



The Interaction of the Exchange Rate Variation with Decisions Regarding Monetary Policy and Investments in Brazil

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Summary

When investing abroad, insurance companies and pension funds are concerned about how exchange rates may vary. This work evidences that investors' decisions in Brazil regarding the investment type (fixed income or equity) should consider the outlook for the exchange rate variation. Such prospect may also influence the decisions of The Monetary Policy Committee (Copom) of Brazil's Central Bank (BCB) regarding the target for the basic short-term interest rate in Brazil (known as Over-Selic interest rate). A statistical analysis of the daily exchange rate variation short before and after sixty-five Copom's meetings disclosed the interaction of each Copom's decision with market expectation and receptiveness. Moreover, a chart with long strings of data from January 1999 until July 2009 offers an overview of the evolution of important variables that should be considered by an investment appraisal, such as: the main stock market index in Brazil (Ibovespa); exchange rates (R\$/US\$ and R\$/euro); main inflation rate index in Brazil (IPCA); the Over-Selic interest rate; and the *spread* between the Over-Selic interest rate and the Federal Funds interest rate (USA). Data spanning over a ten-year period evidence that this spread of interest rates is indeed highly and positively correlated to Brazil's main inflation index IPCA (i.e. .87), which contradicts the belief that interest rates increase curbs inflation rate in Brazil. Actually, Brazil's monetary policy strives to secure or accumulate hard currency, which reduces balance of payments imbalances and hence the probability of currency overshooting. Nevertheless, the trend of the monthly exchange rate variation for a ten-year period is correlated to data of a simple, new ratio, revealing in a straightforward way under which conditions fixed income is more profitable than stock exchange investment. This knowledge is useful for investment assessment in Brazil.

Key Words

exchange rate; interest rate; inflation rate, monetary policy; investment decision; equity and fixed income analysis; stock market.

JEL: G12, E43, E58

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Síntesis

La interacción de la variación de la tasa de cambio con las decisiones sobre la política monetaria y las inversiones en Brasil

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Resumen

Al invertir en el extranjero, las compañías de seguros y los fondos de pensión están preocupados acerca de cómo las tasas de cambio pueden variar. Este trabajo evidencia que las decisiones de los inversionistas sobre el tipo de inversión en Brasil (renta fija o acciones) deberían considerar las perspectivas de la variación de la tasa de cambio. Esta perspectiva también puede influir en las decisiones del Comité de Política Monetaria (Copom) del Banco Central de Brasil (BCB) en relación con el objetivo de fijar la meta de la tasa básica de interés a corto plazo en Brasil (conocida como tasa de interés Over-Selic). Un análisis estadístico de la variación diaria de la tasa de cambio poco antes y poco después de las sesenta y cinco reuniones del Copom reveló la interacción de las expectativas y receptividad del mercado a las decisiones del Copom. Además, un gráfico con series largas de datos desde enero de 1999 hasta julio de 2009 ofrece una visión general de la evolución de variables importantes que deben ser consideradas para una evaluación de la inversión, tales como: el principal índice bursátil de Brasil (Ibovespa); las tasas de cambio (R\$ / US\$ y R\$ / Euro); el principal índice de la tasa de inflación en Brasil (IPCA); la tasa de interés Over-Selic; y el *spread* entre la tasa de interés Over-Selic y la tasa de interés Federal Funds de los EE.UU. Los datos medidos por un período de diez años prueban que este *spread* entre las tasas de interés está de hecho muy positivamente correlacionado (es decir, 0,87) con el principal índice de inflación de Brasil, el IPCA, lo que contradice la creencia de que el aumento de las tasas de interés frena la tasa de inflación en Brasil. En realidad, la política monetaria de Brasil se esfuerza para asegurar o acumular divisas fuertes, lo que reduce los desequilibrios en la balanza de pagos y por lo tanto, la probabilidad de un fuerte rebasamiento de la moneda (“overshooting”). Sin embargo, la tendencia de la variación mensual de la tasa de cambio para un período de diez años se correlaciona con los datos de una nueva y sencilla razón, que revela directamente en qué condiciones la inversión de renta fija es más rentable que la bursátil. Este conocimiento es útil para la evaluación de las inversiones en Brasil.

