Squares) and concluded that there was no relation between company performance on IPAT-e and economic-financial performance. The study proves to be relevant because it presents new research on the relation between economic-financial performance and Corporate Social Responsibility – CSR, and innovative inits use of IPAT-e to measure environmental performanceand subsequent comparison with economic-financial indicators.
Keywords: *Social Responsibility, Sustainability, IPAT-e.*

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HIGHLIGHTS

IPAT-e in the environmental performance assessment of companies.

Economic-financial and environmental performance of paper and cellulose companies.

Performance of companies part of the stock exchange corporate sustainability indexes.

I. Introduction

Since the first world conferences on development and environment, the first of them to be stressed carried out in Stockholm (1972), followed by those carried out in Brazil - Rio de Janeiro (1992) and South Africa - Johannesburg (2002), much have been discussed about sustainable development. The World Commission on Environment and Development (WCED), created by the UN and led by Norway's former Prime Minister Gro Harlem Brundtland, was responsible for the first definition of the concept of sustainability. The "Our Common Future" report from WCED (1987), described sustainable development as that that answered the

needs of current generations through economic development, with social justice and environmental responsibility, so that meeting the needs of future generations was not compromised.

Included in this discussion is the question of the social responsibility attributed to companies. Their activities bring on relevant impact of social and environmental order, which leads them to regard the theme of sustainability. Alves (2003) highlights the companies' contribution to generating human wealth as undeniable: they are sources of economic development and social welfare. However, they have negative aspects that generate social costs, and this leads to the understanding that corporate social responsibility is directly linked to the manifestation of these undesirable aspects.

Alves (2003) stresses that the first studies about Social Corporate Responsibility (SCR) had a strong religious character based on the respect to moral values of North American society. Currently, the concept reveals to be broader from the stakeholders' perception, that is, from the existence of partners, in addition to shareholders or owners, which maintain different degrees of interdependence with the company (employees, providers, competitors, community, groups and government). In this context, companies start to be understood as a social entity that establishes a relationship with all other socioeconomic agents, and has therefore, rights and duties that surpass formal legal obligations.

Insofar as debates on sustainable development and social corporate responsibility advance, there is a consequent awareness in society on these matters, and companies seek recognition as socially responsible to improve their image before potential clients and investors. Studies identifying the relation existing between SCR and economic-financial performance in companies have been done to that effect.

Although several worksindicate that SCR can generate commercial benefits to companies, and even influence consumers' purchase intention, overall, their results show to be a mix of studiesthatnow identify a positive relation, then negative, and others not finding any relation (BHARDWAJ *et al.*, 2017).

On the basis of the questioning of the relation existing between environmental performance and economic-financial performance in wood and paper companies listed on B3, and the hypothesis that the lower the environmental impact generated by a company, the better its economic-financial performance, is that this research aims at assessing the relation between the economic-financial and environmental performance of companies in wood, paper and cellulose segments. They admittedly by their nature, tend to have significant environmental impact, represent 1.2% of Brazil's GDP, according to data from IBA - Brazilian Industry of Trees (available at iba.org), and are present in the Brazilian stock exchange sustainability indexes (B3); our study presupposes that such companies have a greater environmental commitment.

We performed economic-financial performance assessment by analyzing the Return On Asset (ROA), Return on Equity (ROE), Earnings Per Share (EPS) and Leverage Ratio (LR) indicators. We record that for obtaining these indicators, the Economática platform was used, and also, calculations were made from researched entities' accounting statements. In turn, environmental performance assessment was obtained through the IPAT-e indicator recently developed by Silva *et al.* (2019), to gauge the company's impact on the environment from two variables: production, represented by produced amount of consumer goods; and technology, namely: water, energy, effluents, air emissions and solid waste.

The innovation in this paper is in the fact of its being the first to effectuate comparative study between economic-financial and environmental performance using the IPAT-e indicator.

1.1 Corporate Social Responsability

Sustainable development has become a recurring and increasingly relevant theme due to advance in debates and consequent understanding that it is not only connected to environmental questions. Silva (2018) reinforces that sustainability results from the balance of three dimensions: environmental, economic and social. In turn, world conferences promoted by the United Nations (UN) were fundamental for the development of discussions relative to the theme.

There is a close relationship between the concept of sustainable development and that of the social responsibility attributed to companies, since these provoke impacts in the three dimensions comprised in the sustainability concept. Globalization and its consequent formation of large production chains,causetheimpact range totend to be greater. Thus, that these organizations be recognized as socially responsible reveals to be important both for the awareness that businesses interfere with society, and for the strategic benefits that may be explored with this recognition from stakeholders.

Wood (1991) describes that the basic foundation of CSR is that organizations and society are connected, and that society creates expectations of appropriate results and behavior of companies. This author defines the CSR conceptual structure from a three-dimension interaction. The first, composed of CSR principles presented in levels of application, as described in Table 1. The second, named corporate social responsiveness process, refers to the companies' response capacity to social pressure, that is, managerial actions that can be taken in relation to environmental assessment, stakeholders management and problem management. And the last

dimension relates to social corporate behavior results that can be observed from programs used to implement the SCR and policies adopted by the company to deal with social issues and with stakeholders.

