

## **Informational Asymmetry Index**

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### **Abstract**

This research aims to propose an index of informational asymmetry and create a ranking with publicly traded firms in a market analysis that can be used in several studies in corporate finance. The proposed method consists in the construction of an algorithm based on the Elo rating and capture the perception of the analyst that choose, between two firms, the one they consider to have better information. After having two different indexes built on two distinct dates and by different analysts, it was confirmed the consistence of the method once the Spearman rank-order correlation between different combinations of indexes was higher than 70%. This index is a good proxy for use as a measure of disclosure of Brazilian firms and it will help the development of the theory and greater understanding of the impacts of disclosure on many aspects related to finance as value and cost of capital.

## **I. Introduction**

Information is one of the most important factors in achieving market efficiency because agents can use it to adjust production levels and prices that lead to utility maximization. Akerlof (1970) showed that in an environment of asymmetric information, the market as a whole is harmed and could, in extreme situations, collapse.

Akerlof (1970) used the market for used cars ("lemons") to exemplify the adverse selection problem caused by information asymmetry between buyers and sellers. Later research in corporate finance has attempted to explain imperfections based on informational asymmetry between executives and the market.

In corporate finance, information asymmetry is examined primarily from the perspective that executives have more information about the companies than creditors and shareholders. Shleifer and Vishny (1997) argue that the quality and quantity of information provided to the market allow users to distinguish the quality of best practices in corporate governance.

Therefore, the worse the quality and amount of information presented to the market, the higher the information asymmetry between executives and funders (shareholders and debt capital). This, in turn, increases investor risk, which will require greater compensation for capital invested and increase the cost of capital to the company, thereby reducing its value and stimulating retained earnings to finance growth through internally generated funds.

Moreover, the act of producing information for the market generates costs to businesses, and the dissemination of certain information could endanger companies' strategies, should they become aware of competitors, for example.

Consequently, companies should seek an optimal informational level that maximizes the result of this relationship. However, there is an agency problem between information owners and other shareholders. The asymmetry of information allows some to have greater gains than others, and thus creates an incentive for managers to foster information asymmetry and provides them with greater opportunities for gains.

The literature highlights that one of the goals of a company is to maximize firm value, thereby creating wealth for all shareholders. In this context, corporate governance practices have

emerged seeking greater transparency and disclosure of firms' actions, such disclosure contributing to a lower degree of risk and a higher degree of reliability in management and the company.

Thus, a company's level of disclosure should be the best possible, even if additional costs are incurred, as these costs are outweighed by the benefit.

However, not all companies engage in broad disclosure of their actions, and the level of information asymmetry varies greatly among the various companies operating in the same market.

Several studies have been conducted in order to ascertain the impact of information asymmetry on companies because the level of information asymmetry between company managers and the market may have different consequences for each company. These may include executive compensation, cost of capital, level of indebtedness, the company's profitability, shareholder return, liquidity, control structure, and dividend policy.

Modigliani and Miller (1958) demonstrated that the capital structure of a company is irrelevant in an environment without taxes, without the risk of debt, and with fully informed investors.

However, Stiglitz (1969, 1974) presented many market imperfections, one of which was the fact that investors are not fully informed. Stiglitz (1974) also noted that company policies could contain information that is unknown by market professionals.

Ross (1977) developed a model in which managers of firms with low expected cash flow generation are afraid to commit to debt, so the fact that a company is in debt is a sign that it is confident of strong cash generation in the future.

Lintner (1956) had already identified that executives avoid changing company dividend policies, and Watts (1973), Bhattacharya (1979), and Miller and Rock (1985) used this aversion to changing dividends to create a model in which changes in dividends contain information about expected future profits.

Harris and Raviv (1991) argue that information asymmetry and capital structure can be analyzed by two approaches. One is that the capital structure reflects managers' expectations, while the other is that decision-makers are impacted by the level of informational asymmetry between managers and the market.

Many works written since 1991 have tried to use the level of information asymmetry as an explanatory variable for some of the decisions of the executives, but the major challenge faced by these surveys is to effectively measure information asymmetry.

