

Fifty-year history of the Ibovespa

(Ibovespa: 50 anos de história)

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Abstract

We summarize the fifty-year history (1968-2017) of the Ibovespa, a gross total return index that comprises the most liquid stocks traded on the São Paulo Stock Exchange in Brazil. We provide contextual material on the Brazilian economy during this 50-year period (such as the fight against hyperinflation, the privatization of companies, and economic crises) and its impact on the index composition and performance. We discuss the effect of the change in the index calculation methodology that took place in 2014, when companies with lower market capitalization became less representative in the index. Finally, we discuss the representativeness of each industry on the Ibovespa portfolio.

Keywords: Market index; stock market; Brazil

JEL Code: G10, N26.

1. Introduction

The Bovespa index (or simply Ibovespa) was created fifty years ago, on January 2, 1968. Before Ibovespa, prices of stocks traded on the São Paulo Stock Exchange¹ (SPSE) were publicized via a daily bulletin² (Boletim Diário de Informação – BDI). The SPSE wanted to create an index that had a good representation of the most traded stocks on the exchange. It then adopted for the Ibovespa the same methodology used by the Rio de Janeiro Stock Exchange (RJSE) for its own index, the IBV (Índice Bolsa de Valores) (Leite & Sanvicente, 1994).

There are two main types of stock market indexes: stock price indexes and investment performance indexes. Investment performance indexes differ from stock price indexes mainly because in their computation all cash dividends and capital gains are taken into account (Fisher, 1966). Indexes such as the Ibovespa and the S&P 500 are examples of investment performance indexes, whereas the Dow Jones Industrial Average is an example of a stock price index. Indexes that track both the capital gains and the distribution of dividends are also called total return indexes.

Stock market indexes are important for a number of reasons: (i) they serve as a quick proxy for historical market performance, (ii) they are used as benchmarks against which fund managers can measure their performance, (iii) they are necessary to calculate the systematic risk and the cost of equity of firms, and (iv) they reflect investor sentiment. Representation, methodological stability, and institutional reliability are necessary and sufficient conditions for the success of an index (Leite & Sanvicente, 1994).

It is essential to discuss the political and macroeconomic scenario in Brazil over the last 50 years to understand the path and the performance of the Ibovespa. Inflation in Brazil was very high for many years. Successive governments attempted different economic measures to obtain financial stability and control inflation (some unsuccessfully). Annual inflation rates grew from three-digit figures in the 1980s to four-digit figures until the mid-1990s. As a consequence, zeros had to be continuously removed from the Ibovespa. A total of 12 zeros were slashed from the index from 1983 to 1997.

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¹ The São Paulo Stock Exchange is commonly known in Brazil as Bovespa.

² All BDIs published by the SPSE since January 3, 1958 are available online at <http://www.acervobmfbovespa.com.br>.

This article summarizes the history of the Ibovespa, its portfolio constituents, historical performance, calculation methodologies, and an analysis of how representative the index is of the overall Brazilian economy. We provide contextual material on the Brazilian economy during this 50-year period, covering the years when the country was under military rule, the redemocratization, the stagnation and inflation years, the economic stabilization plans to defeat inflation, and the most recent years.

2. History

The first institution in Brazil for dealing in various sorts of merchandise and securities was established in Salvador in 1817. Although it resembled a stock exchange, it was not exactly organized as the ones we know today. The next stock exchange was opened in Rio de Janeiro three years later. All of the stocks traded at the time were issued by Banco do Brasil (Barcellos & Azevedo, 2011). In 1890, president Rangel Pestana founded the Bolsa Livre de São Paulo, which lasted only 14 months. A new stock exchange was founded in 1895 as Bolsa de Fundos Públicos de São Paulo. It was renamed Bolsa de Valores de São Paulo (Bovespa) in 1967 (B3, n.d.). Bovespa merged with BM&F (the Brazilian Commodities and Futures Exchange) in 2008, forming BM&FBOVESPA. Later in 2017, BM&FBOVESPA merged with Cetip Organized Markets resulting in B3 – Brasil, Bolsa, Balcão.

The SPSE started calculating the Bovespa index, commonly known as the Ibovespa, on January 2, 1968. Fifty years after its inception, the Ibovespa is recognized as the most important stock market index in the Brazilian market. In 1962, the now-defunct RJSE³ developed the methodology for its own index. The index underwent some methodological changes to take into consideration the payment of dividends, stock splits, etc., and in 1967 the RJSE started calculating the IBV (or Stock Exchange Index, in English). The SPSE adopted the same methodology used for the IBV and launched the Ibovespa in 1968.

The initial constituents of the Ibovespa were 18 stocks from a range of industries: Aços Villares, Cimento Itaú, Duratex, and Vale do Rio Doce (materials); Alpargatas, Brinquedos Estrela, Casa Anglo, Lojas Americanas, and Melhoramentos (consumer discretionary); Antarctica Paulista, Moinho Santista, and Souza Cruz (consumer staples); Banco Itaú and Banespa (financials); Docas de Santos and Indústrias Villares (industrials); Paulista de Força e Luz (utilities); and Petróleo União (energy). Since 1968, the Ibovespa portfolio of stocks has been rebalanced every four months, always on the first business day of January, May and September. Nine new stocks from seven different firms were added to the index in the first rebalancing period⁴. These new companies were the following: Arno (consumer discretionary); Banco Comercial do Estado, Banco da América, and Banco do Comércio e Indústria (financials); Cimaf (materials); Kibon (consumer staples); and Willys (industrials).

Fifty years after the creation of the Ibovespa, a total of 347 different companies have been listed, at some point, in the index. Vale do Rio Doce (currently called Vale), one of the world's largest mining companies, was the only company to be present in all the 150 Ibovespa portfolios from 1968 to 2017. Souza Cruz, a Brazilian tobacco company, also had a long history on the Ibovespa. The company was part of the index from the first portfolio in 1968 to 2015. In 2016, the company was fully acquired by British American Tobacco, was delisted, and consequently left the index.

Banco Federal Itaú Sul Americano, or simply Banco Itaú, also had a long history on the Ibovespa. In 1969, the company merged with Banco da América, a bank that entered the Ibovespa on the second portfolio rebalancing, and formed Banco Itaú América. The bank was renamed Banco Itaú in 1973, and in 1974, it acquired Banco União Comercial, a bank that had previously merged with Banco Comercial do Estado, an Ibovespa constituent in its early years. In 2008, the bank merged with another Ibovespa member, Unibanco,

³ On January 28, 2000, all stock exchanges that operated in Brazil at the time agreed to gradually transfer the trading of securities to the SPSE. The RJSE, in particular, ended operations in 2002.

⁴ Brazilian firms may issue common and preferred stocks. The former give the stockholder voting rights, whereas the latter do not. Holders of preferred stocks are paid dividends before common shareholders and, in the case of liquidation, preference in capital reimbursement. More than one type of preferred stock can exist, and the differences between them are set in the bylaws. Novo Mercado, a listing segment at the SPSE with higher corporate governance standards that launched in 2000, comprised companies that only had common stocks, complying with the “one share, one vote” principle.

and formed Itaú Unibanco. Duratex, a manufacturing company that is part of the same economic group that controls Banco Itaú, was one of the 18 initial constituents with a high presence on the index.

Companhia Paulista de Força e Luz and Lojas Americanas, after intermittent periods on the index, were still part of Ibovespa on its 50th anniversary. Indústrias Villares was the elevator and escalator arm of the Villares Group. The company was acquired by the Swiss company Schindler in 1999 and was delisted in 2003. The company had a continuous presence on the Ibovespa from 1968 to 1987. Aços Villares was the manufacturer of steel in the Villares group until 2000, when it was acquired by the Spanish group Sidenor and then renamed Villares Metals. In 2004, the company was sold to the Austrian group Böhler-Uddeholm. Later, in 2011, the company was eventually acquired by the Brazilian group Gerdau and was delisted from the SPSE. Aços Villares' shareholders received one non-voting preferred share of Gerdau for every 24 voting common shares they held at the time.

Alpargatas went public in 1913 and was still publicly traded in 2017. The company was a member of the Ibovespa until 1997, when its trading volume eventually declined. Brinquedos Estrela had a similar fate. The company went public in 1946 and, like Alpargatas, was still listed in 2017. The company eventually left the index in 1996 when its trading volume declined. Melhoramentos, a company in the publishing business, went public in March 1947. The company was a constituent of the Ibovespa for only 12 portfolios in the early years of the index.

Antarctica, a beverage company, was a member of the Ibovespa until the mid-1970s. After merging with Brahma to form Ambev in 2000, the company returned to the index. Banespa was a regional bank from the state of São Paulo that was privatized in 2000, when the Spanish bank Santander won the bidding for Banespa. The bank was a regular constituent of the Ibovespa, being left out of the index portfolio in just two occasions until its privatization. Casa Anglo, a company that operated department stores, was a regular member of the index until 1986. In March 2000, the company was delisted after declaring bankruptcy. Cimento Itaú⁵ was in the index portfolio until 1997. The company eventually went private in May 2004.

Docas de Santos was founded in 1892 to operate the Port of Santos concession. The concession contract was granted by the imperial government of Brazil to Gaffrée, Guinle & Companhia in 1888 for a 39-year period. In 1890, with Brazil then under republican rule, the concession contract was extended until 1980. The concession was transferred to Docas de Santos in 1892. With the end of the concession, Docas de Santos changed its name to Docas and established itself in the management of companies and enterprises industry. The company was a continuous constituent of the Ibovespa from 1968 to 1982 and appeared on the index portfolio for the last time in 1987. Docas was delisted in May 2014.