Table 2 - Social Corporate ResponsibilityPrinciples

Principles	Definition	LevelofApplication
Legitimity	Society legitimates and gives power to companies. In the long term, those that do not use power in a way that society consider responsible will tend to lose it.	Institutional and based on generic obligations of a company as a business.
PublicResponsibility	Companies are responsible for results related to their primary and secondary areas of involvement with society.	Organizational, building on the company's specific circumstances and relations with the environment.
ManagerialCriterium	Managers are moral actors. With the social responsibility dominance of a company, they are obliged to exercise the power allowed to them in relation to socially responsible results.	Individual and based on people as actors within organizations.

Source: adapted from Wood, 1991.

Building on the stakeholders theory, Clarkson (1995) addresses SCR as the capacity of managing and satisfying the organization's main interest groups, that is, not to concern oneself only with shareholders' results, but also of others interested. It is necessary to have equity and balance in the distribution of wealth and value created by the company, so that one group is not favored to the prejudice of another. After all, if any group identifies that it is being treated unfairly, it may withdraw from the company's stakeholders system.

Triple Bottom Line (TBL) was included as an important concept related to SCR. Created in 1994, it consists in understanding that corporate performance is not limited to the financial only; other two aspects are included, the social and the environmental (ELKINGTON, 2004). Hubbard (2009) explains that TBL widens the stakeholders theory perspective; the interested parties go beyond the traditional interested, and include, for example, local communities and government. In this context, social performance is measured by the impact a company has in communities where it acts. And environmental performance by the resource amount that an organization uses in its activities, for example, water and energy, and also by by-products of these activities, such as chemical waste, solid residues, air emissions, among others. Thus, it is a complex measurement performance assessment methodology, considering the diverse variables it comprises.

1.1.1The relation between SCR and corporate performance

Several studies identify the relation between economic-financial performance and SCR; furthermore, they use different research methods. Eccles, Ioannou and Serafiem (2014) researched 180 North American companies for a period corresponding to 18 years, and classified 90 as highly sustainable and 90 with low sustainability in comparing the two groups' performance. They concluded that companies considered highly sustainable showed better performance in stock market and in accounting indicators. They identified that from companies considered of high sustainability, those that most benefited were from the B2C sector - which had direct contact with the final consumer - and sectors in which competition happened on the basis of brand and human capital, and in which products sold depended on natural resource extraction.

Lopes, Garcia and Rodrigues (2007) studied performance differences from the accounting indicators analysis of two groups of 55 European companies. One group belonging to DJSI, Dow Jones Sustainability Index, and another not belonging to it, because they did not meet the requirements for integrating the index. They identified differences in lucrativeness and profitability measures between both groups in the short term, while the relation between indicators and SCR showed to be negative. Relevant changes in the variation of asset, capital and revenue were not found, which led to the deduction that costs for sustainability practices application afforded differences in performance indicators. They identified, too, that those differences tended to decrease over time.

From the return evaluation of the Corporate Sustainability Index (ISE), which was created in 2005 by the São Paulo Stock Exchange (Bovespa - current B3), and traditional stock indexes Ibovespa, IBrx and IGC, Rezende *et al.* (2008) concluded that there was no better return between ISE and the other indexes. In the same vein, Carvalho, Souza and Callado (2016) analyzed the ISE and ICO2 financial return against other Brazilian stock exchange indexes and concluded that there was no relevant difference in mean daily return between different indexes.

Cristófalo*et al.* (2016), in turn, assessed the performance of eight companies from four different segments part of or not integrating ISE, via stock valuation and volatility analysis. Results demonstrated that companies belonging to ISE from banks and petrochemical sector showed better performance than those not belonging to it. The opposite was observed in sectors of electric power and paper and cellulose. Establishing a relation between sustainable practices adoption and the performance of companies was not possible. Chetty, Naidoo and Seetharam (2015), in analyzing performance in companies listed on the Johannesburg stock

exchange sustainability index, found that there were no significant differences in the performance of companies that admittedly invested in SCR from those that did not invest.

From the meta-analysis of more than 20 years of studies,and with greater focus on the environmental dimension of SCR concept, Golicic and Smith (2013) identified a positive relation in the performance of companies that adopted environmentally sustainable practices in supply chains. Several studies in this area present contradictory results, and intending to arrive at a conclusion, Orlitzky, Schmidt and Rynes (2003), from the meta-analysis of 30 years of studies, concluded that there is a positive association between SCR and corporate performance.

Lastly, Bhardwaj *et al.* (2017) explain that when consumers recognize that a company invests in SCR, purchase intention increases. However, the authors indicate that there are two types of investment in SCR, those that contribute to the development and manufacture of new products (CSR-CA), which are related to operational efficacy, and those that do not interfere with corporate capacity (CSR-NCA), understood as companies concentrating in philanthropy. Thus, they conclude that investment or not in SCR and type to be chosen depend on the SCR valuation by consumers.