Given the difficulty in determining the informational asymmetry that exists between managers and the market, this research aims to propose an index of informational asymmetry and create a ranking with publicly traded firms in a market analysis that can be used in several studies in corporate finance.

The theory identified several potential impacts of information asymmetry between managers and the market, but has not yet found an effective way to measure it and thus determine its impact on a company.

The creation of an index of reliable information asymmetry, which will be made available to interested researchers, will allow the development of the theory and greater understanding of its impacts on this important aspect of business.

The rest of the paper is organized as follows: a literature review on information asymmetry is provided in section II; the authors' concept of information asymmetry index is developed in section III; the methodology used to build the information asymmetry index is described in section IV; results are reported in section V, and a conclusion is given in section VI.

## **II – Theoretical background**

Information asymmetry occurs when two or more parties negotiate and each has a different level of information. Akerlof (1970), Spence (1973), and Rothschild and Stiglitz (1976) have constructed a theoretical basis for the asymmetry of information.

Akerlof (1970) discussed the differences in information about the quality of a product, using the used car market as an example. In this model, sellers make their decisions based on their

knowledge of the quality of the car, while buyers try to maximize their purchase without this information, i.e., in an environment of information asymmetry.

As buyers are unable to assess the quality of any car individually, all used cars are purchased at the same price. Sellers, connoisseurs of quality cars, will only sell if the price offered is appropriate for the quality of the car, so only cars of lower quality will be offered for sale. In other words, the average quality of cars sold is poorer than that of cars not offered for sale. This situation provides an adverse selection environment.

Spence (1973) created a model of signaling in the labor market, where contractors do not have the same level of information about a candidate's skills. When candidates, in a context of asymmetry, want to convince a company that they are productive professionals and deserve a high salary, they send signals to demonstrate their productivity. This signaling function, the cost of signage, should reflect the difference among candidates, i.e., it should be higher for people with low productivity.

Rothschild and Stiglitz (1976) analyzed the insurance market, in which there is information asymmetry because it is only the insured party who knows his/her true state of health and driving abilities.

Myers and Majluf (1984) and Greenwald, Stiglitz, and Weiss (1984) observed that raising funds through the issuance of shares will generally be problematic, due to the adverse selection problem. Executives wish to issue new shares when they believe, based on information that is not known to the market, that the company's shares are overvalued.

Diamond and Verrecchia (1991) found evidence that a reduction in information asymmetry increases share value, due to the lower cost of capital arising from the higher demand for these shares.

Verrecchia (2001) considers that there is a cost of disclosure of certain information: a company has an incentive to disclose all such information, as the market interprets the absence of information as unfavorable. When the cost of informing begins to increase, the level of disclosure tends to reduce information asymmetry and to grow.

Pires and Macagnan (2012) analyzed 36 international articles that investigated informational asymmetry and found that 47.22% of them did not define a proxy for the measurement of variable asymmetry of information.

In the remaining studies, the following variables were identified as proxies for the measurement of variable asymmetry of information:

- bid-ask spread;
- error and/or dispersion of analysts' share price forecasts;
- stock price volatility;
- informed trading probability;
- Tobin's Q;
- company size;
- systematic risk;
- free float;
- spending on research and development;
- number of analysts covering the company.

The bid-ask spread was used as a measure of information asymmetry in most research projects, namely Chung (2006), Kanagaretnam, Lobo, and Whalen (2007), Chen, Chung, Lee, and Liao (2007), Wang and Zhang (2009), Chu and Song (2010), and Fauver and Naranjo (2010).

The rationale of using the bid-ask spread can be obtained from Glosten and Milgrom (1985), who consider that argument spreads are consequences of asymmetric information among market participants.

On the other hand, Huang and Stoll (1997) find that the bid-ask spread can be broken down into the cost of processing orders, carrying costs, and the cost of adverse selection. However, according to the authors, the most important part in determining the bid-ask spread is the cost of processing.