Palabras-Clave

tasa de cambio; tasa de interés; tasa de inflación, política monetaria; decisión de inversión; análisis sobre las inversiones de renta fija y acciones; mercado de valores.

JEL: G12, E43, E58

Sumario

1. El contexto de este trabajo. 2. Resultados y discusiones. 2.1. Acerca de la política monetaria de Brasil con el régimen de flotación de la tasa de cambio. 2.2. Evolución de las principales variables económicas de Brasil – un vistazo de 10 años. 2.3. La relación entre la inflación y las tasas de interés en Brasil. 2.4. El impacto de la variación de la tasa de cambio sobre las decisiones de inversión. 3. Conclusiones. 4. Referencias bibliográficas. 5. Apéndice.

1. Context of this work

Insurance companies as well as pension funds seek sound investment opportunities for their cash flow income (i.e. premiums or contributions), always trying of course to minimise the possibilities of poor yields and losses. Therefore, risky investments are restrained by strict rules set by companies' policies and by governments as well. Such rules have, for instance, prevented some foreign pension funds from investing in Brazil while the country was not considered to be "investment grade" by notable risk agencies, as Standard & Poor's and Fitch.

This situation changed on the first semester of 2008, when the both aforementioned risk agencies assigned 'investment grade' to Brazil. Moreover, Moody's decided in September 2009 to raise Brazil's government foreign debt rating to "investment grade". Given this new scenario, foreign insurance companies and pension funds may no longer be hindered from investing in Brazil and may even be confident to expand their businesses in the country. Therefore, several financial managers and analysts throughout the world may be willing to understand better how Brazil's economy developed in the last ten years up to attaining "investment grade". They may also want to grasp what are the opportunities and threats when taking investment decisions in Brazil, and how far does Brazil's monetary policy influence such decisions.

Brazil's Central Bank (BCB) runs the country's monetary policy with fairly high, yet informal, independence. Its Monetary Policy Committee (Copom) sets the evolution of the target interest rate, which is known in Brazil as the Over-Selic interest rate, which influences the level of business carried out in the country. The BCB usually emphasises the enforcement to comply with the so-called "inflation-targeting regime", taking into account goals set by the National Monetary Council (Conselho Monetário Nacional, CMN). The chosen inflation target index was the IPCA ("índice de preços ao consumidor amplo" – broad consumer price index), evaluated by Brazil's official statistics institute (IBGE).

The evolution of inflation seems to be a "technical reason" for the Federal Open Market Committee (FOMC, a committee of the American Federal Reserve System – FED) to alter the key interest rate in the USA. Nevertheless, Woodward (2001) described how Alan Greenspan negotiated with political skill these decisions with FOMC members as well as with the high rank of the American government. Moreover, during the second term of 2007, FED Governor Ben Bernanke prompted several cuts of the FED target rate, one percentage point down, despite fears of inflation. However, the outlook for the US economy was gloom. Thus, political circumstances do seem to impact the flow of American monetary policies.

Raising the interest rate may also prevent or even stop a capital flight. This happened in 1847, when an increase in the British interest rate reversed a gold flight to the USA, as remembered by Kindleberger (2000). Furthermore, when describing a series of financial crisis in the world during the 1990's, including the currency crash in Brazil in the first months of 1999, Blustein (2001) observed that an increase of the interest rate could stop a capital flight.

Consequently, interest rate prescription may have “multiple purposes”, as conceptually pointed out by Bresser-Pereira (2003), while Henriques de Brito (2003) used long series of data for several countries around the world to conclude that interest rates values depend on expectations of changes in the exchange rate. This concept is also present on several comments on the Brazilian newspaper *Valor* written by Luiz Sérgio Guimarães. For instance, he pointed out that the foreseen decrease of the target interest rate in Brazil at the beginning of 2009 could be restrained by the expectation of the devaluation of the Real (GUIMARÃES, 2009). At about the same time, Ribeiro (2008) explained, also on the newspaper *Valor*, that Selic was maintained at 13.75%p.y. in December 2008 so as to prepare the spirits of the financial markets for a new cycle in which there would be a decrease of the key interest rate value, following the policy of not promoting either rough or non-signalised movements. Such statement suggests that Copom really tries hard to please the financial market in Brazil, which calls for a closer investigation.