The Brazilian stock exchange currently counts with two sustainability indexes: the Corporate Sustainability Index (ISE) created in 2005, and Carbon Efficient Index (ICO2), created in 2010.

1.2Environmental performance indicator of businesses - IPAT-e

From discussions among the scholars Commoner, Ehrlich and Holdren in the decade of 1970, the IPAT equation arose, in which I is the environmental impact originating at the multiplication between P (population), A (affluence) and T (technology). Discussions that led to the formulation of this equation related to a search for the environmental impact increase caused in society, so that it was possible to measure which of them was the most influential. Chertow (2008) presented diverse variants of this indicator. She concluded that technology isfundamentalfor environmental improvement and that it can compensate for the population and consumption increase.

From the IPAT remodeling, and recognizing the companies' responsibilityas to theimpactcaused by their activities, Silva *et al.* (2019) developed IPAT-e, which is understood as an indicator to measure environmental performance in companies. It considers two variables and results in the following formula: I = P x T, where I is environmental impact, P the production, that is, produced amount of consumer goods, and T, technology, namely: water, energy, effluents, air emissions and solid waste. All considered in tons.

The researchers argued that the main variable of this indicator is production, because it replaces the population and consumption variables presented in IPAT. Furthermore, in the same line of thought as Chertow (2008), Silva *et al.* (2019) defined that technology influences impact. Thus, even if the production volume increases impact may be lower as long as advanced technology is adopted in the production process.

1.3Economic-financial performance indicators

The business environment evolution and investors participation increase have made the economic-financial performance evaluation fundamental for stakeholders decisions (LUZ, 2013). Although non-financial and intangible factors have been given more and more importance, the financial performance evaluation in companies is capable of synthesizing the impact of all management decisions on the ability of creating value, and are, therefore, one of the most relevant perspectives in evaluating performance in companies (TEIXEIRA & AMARO, 2013).

Padoveze (1997) defines economic-financial indicators as mathematical calculations performed from accounting statements for understanding the asset, financial and profitability condition; they are constructed from equity elements inter-relation and interdependence concepts and aim to identify a company's current situation and infer its possible future condition. Such indicators can be classified in five categories, as follows: capacity of payment, of activities, of profitability, of profitability - Dupont method - and of stock value.

Marion (2005), in turn, divides the statements analysis into levels. Classified as fundamental to know the economic-financial situation of a company, the introductory level - first level - is formed by a tripod constructed by net indexes (financial situation), indebtedness (capital structure) and profitability (economic situation).

For Gitman and Madura (2003), the company's profitability indexes, which measure its economic performance, are gross profit, operating profit, net profit, earnings per share (EPS), total return on assets (ROA), and return on equity (ROE). Indebtedness is measured by rate of debt, of interest coverage and of fixed payment coverage. Liquidity, in turn, is measured by current ratio (CR) and quick ratio (QR).

Padoveze (1997), Gitman and Madura (2003) and Marion (2005) conceptualized activity indicators. Those indexes evidence the company's operational dynamics and reflect cash flow administration policies, and also productivity in assets of the company. In this class are the indicators of average receipt deadline, average

payment deadline and inventory turnover (PADOVEZZE, 1997). There are likewise market indexes, which aim at identifying investors' evaluation concerning the company's performance in terms of return and risk; to this end, the price/profit ratio (P/E) and market value/book value ratio (M/B) are used (GITMAN and MADURA, 2003).

In the face of a large number of indicators classified in different ways, Vieira *et al.* (2014) grouped them in five main categories:

Table 3 - Economic and financial indicators

Indexes group	Main indexes	Function	Authors
Liquidity Ratios	• Cash ratio • Current ratio • Quick ratio • Overall liquidity	Ratios in this group are used to evaluate the company's payment capacity. General rule for interpreting is that the higher the value of these ratios, the higher will be the company's capacity of paying its debts, that is, the better its financial situation.	Zanolla and Lima (2011); Barac (2010); Oliveira *et al.*(2010); Iudícibus, (2010); Gitman (2010); Quintana (2009);
Debt Ratios	• Third parties capital investment in total resources • Debt capital • Equity capital • Short-term debt share in total indebtedness	Also called capital structure ratios, this group aims at assessing the degree of the company's dependence on third parties capital by measuring the relation between equity capital, debt capital and invested capital. It indicates the third parties capital resource amount being used, in an attempt to generate profit. General rule for its interpretation is that the lower it is the better.	Borges, Nunes and Alves, (2012); Zanolla and Lima (2011); Oliveira, Silva and Zuccari (2010); Iudícibus (2010); Gitman(2010); Quintana (2009); Largay and Stickney (1980).
Activity indexes	• Inventory turnover • Average receipt deadline of accounts receivable • Average payment deadline of accounts payable	They represent relations between groups of accounts that somehow participate in the company's result calculation. For analysis purposes, the greater the velocity of sales receipt and stock renewal, the better. General rule for its interpretation is that the lower the better.	Barbosa (2010); Oliveira, Silva and Zuccari (2010); Iudícibus (2010); Gitman (2010); Quintana (2009); Ebaid (2011).
Profitability Ratios	• Operating margin • Net margin • Asset turnover • Return on investment • Return on equity	Measure, as a general rule, capital returns through profit or revenue. These indicators inform how much the company's profit relates to another comparability parameter. General rule for its interpretation is that the higher it is the better.	Borges, Nunes and Alves (2012); Barac (2010); Oliveira, Silva and Zuccari (2010); Iudícibus (2010); Gitman (2010); Quintana (2009); Ebaid (2011).
Market Indexes	• Market value • Earnings per share • Dividend per share • Yield dividends • Beta coefficient	Refer to prices and volumes of stocks traded in the market, to quantify companies' stock values.They demonstrate the liquidity of the market.These indexes are used to know the market behavior as a whole or specific segments.	Barac (2010); Silva, Ferreira andCalegário (2009); Costa Junior and Neves (2000).