Moreover, the intuition of using the bid-ask spread as a proxy to measure the asymmetry of information comes from the concept of Diamond and Verrecchia (1991), in which asymmetric information reduces the liquidity of the share. The bid-ask spread can be used as a measure of liquidity of an action, and it would also be a measure of information asymmetry; however, the fact that information asymmetry decreases the liquidity of a share is not the only factor that impacts liquidity and, consequently, the bid-ask spread.

As noted, there have been numerous attempts to measure information asymmetry, highlighting this measure's importance to researchers, but there is no consensus on a variable that does so.

### **III - Informational Asymmetry Index**

Informational asymmetry arises from the fact that managers possess more information about a company than the market does. At first, managers know the true asymmetry of information because they hold all the information and determine what will be disclosed to the market. However, managers have no control over the interest that analysts and investors have in informing themselves about a company.

Thus, neither party has full knowledge of the information asymmetry between a company's managers and the market, and it is not sufficient to inform the other party if it does not seek this information.

Investors are aware of their own level of information about a company, but they do not know all the information held by managers or how big the information asymmetry is between managers and the market.

There may be situations in which an investor believes that a company adopts best practices of disclosure and that information asymmetry is low when, in reality, the company is simply appearing to be transparent while maintaining high levels of information asymmetry. On the other hand, it is also possible for investors to feel poorly informed and believe there is high informational asymmetry, even when the company has a policy of full disclosure of information to the market.

Thus, neither the investor nor the managers truly knows the level of information asymmetry; however, the company is affected by a feeling of existing information asymmetry in the market.

If investors believe that there is great informational asymmetry between managers and the market, the market's perception of risk will increase and, consequently, incur a higher cost of capital. The actual extent of informational asymmetry is irrelevant, since it is unknown. The decisions of the various market players are taken on the basis of their beliefs and perceptions.

Consequently, analysts' perceptions of information asymmetry between firms and markets will be sought. It is not necessarily the analysts' perception that reflects the actual level of disclosure and information asymmetry, but their belief, which, in the end, will impact on the risk perceived by the analyst to the cost of capital.

The information asymmetry index proposed in this research project is supported by the assumption that the impact of information asymmetry on a company is due to investors' perceptions of information asymmetry between the firm and the market.

#### **IV - Method**

In this section, the methodology used to build the information asymmetry index is presented, followed by the data.

##### **A. The rating algorithm**

An algorithm was created based on the Elo rating, which was developed by Arpad Elo (1961) and is best known as the ranking system used to rank chess players.

The logic of this ranking is to check the likelihood of a win between direct disputes. A win when the expected probability was high would add very few high points to the ranking; however, a win with a very small probability adds many points to the ranking.

To illustrate the calculation of rank, let us imagine a confrontation between company X<sub>(Elo rating 1200)</sub> and company Y<sub>(Elo rating 1000)</sub>. The difference between rankings is 200, which would represent a win probability of 76% for X and 24% for Y. The win expectation was used to calculate the expected probability of winning, according to the difference in the ranking presented by Albers and Vries (2001) and shown in Table 1. The new rank of X after this win would be:

New ranking of X = previous rank of X + (1-p) x k

where:

p = win probability

k = constant

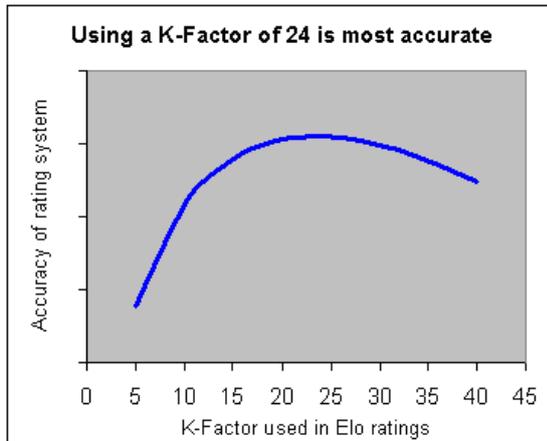
In this example, p is 76% and k was determined by Albers and Vries (2001) as 100. In this case, the new rank of X would be 1224 ( $1200 + (1-0.76) \times 100$ ).