This article initially scrutinises how the exchange rate in Brazil changed every month from January 1999 through July 2009, and also every day shortly before and after each regular meeting of the Copom from January 2003 to July 2009. These data reveal that the Copom does normally grasp the message concerning the movements in the exchange rate market. Furthermore, a graph was conceived to examine at a glance the influence of the exchange rate together with Copom’s selected interest rate on both Brazil’s stock market index (Ibovespa) and inflation index IPCA, which BCB allegedly follows closely so as to keep it under control. Finally, a ratio was developed to identify under which circumstances fixed income investment may be more profitable than investments in Brazil’s stock exchange market. In all cases the investigation of long strings of data should allow reliable conclusions, following the same type of research methodology described and employed by Levitt and Dubner (2006).

2. Results and discussions

This section comprises four interconnected parts. Initially, the evidence of the influence of the exchange rate variation on decisions of The Monetary Policy Committee (Copom) of Brazil’s Central Bank (BCB) regarding the target for the basic short-term interest rate in Brazil is presented. Secondly, a chart with long strings of important economic data from January 1999 until July 2009 fosters a discussion about the relevance of the exchange rate variation in Brazil. In the third part of this work, there is an interpretation of the reasons why the spread between the Over-Selic interest rate and the Federal Funds interest rate (USA) is highly and positively correlated to Brazil’s main inflation index IPCA, and why this fact should not come as a surprise. Finally, a new ratio is developed in order to investigate under which conditions fixed income is more profitable than stock exchange investment, and whether this assessment would be linked to the exchange rate variation.

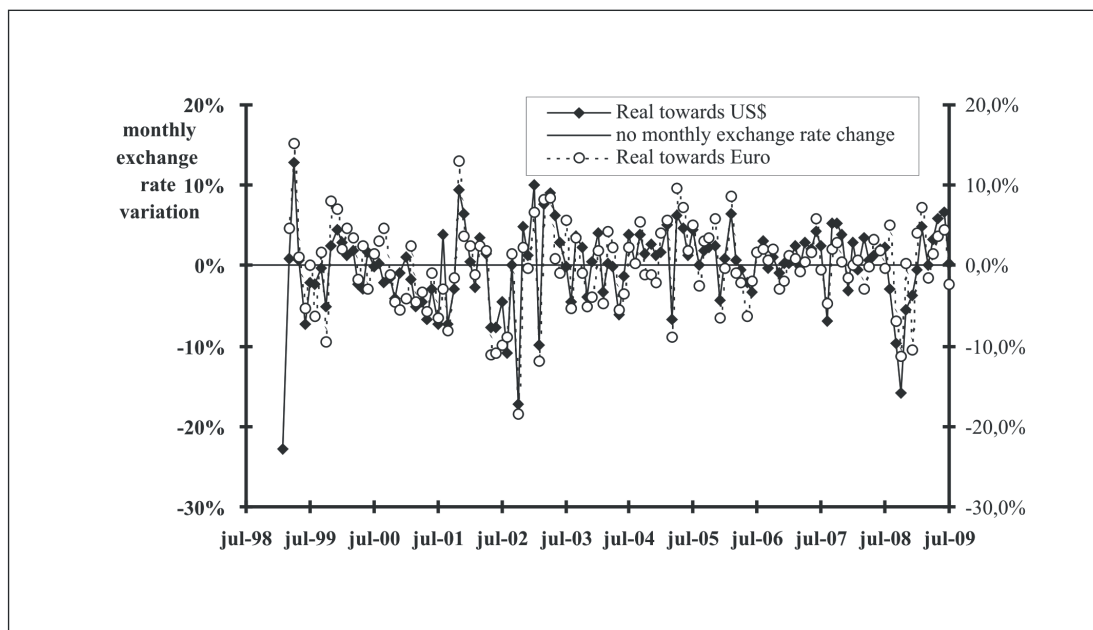
2.1. About Brazil’s monetary policy with floating rate exchange regime

In order to assess Brazil’s monetary policy with floating rate exchange regime, it is worthwhile to investigate the monthly exchange rate variation of the Real against the US Dollar and the Euro, considering that Brazil has sound commercial and financial links with USA and Europe. Therefore, Figure 1 exhibits the monthly exchange rate variation of the Real towards

the American Dollar and the Euro from January 1999 until July 2009, recalling that in January 1999 a serious currency crash begun in Brazil, and the Euro was also launched.