Source: Vieira *et al.*, 2014.

In light of this wide range of indicators, Vieira *et al.* (2014) sought to identify which were the best in the capital market analysts' perception, and concluded that the most used indexes, of frequency higher than 90%, were Asset Profitability (ROA = EBIT/Total Asset) and Debt Ratio (DR = Total Liability/Total Asset); Sales Profitability (SP = Net Profit/Net Revenue) and Earnings Per Share (EPS = Net Profit - Dividends/Number of Shares) ranked second; third, Current Ratio (CR = Current Asset/Current Liability), Working Capital Ratio (WCR = Current Asset - Current Liability/Total Assets) and Equity Profitability (ROE = Net Profit/Equity), and fourth, Dividend Yield (DY = Average Market Price of Share/Profit per Share).

Miranda and Alves (2018) in order to identify among a sample of selected companies, that that represented the best investment with appreciation potential and creation of capital gains to the investor, and building on the premise that the fundamental analysis is one of the most effective analysis methods, opted for the following indicators:

Table 4 - Fundamental indicators

Financial and Market Indicators	Formula / Information
Liquidity	
Degree of current liquidity	Total current asset/Total current liability
Degree of reduced liquidity	(Cash and bank deposits + Clients)/(Total current liability)
Funding	

Debt-to-equity ratio	Total Liability/Equity
Solvency ratio	Equity/Total Liability
Financial autonomy	Equity/Total Asset
Profitability	
Return on Assets (ROA)	Operating Results/Total Assets
Return On Equity (ROE)	Net Result/Equity
Return On Investment (ROI)	Net Result/Total Assets
Financial market	
Earnings Per Share (EPS)	Net Result/Number of Shares Issued
Dividend Per Share (DPS)	Dividends/Number of Shares Issued
Payout Ratio	Dividends/Net Result
Price Earning Ratio(PER)	Price Per Share/EPS
Price Book Value(PBV)	Price perShare/Unit Book Value
Price Cash Flow(PCF)	Price per Share/Cash Flow
Market Value(MKV)	Price per Share x Number of Shares Issued
Dividend Yield	(Dividends/Price per Share) x100

Source: Adapted from Matos *apud* Miranda and Alves, 2018.

Despite the several studies, there is no consensus about the relation between economic-financial indicators and companies' value. Malta and Camargos (2016) identified indicators used in fundamental analysis and dynamic analysis that explain the Brazilian publicly-traded companies' share return. In analyzing 22 variables, they found eight with predictive power of return to shareholders: Third Parties Capital Share (TPCS = Current Liability + Non-Current Liability/Equity), Gross Margin (GM= Gross Profit/Net Revenue), Return On Asset (ROA = Operating Profit/Total Asset), Return on Equity (ROE = Net Profit/Equity - Net Profit), Return On Investment (ROI = Profit Before Interest and Tax/Gross Debt + Equity), Marketability Index (INeg[1]=$\sqrt{\left(\frac{n}{N}\right) x \left(\frac{v}{V}\right)}$), Earnings Per Share (EPS = Net Profit/n° of Shares) and Market-to-Book Ratio (MBR = Market Value of Common Stock + Market Value of Preferred Stock/company's Equity Book Value). In order of importance the most relevant among the listed above are ROA, TPCS, EPS and MBR, respectively.

II. Material and Methods

Sample choice grew out of the premise that companies belonging to sustainability indexes of B3 have a greater commitment to environmental issues. Furthermore, we considered the fact that the environmental performance assessment requires access to information generally contained in sustainability reports. Thus, in June 2019, we identified that from the total of 426 companies listed in the stock exchange 29 were part of the ICO2 sustainability index portfolio and 33 of ISE.