Rating difference	Expected chance of winning	Difference	Chance	Difference	Chance
0>=dif<=3	0.50	122>=dif<=129	0.67	279>=dif<=290	0.84
4>=dif<=10	0.51	130>=dif<=137	0.68	291>=dif<=302	0.85
11>=dif<=17	0.52	138>=dif<=145	0.69	303>=dif<=315	0.86
18>=dif<=25	0.53	146>=dif<=153	0.70	316>=dif<=328	0.87
26>=dif<=32	0.54	154>=dif<=162	0.71	329>=dif<=344	0.88
33>=dif<=39	0.55	163>=dif<=170	0.72	345>=dif<=357	0.89
40>=dif<=46	0.56	171>=dif<=179	0.73	358>=dif<=374	0.90
47>=dif<=53	0.57	180>=dif<=188	0.74	375>=dif<=391	0.91
54>=dif<=61	0.58	189>=dif<=197	0.75	392>=dif<=411	0.92
62>=dif<=68	0.59	198>=dif<=206	0.76	412>=dif<=432	0.93
69>=dif<=76	0.60	207>=dif<=215	0.77	433>=dif<=456	0.94
77>=dif<=83	0.61	216>=dif<=225	0.78	457>=dif<=484	0.95
84>=dif<=91	0.62	226>=dif<=235	0.79	485>=dif<=517	0.96
92>=dif<=98	0.63	236>=dif<=245	0.80	518>=dif<=559	0.97
99>=dif<=106	0.64	246>=dif<=256	0.81	560>=dif<=619	0.98
107>=dif<=113	0.65	257>=dif<=267	0.82	620>=dif<=735	0.99
114>=dif<=121	0.66	268>=dif<=278	0.83	dif>=736	1.00

**Table 1: Difference in Elo rating and the corresponding win expectation**  
Source: Albers and Vries (2001)

The win expectation is presented as an illustrative example of the method that will be used in creating the informational asymmetry index. It is the object of this study to determine the proper probability distribution according to the differences in determining rankings and a suitable constant k. For smaller k values, the rating is too slow to change, and so the rating will not properly measure the perception of informational asymmetry at a determined moment.

For large k values, the rating is too sensitive a perception of recent analyst opinions. Sonas (2002) analyzed 266,000 chess games between 1994 and 2001 using different k-factor values to determine how accurate the ratings were at predicting future results, and concluded that 24 is the most accurate k-factor value, as shown in Figure 1.



**Figure 1 – Sonas (2002) k-Factor accuracy**

The rating calculation was run using the following values as k-factor: 16, 24, 36, 64, and 80, and the rating build was compared from the perception of different analysts at two different dates (October, 2016 and March, 2017).

The rating stability was tested on the basis of the Spearman rank-order correlation coefficient proposed by Spearman (1904), defined as:

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)},$$

where:

n = number of firms;

$d_i$  = difference between the ranks of alternative firm<sub>i</sub> in the pair of rankings compared.

The k-factor value used to calculate the disclosure index was 24, the value which results in the highest Spearman rank-order correlation coefficient and is consistent with the value that Sonas (2002) considers to be most accurate.

## B. Data collection

The authors have developed a website (<http://www.disclosureindex.com/br>), on which the current project is presented and analysts are requested to state whether or not they are

certified, and their state of residence. After the analysts have completed this simple form and sent the information requested, the site presents two companies, of which the analysts choose the one they consider to have better information, i.e., where there is less information asymmetry between the company and the market. Ten pairs of firms were presented each time; some analysts participated more than once, in which case they were presented with another ten pairs of firms.

For this research, all firms composing the Brazil Broad-Based Index were included. These are the firms with stocks actively traded and analyst coverage. In October, 2016, they numbered 116, two of which had returned to being privately owned by March, 2017, when four new firms were included in the index, thus totaling 118 firms, of which 114 participated in both samples.

This study was sponsored by three analyst associations: the CFA Institute; APIMEC (Association of Capital Market Analysts and Investment Professionals), and AMEC (Association of Investors in the Capital Markets), which invited their associates to participate by sending them an email.