Moinho Santista, founded in 1905, was a company engaged in the trading and milling of wheat, with Bunge & Born as a minority shareholder. The firm was a continuous constituent on the Ibovespa until 1991. In 1994, the company was turned into a cement and textile holding company. In 2000, Moinho Santista merged with Ceval Alimentos, a subsidiary of the Bunge group. Petróleo União was a member on the Ibovespa portfolio only until 1974, when it was acquired by Petrobras. Figure 1 shows the timeline of the 18 initial constituents of the Ibovespa portfolio in its fifty-year history.

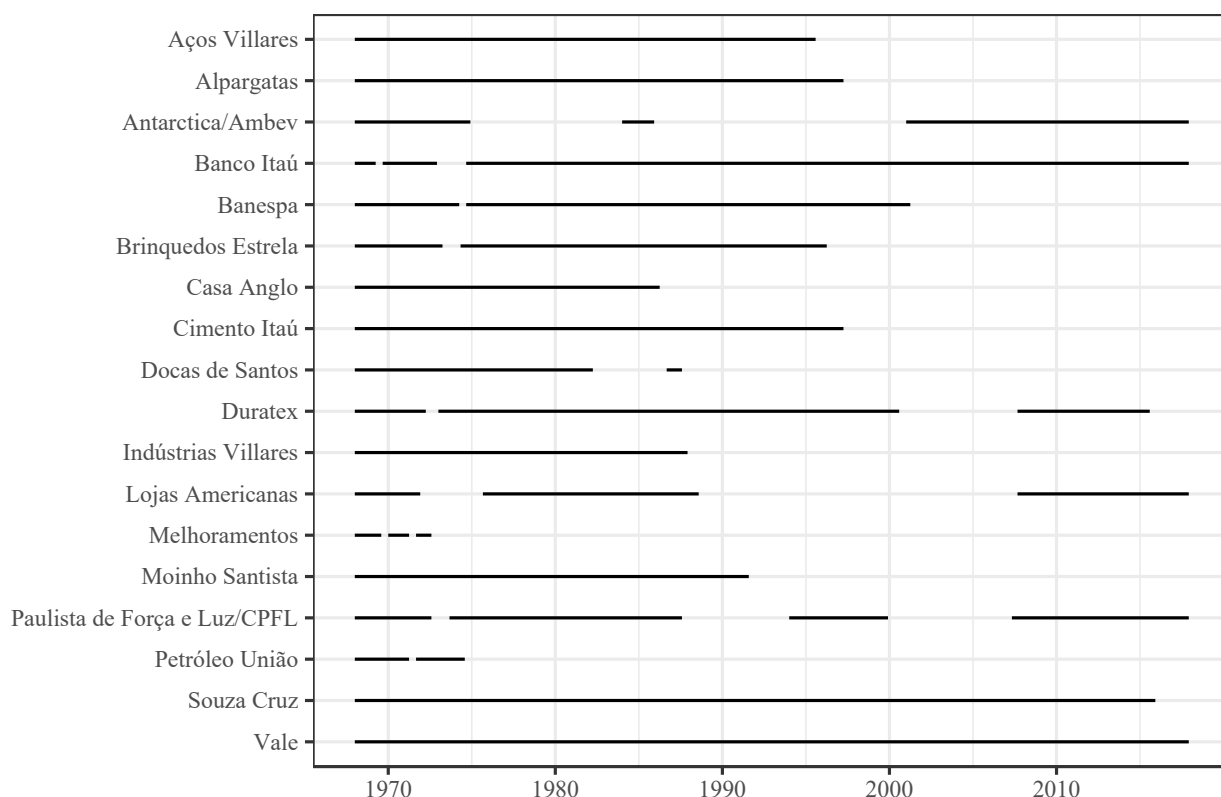
3. Historical performance

When first published, the index was set to 100 points, which corresponded to NCr\$ 100.00 (one hundred cruzeiros novos, the Brazilian currency at the time). In the first ten years after the inception of the Ibovespa (1968-1977), total inflation was 850.3% (average annual rate of 25.25%). Inflation in the following ten years (1978-1987) hit 472,302% (average annual rate of 133%) and an astronomical 9.9 billion percent in the 1988-1997 period (average annual rate of 530.6%). Average annual inflation in the following ten-year periods registered 6.65% (1998-2007) and 6.05% (2008-2017). Inflation rates of this magnitude would have raised the value of the index by a scale of 10^{13} if zeros were not lopped off periodically. Every time the index approached 100,000 points, one or two zeros were removed from the index (see Figure 2a). The first time this happened was

⁵ Cimento Itaú is a company that manufactures and markets construction materials. The company is not related to Banco Itaú and received its name because of its headquarters location at Itaú de Minas, a city in the state of Minas Gerais.

Figure 1

Timeline of the 18 initial constituents on the Ibovespa portfolio. On the 50th anniversary of the Ibovespa: (i) Alpargatas, Ambev, Banco Itaú, Brinquedos Estrela, Duratex, Lojas Americanas, Melhoramentos, CPFL, and Vale were still active; (ii) Aços Villares, Banespa, Indústrias Villares, Moinho Santista, and Petróleo União had been targets of M&A activities; (iii) Casa Anglo had gone bankrupt; (iv) Cimento Itaú, Docas, and Souza Cruz had gone private.



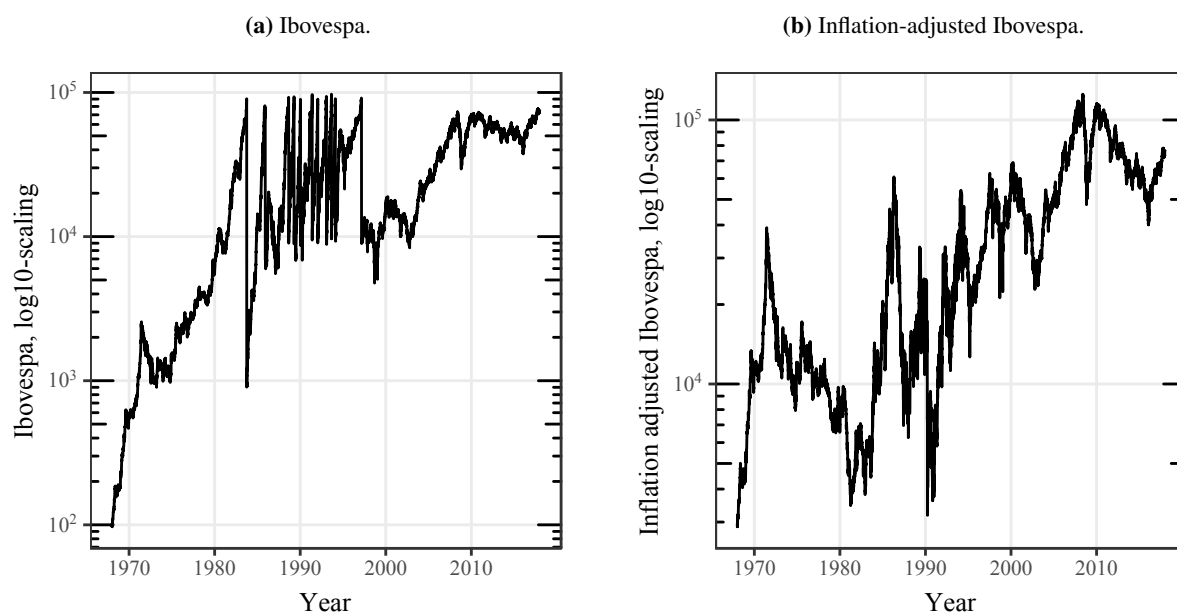
on October 3, 1983, when two zeros were slashed at the same time. Two years later, on December 2, 1985, one more zero was dropped from the Ibovespa. Subsequent zero removals were made on August 29, 1988; April 14, 1989; January 12, 1990; May 28, 1991; January 21, 1992; January 26, 1993; August 27, 1993; February 10, 1994; and the last zero was lopped off on March 3, 1997. After the removal of the 12th zero, no more zeros were dropped from the index for the next 20 years. Figure 2b shows the inflation-adjusted Ibovespa during its 50-year history, from 1968 until the end of 2017, when it was quoted at 76,402 points.

Figure 3 depicts the trailing twelve month (TTM) Brazilian inflation rate in the Ibovespa era. During this period, the last twelve months' inflation rate hit 100% for the first time in 1982, under the administration of General Figueiredo, the last president in the 1964-1985 Brazilian dictatorship. Inflation reached one thousand percent per year in January 1989 under the administration of President Sarney and rose even more in the final years of his administration, reaching a peak of 6,821.3% in April 1990, forty-five days into the administration of Fernando Collor, the first Brazilian president directly elected by the people after the end of the military regime. Collor was unsuccessful in taming Brazilian inflation, was impeached on charges of corruption in December 1992, and was succeeded by Itamar Franco, his vice president. Inflation began to recede in mid-1994, after the effects of the Real Plan, a set of measures taken to stabilize the Brazilian economy. See Sachs & Zini Jr (1996) for an assessment of Brazilian stabilization programs, the tenets of the Real Plan, and for an interpretation of Brazil's high inflation.