Companies belonging to the indexes were then classified by industry. We selected for assessment in this study companies of wood and paper industry comprising wood, paper and cellulose segments. They were three companies: Klabin Co., Suzano Co. and Duratex Co. There are prominent concerns with environmental issues in this type of sector due to the nature of the activities, which explains that choice. Furthermore, this understanding is corroborated in results of the research of Silva *et al*. (2019), for example, in which they identified that companies in the paper and cellulose segment were the ones that most impacted the environment; they considered a sample of companies representative of four other segments. It is observed that Klabin Co. integrates the two indexes (ISE and ICO2), Suzano Co. integrates ICO2 only, while Duratex Co. only ISE. Thus, result comparison on the companies' participation in different indexes is possible.

For assessing economic-financial performance we used the following economic-financial indicators: Return On Assets (ROA), Return On Equity (ROE) and Earnings Per Share (EPS), all collected from the Economática database, and comprehending the period from 2014 to 2018. They are described in Table 5.

Table 5 - Economic-financial indicators used in the research

Description	Formula	Objective
Return On Assets	EBIT/Total Assets	To indicate return rate generated by the

		company's investments in its assets.
Return On Equity	Net Profit/Equity	To indicate the return rate of resources invested in the company by shareholders.
Earnings Per Share	Net Result/Number of Shares Issued	To demonstrate the profit made by every share emitted by the company.

Source: Adapted from Assaf Neto and Lima, 2011.

The choice of indicators considered recent studies of Vieira *et al.* (2014), Malta and Camargo (2016) and Miranda and Alves (2018), in which it was found that this set of indexes were frequently used and understood as effective in the companies' performance analysis, both by financial market analysts and by researchers of the theme.

We used Leverage Ratio, calculated from the ROE/ROA ratio. The choice of this indicator was due to the understanding that it was important to identify whether companies had positive or negative return concerning third parties' capital use.

As for environmental performance assessment the IPAT-e calculation was performed from information obtained in sustainability reports. For data treatment we adopted statistical procedures with econometric analyses via panel data analysis and linear regression model.

The panel data analysis used the pooled OLS (Ordinary Least Squares) comparative estimators in grouped data models, random effect and fixed effect, in addition to the following robustness tests: LM test for fixed effects *versus* OLS - Honda; Hausman Test for fixed effects x variable effects and Breush Pagan LM Test for variable effects x OLS.

The theoretical model of panel data for multiple linear regression used in the literature, of *N* cross sections, *T* time series observations and *K* - 1 explanatory variables, can be described as follows:

$$y_{it} = \beta_{0it} + \sum_{k=2}^{k} \beta_{kit}\, x_{kit} + \varepsilon_{it}$$

Where i = 1, ..., N. and t = 1, 2, ..., T.

In which β_{0it} is the intercept different for each cross section unit i in the period t, β_{kit} represents different inclinations for each cross section unit i analyzed in each period t, while ε_{it} is the random error. Table 6 describes variables selected for the models:

Table 6 - Statistical variables

Independent variable	**IPAT-e**	Total environmental impact generated by the company annually expressed in tons.
Explanatory variable	**Return On Assets (ROA)**	Return rate generated by the company's investments in its assets.
Explanatory variable	**Return On Equity (ROE)**	Return rate of resources invested in the company by shareholders.
Explanatory variable	**Earnings Per Share (EPS)**	Profit made by every share emitted by the company.
Explanatory variable	**Leverage Ratio (LR)**	Impact of third parties capital on return to shareholders

Source: Elaborated by the authors, 2019.

The econometric model of fixed effects (Model 1):

$$IPATe_{it} = \beta_{0it} + \beta_1 ROA_{it} + \beta_2 ROE_{it} + \beta_3 EPS_{it} + \beta_4 LR_{it} + \varepsilon_{it}$$

Where: $IPATe_{it}$ is the independent variable of company i in the period t; β_{0it} is the specific effects vector for each situation; $\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5$ represent different inclinations, also for each cross section unit i analyzed in each period t, and are the explanatory variables ROAit, ROEit, EPSit, LRit, and εit, the term of error.

III. Results and Discussion

3.1 Economic-financial performance analysis

Table 1 presents values found for economic-financial indicators of companies researched in the period analyzed and each indicator's respective mean values by company.

Table 1 - Economic-financial indicators result

Company	Year	ROA(%)	ROE (%)	EPS (R$)	LR
	2014	7.04	8.54	0.59	1.21
Duratex	2015	3.61	4.15	0.28	1.15
	2016	3.39	0.57	0.03	0.17

	2017	4.45	3.92	0.27	0.88
	2018	7.61	9.32	0.63	1.22
	Mean	**5.22**	**5.3**	**0.36**	**0.93**
Suzano	2014	4.37	-2.54	-0.24	-0.58
	2015	10.86	-10.07	-0.85	-0.93
	2016	4.5	16.68	1.55	3.7
	2017	11.4	15.55	1.66	1.36
	2018	9.27	2.65	0.29	0.29
	Mean	**8.08**	**4.46**	**0.48**	**0.77**
Klabin	2014	7.8	10.35	0.16	1.33
	2015	5.57	-23.41	-0.27	-4.21
	2016	4.6	34.96	0.54	7.6
	2017	5.04	7.36	0.12	1.46
	2018	10.05	2.86	0.03	0.28
	Mean	**6.61**	**6.42**	**0.11**	**1.29**

Source: Elaborated by the authors on the basis of data extracted from the Economática database, 2019.