The first partial rating was built on October 6, 2016, after 41 analysts had chosen the firm with the best disclosure from 712 pairs of firms. The second partial rating was built on March 10, 2017 after 52 analysts had chosen the firm with best disclosure from 932 pairs of firms.

## **V - Results**

After having two different indexes built on two distinct dates and by different analysts, the authors obtained the conditions necessary to compare them, confirm whether the method described above efficiently captured analysts' perceptions, build a reliable index, and define the best k-factor to be used.

The results of the Spearman rank-order correlation coefficient are presented in Table 2. As can be observed, the k-factor does not cause much difference in rank correlation.

<b>k-factor</b>	<b>Spearman's rho</b>
16	52.28%***
24	53.89%***
32	52.82%***
64	51.61%***
80	50.97%***

**Table 2: Spearman rank-order correlation between ranks of October, 2016 and March, 2017**  
\*\*\* indicates significance at the 1% level

The k-factor that resulted the highest Spearman's rho was the value 24, which Sonas (2002) considered most accurate. Beyond the Spearman rank-order correlation coefficient between the first and second index, the authors tested the Spearman rank-order correlation coefficient between the different ranks built using different k-factors. The minimum Spearman's rho found was between k-factor 16 and k-factor 80, where the correlation was 97.67%. The maximum Spearman's rho found was between k-factor 16 and k-factor 32, where the correlation was 99.72%. These results confirm that the k-factor values are not relevant; thus, we adopted the k-factor value 24.

With the k-factor value defined as 24, an accumulated rank was built with the 1644 pairs of firms chosen by 93 analysts. This rank is presented in Table 3. It is also available online at <http://www.disclosureindex.com/>. Past and future ranks will continue to be presented on this website.

The Spearman rank-order correlation coefficient between the accumulated rank and the first rank (with the data of the first wave of participation only) has Spearman's rho of 78.01%, and the accumulated rank and the second rank (only with the data of the second wave of participation) has Spearman's rho of 93.56%. These results demonstrate that our index is consistent, and the more recent perception of analysts have more impact on the index.

Position	Firm	rank value	Position	Firm	rank value	Position	Firm	rank value
1	ITAUUNIBANCO	1716	41	HYPERMARCAS	1532	81	MARCOPOLO	1470
2	BRADESCO	1668	42	SANTANDER BR	1529	82	ESTACIO PART	1469
3	BRF SA	1642	43	CETIP	1527	83	CVC BRASIL	1468
4	CPFL ENERGIA	1626	44	TIM PART S/A	1526	84	TAESA	1465
5	LOJAS RENNEN	1626	45	GOL	1522	85	ELETROPAULO	1463
6	ITAUSA	1624	46	ANIMA	1521	86	MAGAZ LUIZA	1461
7	P.ACUCAR-CBD	1618	47	EZTEC	1516	87	DURATEX	1460
8	ODONTOPREV	1616	48	IGUATEMI	1515	88	SABESP	1454
9	ULTRAPAR	1606	49	ALIANSC	1515	89	PAR CORRETORA	1453
10	FIBRIA	1606	50	CEMIG	1514	90	PETROBRAS	1451
11	CIELO	1604	51	M.DIASBRANCO	1513	91	COSAN LOG	1443
12	AES TIETE	1599	52	ENERGIAS BR	1510	92	LOJAS AMERIC	1443
13	NATURA	1597	53	SER EDUCAÇÃO	1508	93	ALUPAR	1439
14	SULÁMERICA	1593	54	SMILES	1507	94	LINX	1434
15	TOTVS	1591	55	VALID	1498	95	COPEL	1429
16	VALE	1590	56	TEGMA	1497	96	IMC S/A	1428
17	LOCALIZA	1585	57	SANEPAR	1494	97	EQUATORIAL	1428
18	EMBRAER	1582	58	VIA VAREJO	1492	98	TUPY	1422
19	CCR SA	1580	59	SOMOS EDUCAÇÃO	1490	99	TECNISA	1421
20	BRASIL	1577	60	LIGHT S/A	1490	100	QGEF PART	1421
21	SUZANO PAPEL	1576	61	METAL LEVE	1488	101	GAFISA	1420
22	WEG	1576	62	CIA HERING	1488	102	JBS	1419
23	PORTO SEGURO	1573	63	SLC AGRICOLA	1487	103	MRV	1419
24	BMFBOVESPA	1573	64	RUMO LOG	1485	104	COPASA	1415
25	ENGIE BRASIL	1568	65	EVEN	1484	105	LOJAS MARISA	1414
26	FLEURY	1565	66	GRENDENE	1483	106	CTEEP	1409
27	KLABIN S/A	1564	67	RANDON PART	1482	107	QUALICORP	1407
28	MULTIPLAN	1561	68	IOCHP-MAXION	1481	108	BR INSURANCE	1402
29	CYRELA REALT	1551	69	ELETROBRAS	1481	109	USIMINAS	1393
30	BRASKEM	1549	70	ABC BRASIL	1481	110	B2W DIGITAL	1390
31	GERDAU	1549	71	BANRISUL	1481	111	BR PROPERTIES	1386
32	AMBEV S/A	1547	72	BR MALLS PAR	1477	112	OI	1386
33	Telefônica	1547	73	MILLS	1477	113	DIRECIONAL	1383
34	MULTIPLUS	1545	74	ECORODOVIAS	1476	114	ROSSI RESID	1379
35	RAIADROGASIL	1541	75	HELBOR	1475	115	SAO MARTINHO	1360
36	BRADESPAR	1541	76	AREZZO CO	1475	116	BR BROKERS	1357
37	KROTON	1539	77	CESP	1473	117	MARFRIG	1355
38	COMGAS	1536	78	COSAN	1472	118	PETRORIO	1315
39	SID NACIONAL	1535	79	MINERVA	1471			
40	BSEGURIDADE	1535	80	ALPARGATAS	1470			