In the years immediately after 1968, the Ibovespa had a steady increase in real value (adjusted for inflation) until it reached its first peak on June 14, 1971, with a value more than 13 times its initial value. In June 1971, prices strongly exceeded their intrinsic values. The burst of a speculative bubble caused a shortage of liquidity

Figure 2

Chart (a) shows the Ibovespa in its fifty-year path since inception, when it was quoted at 100 points. Every time the index approached the 100,000 point threshold, one or two zeros were lopped off from the index. The first time this happened was on October 3, 1983. In total, 12 zeros were removed from the index, mostly due to hyperinflation in Brazil during this period. Chart (b) shows the inflation-adjusted Ibovespa using the IGP-DI inflation index calculated by Fundação Getúlio Vargas (FGV). By the end of 2017, the index was quoted at 76,402 points.



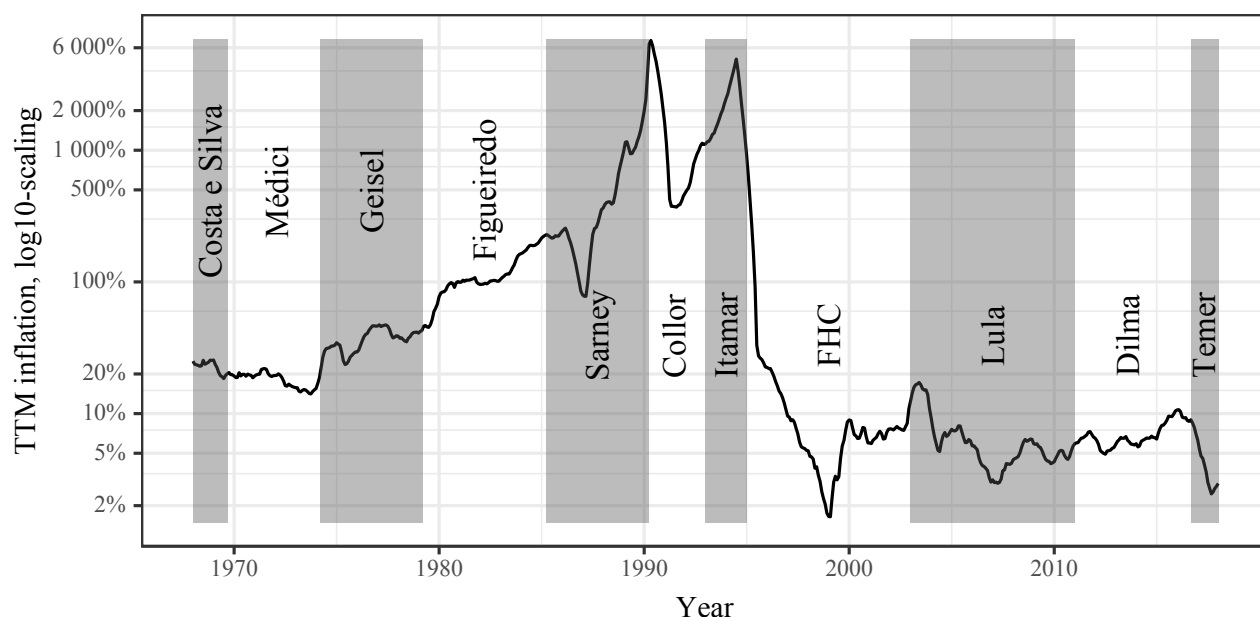
and a consequent difficulty in trading assets (Macarini, 2008). Prices started to decrease, and by December 19, 1973, the index had dropped 73.3% from its peak, adjusted for inflation. A negative net balance of trade and the rise of inflation increased Brazil's dependence on external debt in the second half of the 1970s (Tyler, 1986). Higher international interest rates pushed the economy into a recession, and the Ibovespa faced a new thirteen-year low on April 6, 1981, merely 16.7% above its starting value in 1968.

The Ibovespa's performance remained almost unchanged until the end of 1982, when the index began its bullish run. As Brazilians took to the streets demanding a direct vote for President in the coming election, in 1984, Congress failed to approve the constitutional amendment that granted the people their wish (Foweraker, 2001). The following president was a civilian indirectly elected by the Congress, ending in 1985 the 21 years of military rule in the country. The Ibovespa closed at its record high on April 25, 1986, with a gain of approximately 1,400% in only 40 months. The record was set two months after the launch of the Cruzado Plan, an anti-inflationary program that included wage and price freezes, under the administration of President Sarney (Flynn, 1986). The plan went poorly, and the government launched a new plan in November of that same year, the Cruzado II Plan. After another failure, the government launched another plan in June 1987, but there was little effect on inflation and stagnation. The Ibovespa experienced a new downturn, and on December 30, 1987, only 20 months after its previous record high, the index fell 89.7% in real terms. In the same period, the nominal decline was 23%.

The Ibovespa began a new upward movement in the beginning of 1989, when in only three months, from January to April, the index rose 216%. From April 26, 1989, to March 30, 1990 the index fell 90.4%, hitting a new twenty-two-year low. Two weeks earlier, on March 15, 1990 the Collor administration began. Collor was the first Brazilian president directly elected by the people after the end of the military regime. Right after his inauguration, Collor launched Plano Collor, which, among other things, froze 80% of the financial assets (money market, time deposits and even checking and saving accounts balances) of the private sector that exceeded NCz\$ 50,000 (fifty thousand cruzados novos, approximately US\$ 1,250 at that time) for 18 months (Crabtree, 1991). The index then began an upward trend, and on February 23, 1994, it had regained

Figure 3

Brazilian trailing twelve-month inflation rate from January 1968 to December 2017. Until 1979, inflation was measured by the IGP-DI calculated by Fundação Getulio Vargas (FGV). From 1980 until 2017, inflation was measured using the IPCA calculated by Instituto Brasileiro de Geografia e Estatística (IBGE). Shaded areas represent different Brazilian federal government administrations during this fifty-year period since the inception of the Bovespa index. The chart uses a log-10 scale. The highest TTM inflation in this period was 6,821.3% in April 1990, immediately after the inauguration of President Collor.



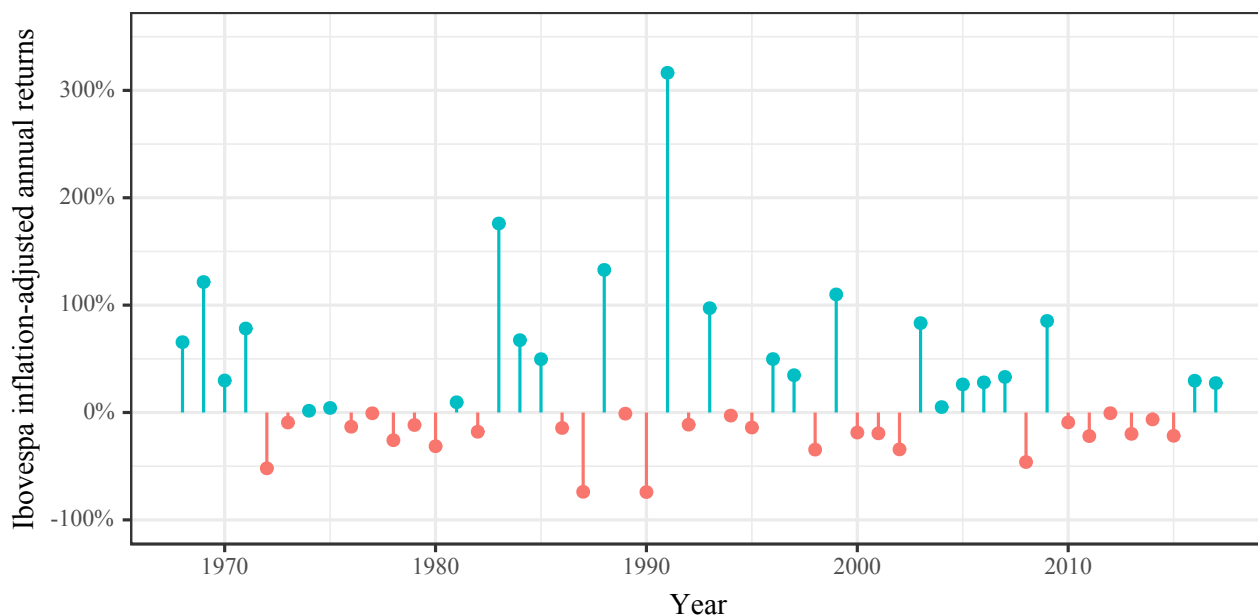
almost all of its lost ground, with a 1,600% gain in the period. Inflation in Brazil began to slow in June 1994, after the adoption of the stabilization measures proposed in the Real Plan. However, at the end of 1994, Mexico suddenly devalued its currency, which caused other currencies in the region to decline as well, including Brazil's (Averbug, 2002). By the end of March 1995, the Ibovespa had fallen 76.6% in only twelve months.