The ROA is positive for all companies analyzed. Suzano showed the best performance when compared to the others, mainly due to results achieved in 2015 and 2017. Klabin and Duratex obtained their best results in 2018.

As for ROE, in spite of the fact that the mean value of all companies had been positive, only Duratex Co. showed positive result in the whole period analyzed, with its highest result occurring in 2018. Suzano Co. did not show capacity of generating return on shareholders' capital in 2014 and 2015, while Klabin showed negative result in 2015. In subsequent years all companies demonstrated positive results, mainly in 2016 and 2017.

In EPS, Duratex was the only one that had a positive result; it recorded the highest earning per share in the year 2018. Nevertheless, Suzano had the highest mean EPS among companies, mainly due to results achieved in 2016 and 2017, surpassing negative results obtained in 2014 and 2015. Klabin had a negative result in 2015. Conversely, in 2016 it showed its highest result per share. Klabin's mean result was the lowest among companies analyzed.

Lastly, LR in Duratex was below 1 in 2016 and 2017, that is, third parties capital consumed the company's equity in these periods. By relating it to the other indicators, we verify that ROE and EPS values shown in these years were the lowest of the company in comparison with other years. Suzano showed results lower than 1 for LR in the years 2014, 2015 and 2018, while in 2016 and 2017 they were higher. Klabin obtained results lower than 1 in the years 2015 and 2018, while in other years values were higher.

3.2 Environmental performance analysis by means of IPAT-e

In tables 2, 3 and 4, variables and values found for the IPAT-e indicator of companies researched in the period analyzed from 2014 to 2018 are presented. They enable verifying the companies' environmental performance.

Table 2 - IPAT-e Calculation inDuratex Co. (data in tons)

Variables	2014	2015	2016	2017	2018	Δ period
Production	4,349,535	4,201,922	3,749,061	3,759,992	4,233,194	-2.67%
Water Consumption	5,480,423	5,117,221	5,359,505	4,438,323	4,289,444	-21.73%
Energy Consumption	2,567,508	2,642,914	2,675,434	2,464,744	2,735,647	6.55%
Air Emissions	512,182	476,826	391,718	406,084	366,791	-28.39%
Effluents	2,613,669	2,616,641	2,608,796	2,071,236	1,615,473	-38.19%
Solid Waste	252,463	201,471	144,056	132,610	125,068	-50.46%
IPAT-e	**11.426.244**	**11.055.074**	**11.179.509**	**9.512.997**	**9.132.423**	-
Unit IPAT-e	**2.63**	**2.63**	**2.98**	**2.53**	**2.16**	**-17.87%**

Source: Elaborated by the authors on the basis of data extracted from Sustainability Reports, 2019.

In table 2, it is found that Duratex maintained environmental impact at 2.63 per unit of product (ton) in 2014 and 2015. Although there was a decrease of water consumption, air emissions and of solid waste, an increase in energy consumption and effluentscontributedto maintain the impact even withthe production decrease. The year 2016 showed the highest impact in the period analyzed. Although there had been a considerable production decrease in relation to previous years, the consumption of water and energy increased, which raised the rate to 2.98 per unit of product (ton). Conversely, the years 2017 and 2018 showed the lowest indexes per unit of product. In the whole period water consumption, air emissions and disposal of effluent and solid waste had a reduction; only energy consumption showed a small rise.

Table 3 - IPAT-e Calculation inSuzano Co. (data in tons)

Variables	2014	2015	2016	2017	2018	Δperiod
Production	4,282,700	4,582,000	4,655,000	4,698,000	4,767,000	11.31%
Water Consumption	135,491,000	138,210,118	145,015,970	143,156,230	145,905,280	7.69%
Energy Consumption	24,085,173	25,933,886	28,310,624	28,295,575	27,179,849	12.85%
Air Emissions	1,250,398	2,247,047	1,470,147	1,408,460	1,568,614	25.45%
Effluents	105,737,000	106,112,878	106,555,916	112,131,990	119,081,987	12.62%
Solid Waste	13,476,104	1,300,951	859,152	887,212	1,098,050	-91.85%
IPAT-e	**280,039,675**	**273,804,880**	**282,211,809**	**285,879,467**	**294,833,780**	**-**
Unit IPAT-e	**65.39**	**59.76**	**60.63**	**60.85**	**61.85**	**-5.41%**

Source: Elaborated by the authors on the basis of data extracted from Sustainability Reports, 2019.

In table 3 Suzano shows highest environmental impact in 2014, with 65.39 per unit of product (ton.). That was mainly due to solid residues, whose amount was the highest recorded. By contrast, 2015 had the lowest index and significant reduction in solid waste even with production increase. There was a gradual increase from 2016 to 2018. In this period there was an increase of production and of solid waste, as well as effluent disposal and water and energy consumption in comparison with 2015. Even so, throughout all periods, even with growth in production and in four of the five environmental variables analyzed, IPAT-e decreased, mainly due to a negative variation in the solid waste disposal.