**Table 3: Informational Asymmetry Index from March, 2017**

The Informational Asymmetry Index ranks the analysts' perceptions of information asymmetry between firms and markets. The authors believe that it is a good proxy to measure disclosure because it reflects what the market believes is a good level of information.

### **Robustness**

Robustness tests were performed to verify the reliability of the Informational Asymmetry Index. The Spearman rank-order correlation coefficient between our Informational Asymmetry Index and two different indexes was tested, one with only Chartered Financial

Analysts and other with only non-Chartered Financial Analysts. We found Spearman's rho of 69.04% and 88.79% respectively.

We also tested the Spearman rank-order correlation coefficient between our Informational Asymmetry Index and some other index ranks, such as price/earnings, price/book value, dividend yield, and return on equity. We found Spearman's rho of 23.24%; 42.49%; 22.71%, and 40.01% respectively.

The greatest Spearman's rho between the Informational Asymmetry Index and other index ranks was found between the Informational Asymmetry Index and price/book value (42.49%). This is not a surprise because it is one of the measures used as proxy for disclosure. It is expected that better disclosure increases firm value.

Despite the good correlation found between the Informational Asymmetry Index and other indexes, it is much smaller than the correlation found between the Informational Asymmetry Index and different groups of analysts. This high correlation with different groups of analysts confirms the consistency of the method described in this paper of building the Informational Asymmetry Index.

## **VI - Conclusion**

The purpose of the research was to build an index of informational asymmetry. This paper adds to disclosure research since it provides a reliable proxy to be used in the field. Several studies have aimed to find the benefits of good disclosure for firms, but they have as a limitation the absence of a good proxy for the disclosure level of a company. This study considers that the perception of analysts is a good proxy for the disclosure level of a company, and a tool was constructed to collect analysts' perception and create an index with an algorithm based on Elo ratings.

After two waves of analyst participation, three rankings were calculated: with data from the first wave only, with data from the second wave only, and with all data. The high correlation found between the different rankings eliminates the possibility that the answers were random, and confirms that the disclosure index described in this paper indicates analysts' perception, and is a good proxy for use as a measure of disclosure of Brazilian firms.

For further research, the authors consider running a regression model whose dependent variable are the measure of disclosure and whose independent variables are the other proxies used to measure disclosure. This model could be a reliable measure of disclosure which does not depend on the collaboration of analysts.

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