On July 8, 1997, the Ibovespa closed at a record high. A new record high was broken two years later, on December 30, 1999, and another one three months later, on March 27, 2000. From March 9, 1995 to March 27, 2000, the Ibovespa accumulated a positive 445.5% return, despite the negative effects of the 1997 Asian financial crisis and the 1998 Russian crisis on its bullish climb. From July 2001 to February 2002, Brazil faced a serious energy crisis due to a sequence of drier-than-average years with implications for economic growth (Jardini, Ramos, Martini, Reis & Tahan, 2002). Additionally, it was a presidential election year, and the prospect of victory for the left-wing opposition candidate, Lula, rattled the markets (Jensen & Schmith, 2005). On October 16, 2002, eleven days before the second round of the presidential election, the Ibovespa had fallen 67% from its previous record high in 2000. After his inauguration, President Lula slowly gained the market's confidence, and the fear of drastic measures dissipated. The commodities boom of the 2000s benefited emerging markets, including Brazil, and the local market experienced successive growth (Gallagher & Porzecanski, 2009). The index hit a record high on December 27, 2006, again on October 29, 2007, and then again on May 20, 2008. The Ibovespa rose 448.9% from October 16, 2002 to May 20, 2008. The upward movement was halted only by the 2008 global financial crisis, and on October 27 the Ibovespa hit its lowest value that year after losing 61.8% in the previous five months. The bearish market did not last long and, by the end of 2009, the index almost fully recovered the losses sustained during the crisis.

From March 13, 2012, to January 26, 2016, the Ibovespa fell 58%. When the index approached its 50th anniversary, Brazil entered a severe economic and political crisis that culminated with the impeachment of President Dilma Rousseff on August 31, 2016 (Melo, 2016). She was succeeded by her vice president, Michel Temer. After the impeachment, the index rose 31.1% and closed the last trading day in 2017 at 76,402 points. The Ibovespa's inflation-adjusted yearly returns are shown in Figure 4. In its fifty-year history, the Ibovespa

Figure 4

Ibovespa inflation-adjusted annual returns from 1968 to 2017. The best year in the history of the index was 1991, when the index value increased by 316.4%. The index had plunged the year before, when it recorded its worst negative return (−74.1%). The largest sequence of consecutive negative annual returns took place from 2010 to 2015. A sequence of five consecutive positive returns happened from 2003 to 2007.



averaged a 6.71% annual compounded return after adjusting for inflation. If an investor had invested the equivalent of R\$ 100 in the stock market in early 1968, she would have had R\$ 2,573.49, adjusted for inflation, by the end of 2017. The worst year in the history of the Ibovespa was 1990, when the index plunged 74.1%. The following year, the Ibovespa would register its best-performing year, with a return of 316.4%. The largest sequence of consecutive positive annual returns was from 2003 to 2007. A sequence of six consecutive negative annual returns took place from 2010 to 2015.

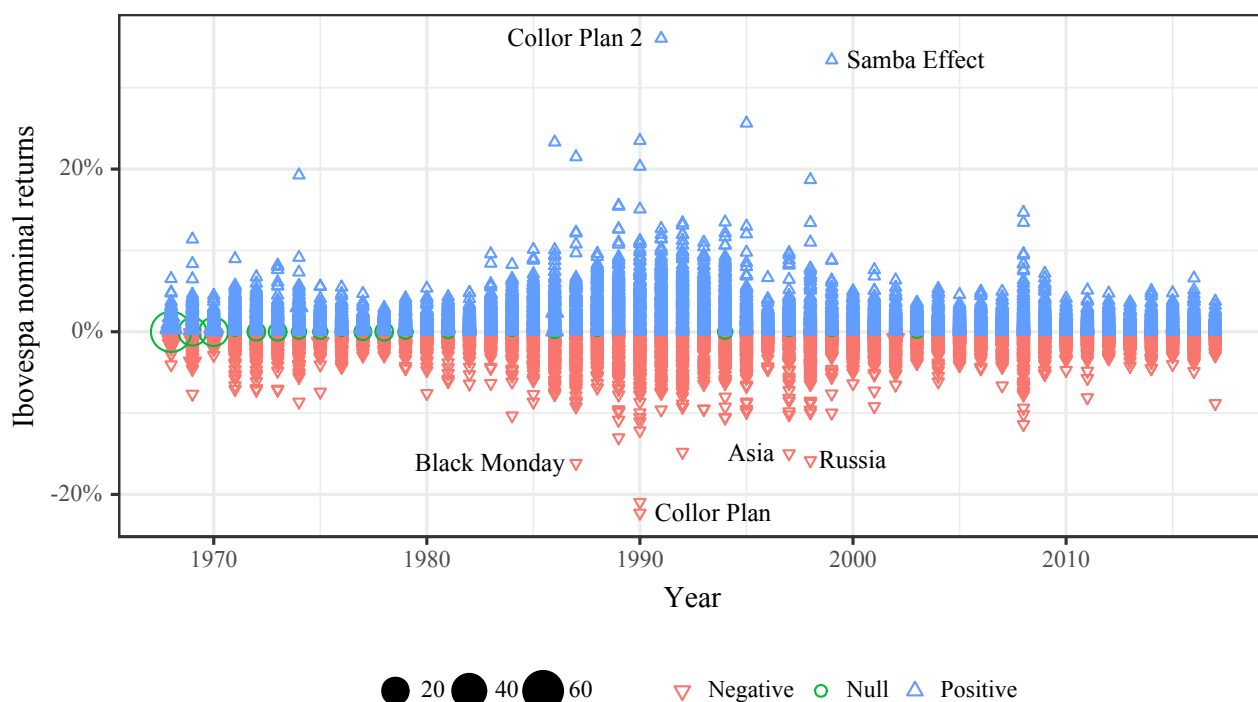
The largest one-day percentage drop in the nominal value of the Ibovespa was on March 21, 1990, when the index fell 22.27% from 12,952 to 10,067 points. One day earlier, the index fell 20.95%, the second-largest one-day nominal drop in the index to date, when it fell from the 16,384 level to 12,952 points. These drops happened in the first week of the Collor administration, when news of the Collor Plan hit the market. The third largest one-day percentage drop was on October 20, 1987, one day after Black Monday. The Brazilian index was down by 16.17%, and it fell from 15,400 to 12,910 points on that day. There are no clear explanations for Black Monday, but algorithmic trading may be one of them (Waldrop, 1987). The next largest one-day percentage drops were on September 10, 1998, and on October 27, 1997, when the index fell 15.83% (from 5,655 to 4,760 points) and 14.98% (from 11,545 to 9,816 points), respectively. The events surrounding these dates became known, respectively, as the 1998 Russian financial crisis and the 1997 Asian financial crisis⁶. Figure 5 illustrates the Ibovespa's nominal returns and highlights these events.

The largest one-day percentage gain in the index, 36.06%, was on February 4, 1991. The Ibovespa gained 17,121 points to close at 64,601. That day was the first day of Collor Plan 2. The second largest one-day percentage gain was on January 15, 1999, when Brazil's Central Bank withdrew from the foreign exchange market. The 33.40% gain was registered after the Ibovespa had negative nominal returns for six days in a row during the Brazilian currency crisis. In that week, President Cardoso started devaluing the Brazilian currency. By March 5, the real had devalued 85 percent (Holz, 2000). This large drop in the value of the Brazilian

⁶ On October 28, 1997, the SPSE implemented the circuit breaker rule designed to halt trading to prevent stock market crashes. On September 10, 1998, the circuit breaker was put in place two times. The rule was triggered 17 times before the end of 2017.

Figure 5

The Ibovespa daily nominal returns from 1968 to 2017. Important events around record high and lows are highlighted. The two largest nominal price drops were recorded on March 21 (−22.27%) and March 20, 1990 (−20.98%), immediately after the launch of an economic stabilization plan at the beginning of the Collor administration. The third largest nominal price drop was on October 20, 1987 (−16.17%), one day after Black Monday. The next largest one-day negative nominal returns were on September 10, 1998 (−15.83%), and October 27, 1997 (−14.98%), during the Russian and Asian crises, respectively. The largest one-day nominal price increase was on February 4, 1991 (36.06%), on the first day of the Collor Plan 2, the second attempt made by the Collor administration to stabilize the Brazilian economy. The next largest price gain was on January 15, 1999 (33.40%), during the Brazilian currency crisis, when Brazil's Central Bank withdrew from the foreign exchange market. The Samba effect was the name given to the devaluation of the Brazilian currency that took place in 1999.



currency became known as the Samba effect (Cardoso, 2007; Rosen, 1999).

4. Index methodology

Over its history, the Ibovespa has changed its original methodology only once. The change was announced in 2013 and took effect in 2014. Among the main changes were the exclusion of penny stocks (stocks worth less than one Brazilian real) and of firms under corporate restructuring. Changes were also made in the determination of the weights for each stock on the index portfolio. Under the original methodology, traded volume was the only determinant. Since 2014, the methodology has considered both market capitalization and traded volume as determinants.

4.1 Original methodology

The Ibovespa was conceived as a total return index weighted by traded volume to comprise the most liquid stocks traded in the SPSE. The index represents the current value in Brazilian currency of a hypothetical investment in a portfolio of stocks, first constituted on January 2, 1968. The initial base value was set to 100 points, representing NCr\$ 100 (one hundred cruzeiros novos, the Brazilian currency at the time). The portfolio has received no additional investment since then, except for the reinvestment of cash benefits, such as dividends, subscription rights and bonus issues. Variation in the index represents the return an investor would have had she kept an investment in such a portfolio between any two given dates.