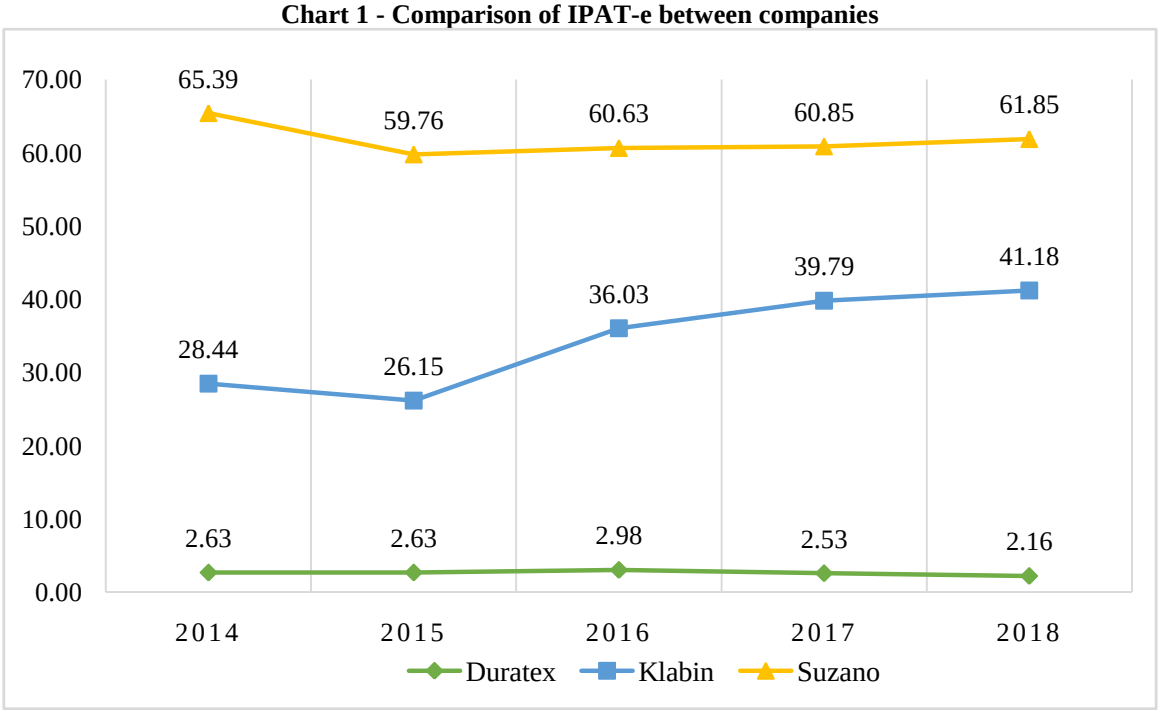
Table 4 - IPAT-e Calculation inKlabin Co. (data in tons)

Variables	2014	2015	2016	2017	2018	Δperiod
Production	4,608,000	4,997,000	5,093,000	5,808,000	5,299,000	15.00%
Water Consumption	62,719,998	61,980,750	92,685,263	112,269,300	109,413,520	74.45%
Energy Consumption	8,707,992	9,032,908	15,010,992	16,840,246	16,331,658	87.55%
Air Emissions	691,870	646,940	858,008	990,757	927,210	34.02%
Effluents	58,758,465	58,811,098	74,195,940	100,014,480	90,677,541	54.32%
Solid Waste	191,328	182,585	740,737	956,792	853,564	346.13%
IPAT-e	**131,069,653**	**130,654,281**	**183,490,941**	**231,071,576**	**218,203,494**	**-**
Unit IPAT-e	**28.44**	**26.15**	**36.03**	**39.79**	**41.18**	**44.80%**

Source: Elaborated by the authors on the basis of data extracted from Sustainability Reports, 2019.

As for Klabin (table 4), IPAT-e increased from 28.44 in 2014 to 41.18 per unit of product (ton) in 2018. This rise began in 2016, when all variables showed a relevant increase. Growth occurred as well in all variables in 2017 the year in which the highest quantity produced was recorded and IPAT-e arrived at 39.79 per unit of product (ton). In 2018, by contrast, all variables showed a decrease in comparison with 2017; even so, it was the year when the greatest impact was recorded, because of the drop in the company's production. In the analyzed period, solid waste disposal had the highest increase, followed by energy and water consumption, respectively.

Chart 1 - Comparison of IPAT-e between companies



Source: Elaborated by the authors, 2019.

Comparing the researched companies' IPAT-e results, Suzano is the one that has the greatest environmental impact, with IPAT-e at a level close to 60.00 per unit of product (ton). Nonetheless, even though there is a continuous production increase between 2014 and 2018, Suzano's environmental impact measured for 2018 is lower than in 2014.