The most actively traded stocks in the previous 12 months were included in the Ibovespa portfolio. Together, the stocks in the portfolio had to account for at least 80% of the sum of all Negotiability Indexes (NI) calculated for each stock in the preceding 12-month period. The NI was given by

$$NI = \frac{\sum_{i=1}^P \sqrt{\frac{n_i}{N} \times \frac{v_i}{V}}}{P}, \quad (1)$$

where n_i is the volume of trades for round lots of stock i in the equity market, N is the sum of n_i for all stocks in the market, v_i is the financial value generated by the trades for round lots carried out with stock i in the equity market, V is the sum of v_i for all stocks in the market, and P is the number of trading sessions in the previous 12 months. No private transactions were considered in the calculation of the NI. The NI was interpreted as the daily geometric average of two trading indexes, one representing the volume traded and the other representing the financial value generated by the trades.

Additionally, to be part of the Ibovespa portfolio, each of the selected stocks had to be traded in at least 80% of the trading sessions in the previous 12 months, and the financial value generated by the trades had to be at least 0.1% of the financial value generated by all trades in the SPSE in the same period. In January 1968, 18 companies were selected to be part of the first Ibovespa portfolio. The weight of each stock in the portfolio was proportional to its respective NI values. The portfolio has been rebalanced every four months, always on the first business day of January, May, and September.

A stock selected for the Ibovespa was dropped from the index when it no longer met at least two of the three criteria for inclusion. Companies that were under judicial reorganization, that filed for bankruptcy, or that were suspended for more than 50 days were excluded from the index.

4.2 Current methodology

The original methodology of the Ibovespa lasted for 46 years with no modifications. In September 2013, the SPSE announced a set of new rules that came into effect in January 2014. Under the new methodology, only stocks that together represent at least 85% of the sum of all NI calculated for all stocks in the preceding 12 months are eligible. The NI formulation of equation (1) was also modified. The financial value generated by the trades was set to be twice as important as the volume of trade, and the new NI (NI_{new}) is measured as

$$NI_{new} = \frac{\sum_{i=1}^P \sqrt[3]{\frac{n_i}{N} \times \left(\frac{v_i}{V}\right)^2}}{P}, \quad (2)$$

where all variables follow the same definitions as in equation (1).

Additionally, each of the selected stocks must have been traded in at least 95% of the trading sessions in the preceding 12 months, and the financial value generated by the trades must have been at least 0.1% of the financial value generated by all trades in the SPSE in the same period. Under the new rule, penny stocks, those worth on average less than R\$ 1 (one real) in the previous rebalancing period, are not eligible for the index. Companies that are under judicial reorganization, that filed for bankruptcy, or that are suspended for more than 50 days are excluded from the index.

The weighting of each stock on the Ibovespa is now based on the market capitalization of free-floating shares, and no single company can have a weight greater than 20% on the index. Additionally, a liquidity cap was adopted, and no stock can have more than twice its hypothetical weight calculated by the old rule of relative importance of the NI measure using equation (2).

The index portfolio still observes the same four-month cycle, but now, each cycle starts on the first Monday (or the subsequent day, if not a business day) of the first month of each cycle. The set of changes was implemented in two phases. For the portfolio that began in January 2014, the index weightings were calculated using the average of the new and old methods. The full implementation of the new method started in the portfolio of May 2014.

4.3 Benefits of the new methodology

In the beginning of 2013, OGX Petróleo had the sixth largest weight on the Ibovespa. At the same time, the company was having difficulty in turning their promising offshore fields into producing ones. That raised concerns that the company could not obtain new financing for its investments, maintain its operations, nor repay existing debt. Rating agencies downgraded their corporate debt, indicating that the company was at high risk of default.

From January to September 2013, the share price of OGX plunged more than 95%, from R\$ 4.38 to R\$ 0.21 per share. In the same period, the share of OGX experienced an increase in its trading volume due to selling pressure. Since the methodology of the Ibovespa in force at that time weighted the stocks based on the relative importance of the negotiability indexes for all stocks in the portfolio, OGX's weight on the Ibovespa rose from 2.19% in May to 4.26% in the rebalancing made in that September.

The change in the index methodology served to prevent companies in financial distress from having high weights in the index portfolio. The original Ibovespa methodology was heavily based on the trading volume and value of trades for each stock. Had the new methodology been fully implemented a year earlier, for instance, OGX's weight on the Ibovespa would have been 0.71% in January 2013, 0.27% in May 2013, and would not have been part of the index in September 2013 (due to the penny stock barrier).

Figure 6a displays the treemaps of the actual constituents of the Ibovespa in September 2013, and Figure 6b shows the hypothetical constituents on the same date, had the new methodology been implemented at the time. All stocks are grouped by industry classification. The area of each rectangle is directly proportional to the weight of the corresponding stock on the index in that period. The color of each rectangle represents the log of the market value of the corresponding company, where darker colors refer to companies with smaller market values. The bottom right corner of Figure 6a shows OGXP3, the ticker symbol for the common stock of OGX Petróleo. At the time, the company's weight in the portfolio of Ibovespa was 4.26%, making it the fourth largest weight on the index. Had the new methodology already been in practice, OGX would no longer be part of the index.

Most indexes are subject to criticism. Even the most widely recognized index, the Dow Jones Industrial Average (DJIA), was subject to criticism for being a nominal price-weighted index and having too few constituents for the US equity market (Charles & Darné, 2014; Shaw, 1955). The Standard and Poor's Composite Index, the other famous market index for the US market, expanded in 1957 its market-capitalization-weighted Composite Index to 500 stocks to become broader and more representative of the economy.

In 1968, the SPSE innovated when it adopted an index that used the volume and value of trades as the main criteria for stock eligibility and weighting. The index was initially highly concentrated, reflecting in its composition a characteristic of the Brazilian equity market (Leite & Sanvicente, 1994). Mixed-economy companies, that is, those with the majority of stocks owned by the government but that also have stocks owned by the private sector, were among the most traded stocks in the Brazilian market. They were also among the largest companies in terms of market capitalization. If the Ibovespa had been conceived as a market-capitalization-weighted index instead, it is hard to believe that the index would be any less concentrated.

In the 1990s, the stock with the largest weight on the index was Telecomunicações Brasileiras, known as Telebras, the state-owned telecommunication company that had a monopoly on the telephone system in the country. In July 1998, the 12 Telebras units were auctioned to the private sector, but Recibo Telebras (Telebras Receipt) continued to be part of the Ibovespa until 2000. Recibo Telebras consisted of a portfolio of 13 stocks, i.e., the 12 different Telebras units and Telebras itself. The stock eventually became illiquid as the stockholders of Telebras sold their shares or swapped them for the constituent stocks of the receipt.

The Ibovespa went through periods of higher concentration in just a few stocks and periods when this concentration declined considerably. Figure 7 summarizes the percentage weight on the Ibovespa by the top five stocks from 1970 to 2017⁷. The figure shows how concentrated the index was in the top five stocks in some

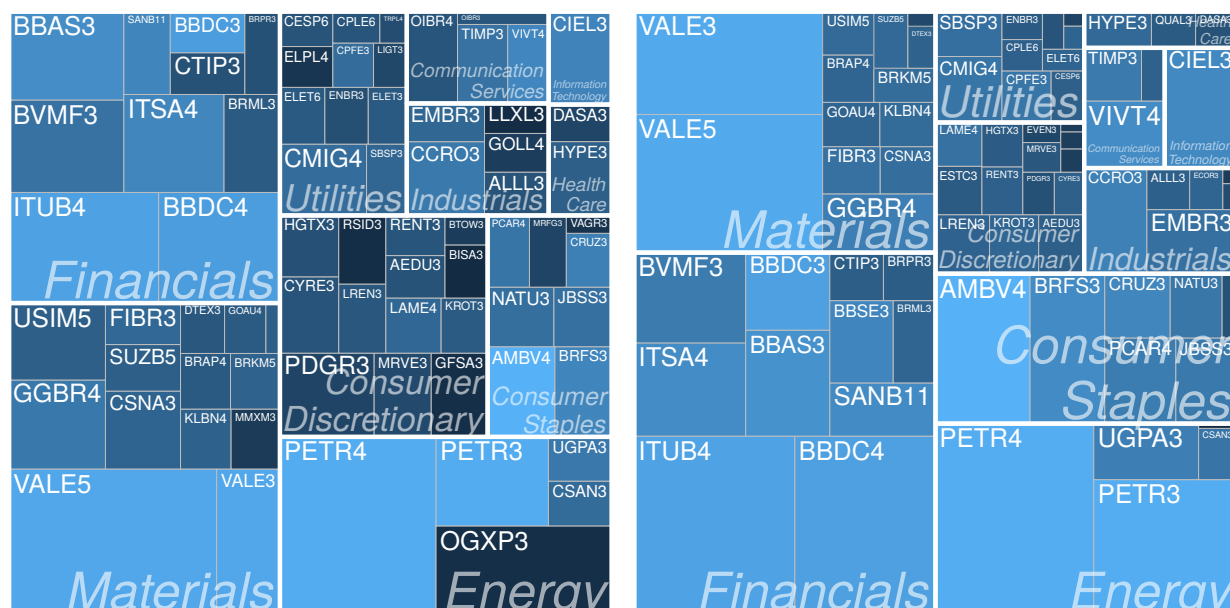
⁷ Unfortunately, no information about portfolio weights or theoretical quantities for each stock was available for the years 1968 and 1969. We carefully examined all BDIs published by the SPSE in this period, but none mentioned this information. The database available from the SPSE has theoretical quantities for all constituents but no weights for the period from 1970 until 1979. We hand-collected

Figure 6

Stocks are referenced by their respective ticker symbols and grouped by industry classification. The area of each rectangle is directly proportional to the weight of the corresponding stock on the index in that period. The color of each rectangle represents the log of the market value of the corresponding company, where darker colors refer to companies with smaller market values.

(a) Treemap of actual constituents of the Ibovespa in September 2013.

(b) Treemap of hypothetical constituents of the Ibovespa in September 2013, had the new methodology been implemented then.



periods. The average weight of the top five stocks was 45.1%. There were years, such as the mid-1970s and especially the 1990s, when the top five largest weights ranged from 70 to 75%. From 1991 to 2000, Telebras alone had a median weight of 41.7%, with a maximum of 50.6%, being the largest constituent in almost every index portfolio in that decade. Eventually, when the Telebras receipt stopped being traded, it left the index and concentration declined. In less concentrated years, the top five largest weights ranged from 30 to 40%. Since 2014, with the implementation of the new calculation methodology, the index concentration reversed its decline.

5. Main constituents of the Ibovespa

Although the Ibovespa contained only 15.1% of the traded stocks on the SPSE by the end of 2017, the index portfolio always represented a large fraction of the market capitalization of all firms. Taking December 2017 for reference, the market value of the 344 public companies traded on the SPSE was R\$ 3.16 trillion (the equivalent of US\$ 955.55 billion), and the 59 constituents of the Ibovespa together represented 81.5% of that value.

Figure 8 shows the number of constituents on the Ibovespa portfolio at the end of each four-month period from 1968 to 2017. The average (median) portfolio size was 70.6 (66) stocks, with a maximum of 139 stocks in the portfolios from September to December 1986 and January to April 1987. Also on the chart is the number of new stocks added to the portfolio in each period. The average (median) number of new stocks was 4.5 (2.5). The dashed line on the chart represents the total flow rate, calculated as the percentage number of stocks added to and deleted from the Ibovespa portfolio each period relative to the average number of stocks on the portfolio at periods t and $t - 1$. The average total flow rate before 1992 was 17.1%. It decreased to 8.1% from 1993 to 2017. The average total flow rate for the whole period was 12.6%.

closing prices for all constituents in the beginning of each portfolio window to calculate the weights. The SPSE has weights for the

Figure 7

Percentage weight on the Ibovespa by the top five stocks from 1970 to 2017.

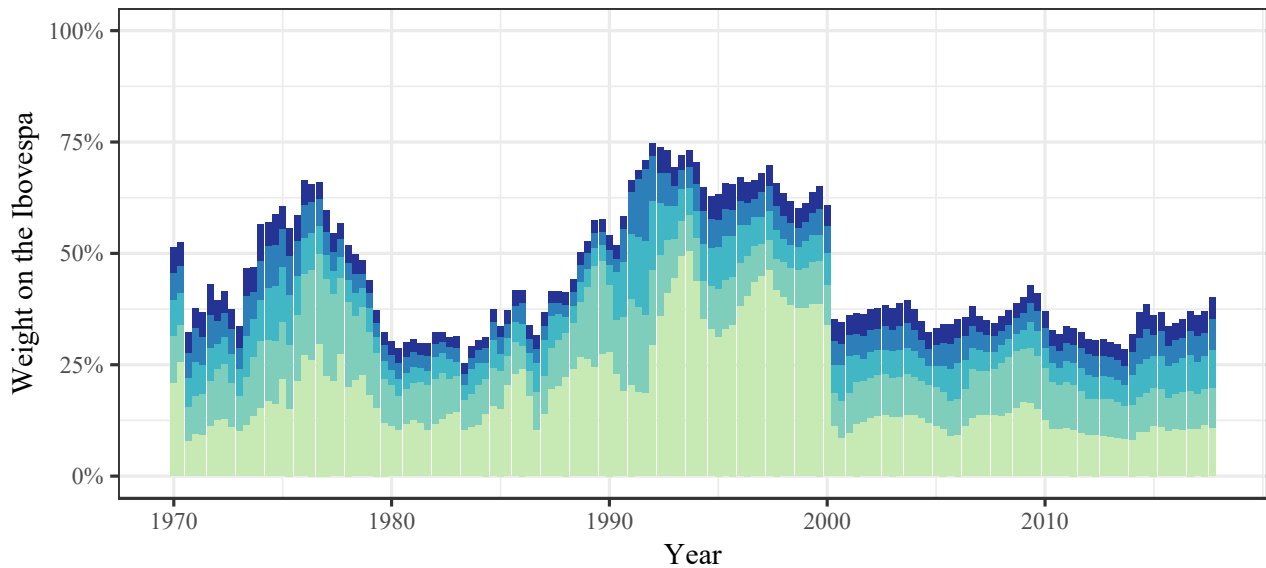
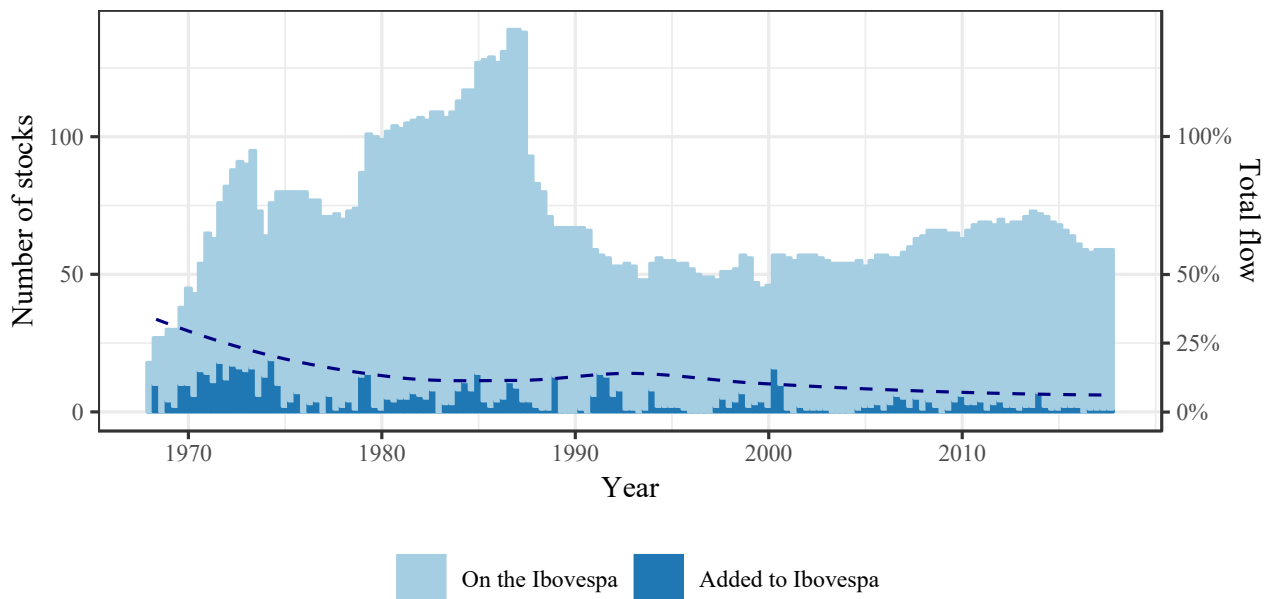


Figure 8

Number of stocks on the Ibovespa portfolio (lighter color) and the number of new stocks added to the index (darker color) each four-month period from 1968 to 2017. The dashed line represents the total flow rate, calculated as the percentage number of stocks added to and deleted from the Ibovespa portfolio each period relative to the average number of stocks in the portfolio in periods t and $t - 1$.



In December 2017, Vale had the fourth highest market value on the SPSE (R\$ 212.8 billion, or US\$ 64.3 billion). From 1990 to 2017, with few exceptions, Vale had one of the five largest weights in the Ibovespa

remaining years.

portfolio. From 2014 (the year the SPSE changed the methodology for the Ibovespa) to 2017, Vale had an average weight of 7.9% in the index.

As of December 2017, Petrobras had the second longest continuous presence on the Ibovespa. Its first appearance as a constituent on the portfolio was in September 1969. Petrobras had only five portfolio appearances less than Vale and had the third largest market value among the public firms listed on the SPSE (R\$ 216.0 billion, or US\$ 65.3 billion). With very few exceptions, Petrobras had one of the three largest weights in the history of the Ibovespa, with an average weight of 9.66% from 2014 to 2017.

Three banks and a tobacco company (Banco do Brasil, Banco Itaú, Bradesco, and Souza Cruz, respectively) appeared next in the rankings of companies with the longest presence on the Ibovespa portfolio, with 144 appearances each. Souza Cruz was part of the index at its inception in 1968 and left the index only when it was fully acquired by British American Tobacco and was delisted. Banco Itaú, Bradesco, and Banco do Brasil were, as of December 2017, the second, fifth, and seventh largest public companies in market capitalization on the SPSE, respectively. Banco Itaú had the largest weight on the Ibovespa portfolio from the rebalancing in January 2015 to December 2017, with an average weight of 10.78%. In the same period, with two exceptions, Bradesco had the second largest weight on the Ibovespa, with an average of 9.47%. Banco do Brasil, a government-controlled bank, first appeared on the Ibovespa in 1970 and was still part of the index in December 2017. Banco do Brasil was among the largest weights on the index until the mid-1980s, only recovering its prominent position in the 2010s.