Duratex had the lowest environmental impact, with a mean IPAT-e of 2.59 per unit of product (ton). In additionwe verified that production in 2018 was lower than in 2014, but IPAT-e reduced, which demonstrates positive results in containing environmental impacts caused by the company.

Klabin is the second company of highest environmental impact, with mean IPAT-e of 34.32 per unit of product (ton). However, if we consider results from 2016 to 2018, this mean increases mainly because the company's production was 15% higher in 2018 when compared to 2014, while IPAT-e increased 44.80% in this period, which leads to the conclusion that the company was not effective in its contingency actions of environmental impact generated.

3.3 Statistical and econometric analysis

The premise of analysis and expected results followed the hypothesis that the lower the environmental impact generated by a company, the better its economic and financial performance. The research sought to identify which variables influenced on the impact generated by companies, following procedures of Gujarati and Porter (2011). Table 5 contains Model 1 estimation results using the OLS method, fixed effects and random effects as per procedures of Gujarati and Porter (2011).

Table 5 - Model 1 Estimation Results with OLS (Ordinary Least Squares).

RESULTS - PANEL ANALYSIS		
	OLS Estimation	
	Estimator	**T Test**
Intercept	-6.0988	0.77716
$\beta_{1(ROA)}$	5.5296	0.08182
$\beta_{2(ROE)}$	-3.1464	0.31561
$\beta_{3(EPS)}$	11.4688	0.51173
$\beta_{4(LR)}$	15.6330	0.29202
R^2	0.27952	
R^2aj.	-0.0086725	
F-statistic	0.969907 in 4 and 10 DF	
P value	0.46547	

Significances: (***) 0.1%, (**) 1%, (*) 5%, (.) 10%, DF = Degree of Freedom
Source: Elaborated by the authors with the aid of RStudio program, 2019.

Table 5 presents results of the model using the fixed effects estimation test. The first difference between estimators is rejected because it shows a p value of only 0.061472, and also, it was not possible to calculate fixed effects and variable effects estimators due to the quantity of data available in time series (only 3). It is worth stressing the ponderation of Duarte *et al.* (2007), who affirm the Fixed Effects model to be the best option for modeling panel data when the intercept $\propto 1$ is correlated to explanatory variables at any time period. Marques (2000) stresses that for fixed effect models, priority must be given to models whose coefficients vary from individual to individual or in time, though they remain as fixed constants, for example for data from countries, companies, etc. However, to consider this model, a number of observations equal to or higher than 5 (five) is necessary.

Tests of normality, independence and variance homogeneity were carried out. The R^2 is 0.27 and adjusted R^2 is -0.008, which reveals that the model does not explain the test fully, although it is suitable to consider that several studies have already found that the search for impact reduction does not reflect onthe company's result.

IV. CONCLUSIONS

The increasing development of debates on sustainability leads organizations to seek recognition as socially responsible. The research's main aim was to assess the economic-financial performance and environmental performance relation in wood, paper and cellulose companies present in the Brazilian stock exchange sustainability indexes (B3), in the period from 2014 to 2018.

We used the IPAT-e indicator, which is capable of gauging the company's impact on the environment from two variables: production, represented by the quantity produced of consumer goods, and technology, namely, water, energy, effluents, air emissions and solid waste. Data for calculation were obtained in the companies' sustainability reports. By comparing results of the ROA, ROE, EPS and LR economic-financial indicators with results obtained from the IPAT-e indicator, it was possible to concludethe following:

i. As toresults of mean values concerning economic-financial indicators for the period analyzed, Suzano Co. showed the best results for ROA and EPS indicators, while Klabin Co. had the best results for ROE and LR. Even so, it was found that Duratex Co. was the only company that did not have negative results in the whole period analyzed for the ROE, EPS and LR indicators.

ii. Concerning IPAT-e it was found that companies of the paper and cellulose segment are the ones most impact the environment. Suzano Co. had the highest results, with an IPAT-e close to 60.00 per unit of product (ton). Nevertheless, it showed impact decrease in the comparison between 2014 and 2018. Klabin Co., the onlycompany that partakes the two B3 sustainability indexes, had an impact increase of 44.80% in the period analyzed. It was found that this increase rose as of 2016. Duratex Co., in turn, had the lowest rates. It showed the highest IPAT-e decrease in the analyzed period.

Correlation index between dependent variables (ROA, ROE, EPS and LR) and independent variable (IPAT-e) was calculated using econometric analysis, so as to identify which variables influenced on the impact generated by companies. Results obtained indicate that there is no relation between company performance in the IPAT-e and economic-financial performance, since R^2 is low. Hence, the model is not sufficient to explain the behavior of variables in this respect.

From results obtained, and knowing that there are limitations to the research, especially concerning the short period of data analysis and restricted number of companies selected, elaborating future works considering a greater time period and selecting a larger business group, and from diverse sectors, is suggested. Another important aspect to be observed to this effect, are variables for assessing economic and environmental performance by making use of other economic-financial indicators, in addition to the possibility of adding social indicators, so as to contemplate all aspects comprised in the concept of Corporate Social Responsibility.

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