In 1999, Brahma and Antarctica, two of the largest Brazilian brewing companies at the time, merged and formed Ambev. Ambev began trading under its own name on the SPSE in 2001, but if we consider the history of both parent companies on the index, Ambev was one of the top 10 companies with the longest presence on the Ibovespa portfolio. At the end of 2017, Ambev was the largest company as measured by market capitalization in the Brazilian market, at R\$ 334.5 billion, or US\$ 101.1 billion.

Gerdau, a company founded in 1901 that operates in the steel industry, was on the top 10 list and was still part of the Ibovespa in 2017. Gerdau is the result of a restructuring process that began in 1995 and was concluded in 1997 to simplify its organizational structure, which resulted in the incorporation of 28 companies. Among the incorporated companies was Siderúrgica Riograndense, a company founded in 1948 and a continuous constituent on the Ibovespa from 1969 until 1997. From 2014 to 2017, Gerdau had an average weight of 1.03% on the index portfolio. Duratex, one of the initial constituents, and Light appeared last in the Ibovespa portfolio in 2015, with weights of 0.188% and 0.192%, respectively. Figure 9 reports the timeline of the top 10 companies with the longest presence on the Ibovespa portfolio. The companies are ranked, from top to bottom, by the number of presences on the index.

6. Industry representativeness

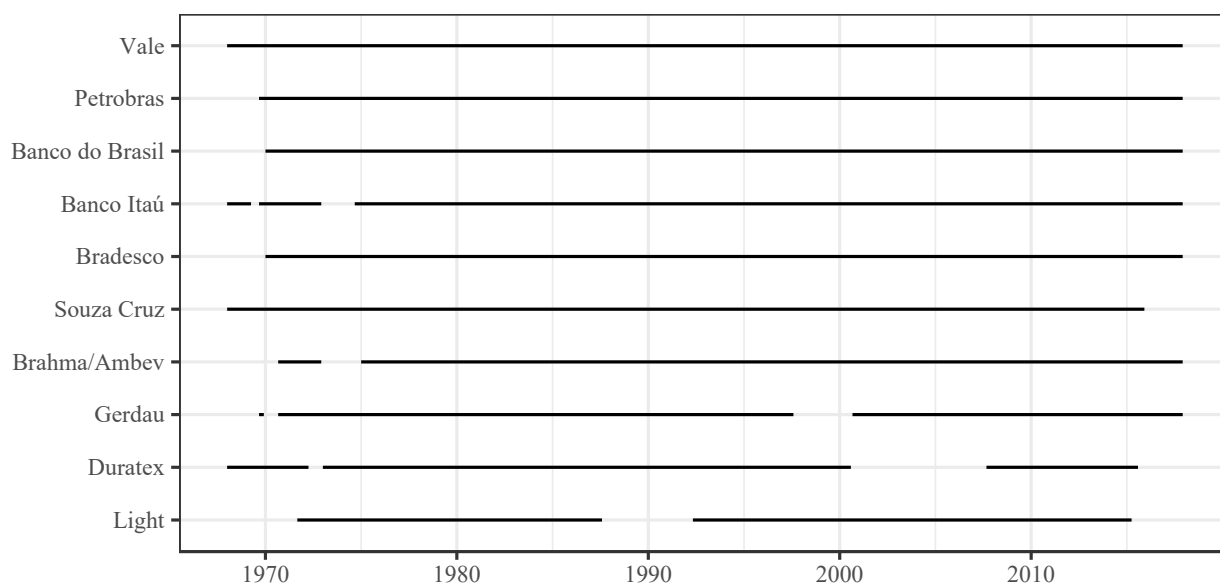
The representativeness of each industry on the Ibovespa varied along its 50-year history. The materials industry was, at the same time, the largest industry on the index in terms of the number of stocks and the average weight. Materials represented, on average, 26.5% of the size of the Ibovespa portfolio, with an average weight of 25.1% on the index. From 1985 to 1991, the combined weight of the constituents from this industry represented 45.8% of the Ibovespa. Paranapanema, a firm that operates in the manufacturing and sale of copper products, represented, on average, in that period, 17.3% of the Ibovespa. Vale had the second largest average weight in this industry (5.6%).

The communication services industry was very influential on the Ibovespa from 1992 to 2005. Prior to 1998, Telebras alone had an average (median) weight of 36.5% (41.3%) on the index. From 1999 to April 2000, after its privatization, Telebras was still traded on the SPSE as a portfolio of its regional units, called Recibo Telebras. Even during this time period, the Telebras receipt still held a large stake on the Ibovespa, with an average (median) of 42.8% (42.8%). When the regional units started to be traded independently, the industry saw its importance on the index diminish. The communication services industry's average weight was the second largest in the Ibovespa history (18.0%).

The financial industry was the next largest industry in average weight over Ibovespa's 50-year history. The

Figure 9

Timeline of the top 10 companies with the longest presence on the Ibovespa portfolio. Companies are ranked by number of appearances on the index.



financial industry rivaled materials as one of the most important industries on the index until 1984, when its relevance diminished, only to recover in 2008. After the adoption of Ibovespa's new methodology in 2014, the financial industry had the largest weight on the index. Banco Itaú and Bradesco, two of the largest Brazilian banks, had an average weight of 10.3% and 9.3%, respectively, on the index portfolio in this period.

There are very few Brazilian energy firms listed on the SPSE. No more than 5 energy companies were ever part of the Ibovespa at the same time, making this industry one of the smallest in the index. Nonetheless, energy firms together had an average weight of 14.5% on the Ibovespa. Petrobras was the most important constituent of this industry. The company represented on average 10.0% of the portfolio weight from 2013 to 2017. The whole energy industry represented 13.6% of the Ibovespa.

The consumer discretionary sector was the second largest industry in number of firms on the index, with an average of 10.7 firms per portfolio. The industry's most important period was in the early years of the index, until 1973, and then from 1979 to 1983. Firms such as Alpargatas and Casa Anglo, two of the original Ibovespa constituents in 1968, were among the companies from this industry with the highest weights in the index portfolio.

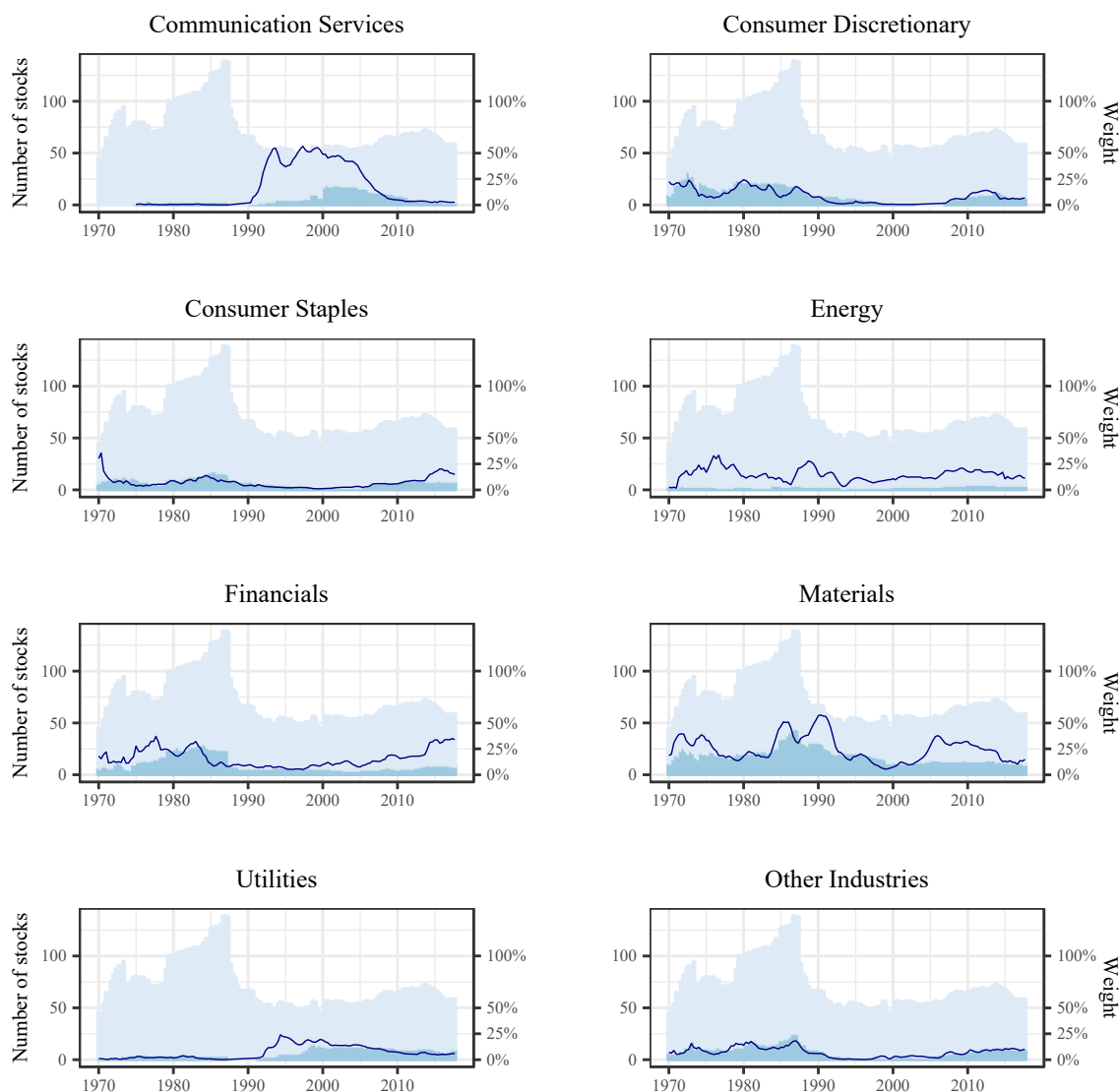
The utilities industry had its highest weight on the Ibovespa in the years from 1994 to 2000, with an average of 18.3% of the portfolio weight. Eletrobras, a mixed-economy power company that holds stakes in a number of regional electric companies in Brazil, alone represented 10.8% of the Ibovespa portfolio during this period.

Consumer staples were historically one of the least-represented industries on the Ibovespa. Nevertheless, from September 2014 to December 2017, the industry was the second largest in weight on the index. Most responsible for this feat was Ambev, a beverage company that was the largest Brazilian public company in 2017. Ambev had an average weight of 7.5% on the index in this period.

Figure 10 depicts, for each representative industry on Ibovespa, the number of stocks (darker columns in the bar plot) compared to the total number of stocks on the index portfolio (lighter columns in the bar plot), as well as the percentage participation (dark line) of all companies from that industry on the Ibovespa. The less representative industries on the Ibovespa were industrials, information technology, real estate, and health care; in the history of the Ibovespa, they represented, respectively, 5.9%, 1.3%, 1.2%, and 0.8% of the portfolio weight. On the chart, they are shown combined under other industries.

Figure 10

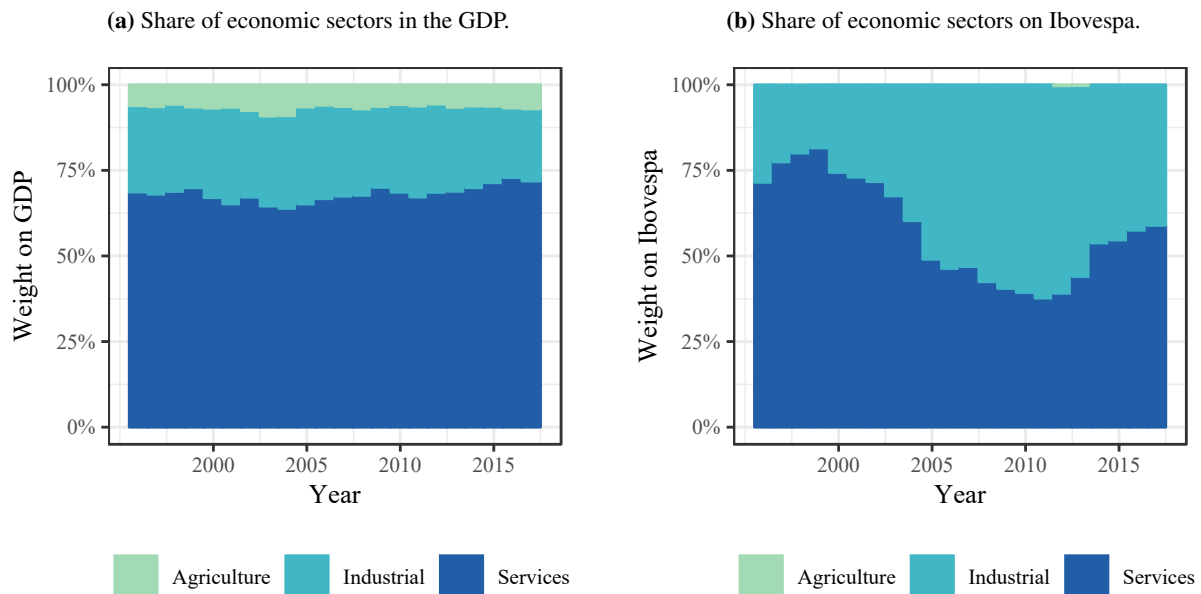
Number of stocks and respective weight on the Ibovespa by industry classification. Light-colored bars represent the Ibovespa portfolio. Dark-colored bars represent the number of stocks from an industry. The dark line (secondary axis) represents the industry weight on the Ibovespa.



The Brazilian equity market is considered hard for smaller firms to access because of the high fixed costs of issuing public securities (Carvalho & Pennacchi, 2012) and characteristics of the local credit market that create distortions, such as subsidized credit (Zeidan, Galil & Shapir, 2018). From 2004 to 2017, the number of equity issues in the Brazilian market via initial public offerings (IPOs) was 167 with a total volume of R\$ 174.33 billion. On the other hand, 140 seasoned equity offerings (SEOs) raised a total volume of R\$ 317.89 billion in the same period. In other words, the volume raised by companies already in the stock market was almost double the volume raised by companies making their IPOs. As of December 2017, 404 companies were listed on the SPSE, and 59 of them constituted the Ibovespa portfolio. These companies were among the largest corporations in the country and did not perfectly represent the Brazilian economy as a whole. Figure 11a displays the share of economic sectors in the gross domestic product (GDP) in Brazil from 1996 to 2017. The plot shows the dominance of the services industry in the GDP, with an average of 68.2%. The industrial sector contributed approximately 25.1% to GDP, and the agricultural sector contributed 6.7%.

Figure 11

Plot (a) shows the share of economic sectors on GDP, while plot (b) shows the share of economic sectors on the Ibovespa.



The Ibovespa, in contrast, did a poor job representing the Brazilian economy's GDP. Figure 11b shows the share of economic sectors on the Ibovespa from 1996 to 2017. Until 2005, the services industry, on average, accounted for 71.4% of the Ibovespa. In 2006, industrial companies began to weigh more than 50% of the index. Until 2013, the industrial sector weighted, on average, 56.8% on the Ibovespa. From 2014 to 2017, as a result of the methodological changes to the calculation of the index, some banks began to have a higher participation in the index, and the services sector surpassed the industrial sector once again. The services sector represented 55.7% of the Ibovespa in this period. Although the agricultural sector represented 6.7% of the GDP from 1996 to 2017, only one company (V-Agro) was part of the Ibovespa in the short period from 2012 to 2013, representing only 0.3% of its total weight. This sector is hardly visible on the top right of Figure 11b.

7. Final remarks

In this article, we summarized the fifty-year history of the Ibovespa, a gross total return index that comprises the most liquid stocks traded on the São Paulo Stock Exchange in Brazil. The Ibovespa was established on January 2, 1968, and it is the most important reference index for investors in the Brazilian equity market, the largest in Latin America. We provided contextual material on the Brazilian economy during this 50-year period (such as the fight against hyperinflation, the privatization of companies, and economic crises) and its impact on the index composition and performance.

The initial Ibovespa portfolio consisted of 18 firms from several industry classifications. We presented a brief description of each company and of its history as a constituent of the index portfolio. We also paid particular attention to the companies with the longest presence on the Ibovespa. Vale, a company that produces and sells iron ore and iron ore pellets for use as raw materials in steelmaking in Brazil and internationally, was the only company with a continuous presence on the index.

We calculated the historical return of the Ibovespa and discussed the events related to its largest one-day gains and losses. Coincidentally, the largest one-day loss and one-day gain were related to the launching of economic plans under President Collor's administration. The largest one-day drop was on March 21, 1990, when the index plunged 22.27%. The inauguration of Collor was on March 15, 1990, and the Brazilian economy was still under the impact of the measures in the economic plan to combat inflation, which became known as the Collor Plan. Less than a year later, on February 4, 1991, the largest one-day gain was observed. That day,

the first day of the Collor Plan 2, the index rose 36.06% in the expectation that the economic measures would be effective in defeating inflation.

We presented the methodology used to calculate the constituent weights on the Ibovespa portfolio from its inception until the end of 2013. That methodology was based on the negotiability index adopted by the SPSE and was responsible, in some periods of time, for the high representation of a single company on the index. From 1990 to 1998, when Telebras was part of the Ibovespa, the company had a median weight of 41.3% on the index. A new weighting methodology was adopted in 2014, giving less importance to the negotiability index, and increasing the relevance of market capitalization. We illustrated the reasons for the change in the methodology with the OGX Petróleo example. In 2013, the price of OGX dropped rapidly such that its market value plunged more than 95% by September of that year. At the same time, the weight of OGX on the Ibovespa almost doubled (from 2.19% to 4.26%) because of the high volume of trade on the company stock. The new methodology was established to inhibit this phenomenon from occurring again.

Finally, the representativeness of each industry on the Ibovespa portfolio was discussed. By the end of 2017, the index comprised 59 stocks from a wider range of industries, but its composition was not a perfect representation of the Brazilian economy. From 1996 to 2017, the share of the services sector in GDP was approximately constant, with an average of 68.2%. The share of this sector on the Ibovespa varied from a high of 82.3% in 1999, when Telebras was a large constituent on the index, to a low of 37.1% in 2011. Companies in the industrial sector, on the other hand, were over-represented on the index. From 1996 to 2017, this sector represented 25.1% of GDP but represented 42.2% of the Ibovespa portfolio. The agriculture sector was poorly represented on the equity market index portfolio. Only one company, with an average weight of 0.3%, and only for the years of 2012 and 2013, was part of the Ibovespa. In contrast, the sector represented 6.7% of GDP.

Despite the criticism that one can make about Ibovespa's representativeness of the Brazilian economy, the index is a valuable gauge of the equity market. Moreover, for listed firms, being part of the index portfolio is very positive because it enhances company visibility and the attention investors pay to their stock.

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