Both series in Figure 1 have a very similar trend and the data scatter whereabouts zero with great volatility. The correlation coefficient for the two series is .83, which indicates a positive linear relation of how the US Dollar and the Euro responded to the Real. From 1999 through 2002, the Real tended to devalue towards both the US Dollar and the Euro, whereas the Real revaluation against the US Dollar was more frequent specially from July 2006 to July 2008, also because the US Dollar did devalue against the Euro during that period. Therefore, the correlation coefficient for the two series from 1999 through 2002 (.86) is slightly higher than the correlation coefficient from 2003 through July 2009 (.80). This remark fosters a better understanding of how BCB decisions may alter exchange rate variations, bearing in mind the fact that both Brazil and its Central Bank have a new President since January 2003.

Figure 1 – Exchange rate variations of the Real (January/1999 through July/2009)



The BCB does gather opinions and expectations from the financial markets, as when it regularly surveys within financial analysts and institutions their beliefs about several economic data. The results are published on the BCB's website, without any comment or promise to take them into account when setting monetary or foreign exchange policies. A way of checking if, when, and how these decisions please or upset the financial markets is to eventually detect a change of the exchange rate when Copom sets Brazil's key interest rate.

The Copom's regular meetings always begin on a Tuesday and last two days. Since 2006, they are held every six weeks, hence eight times a year, but before the meetings used to take place once a month, starting in the year 2000. Three years later, in January 2003, President Luiz Inácio Lula da Silva took office with Mr. Henrique Meirelles as the Governor of Brazil's Central Bank (BCB). From January 2003 until July 2009, Copom held sixty-five meetings, and, as a result, decided to increase, reduce or just maintain the target value for the Selic rate.

Table 1 gives an example of how weighted-averages of three daily exchange rate variations before and after Copom's meeting may be calculated, using data for the Copom's meeting on October 19-20th, 2004. The weights become smaller, the more distant the daily exchange rate variation is from the decision announced on a Wednesday evening. The goal is to be able to grasp systematically the correct trend for a devaluation or a revaluation. For instance, instead of -.18% and .41%, normal averages calculated with data on Table 1 would give -.1% and .1%, which would not undoubtedly reveal that that Copom's meeting actually did change the normal trend of the exchange rate. In fact, some newspapers in Brazil did report the speculative attack on Tuesday, October 19th, 2004. The significant revaluation of the Real on Thursday, October 21st, 2004 resulted well from Copom's decision to raise the Selic rate according to the most conservative estimate at that time.

Table 1 – Example of the determination of the average exchange rate variation

date	exchange rate R\$/US\$	daily exchange rate variation	weighted average for the exchange rate variation
Thursday, 10/14/2004	2.8623		-.18% (devaluation)
Friday, 10/15/2004	2.8615	.0% (weight = 1)	
Monday, 10/18/2004	2.8539	.3% (weight = 2)	
Tuesday, 10/19/2004	2.8698	-.6% (weight = 3)	.41% (revaluation)
Wednesday, 10/20/2004	2.8839		
Thursday, 10/21/2004	2.8527	1.1% (weight = 3)	
Friday, 10/22/2004	2.8481	.2% (weight = 2)	
Monday, 10/25/2004	2.8809	-1.1% (weight = 1)	

Table 2 displays the four combinations resulting from devaluation and revaluation of the Real towards the US Dollar, shortly before and after sixty-five Copom's decisions. The resulting four situations shown in Table 2 are discussed below.

Table 2 – Exchange rate trend shortly before and after 65 Copom’s meetings

		Trend after Copom’s meeting	
		devaluation (22 times – 33.8%)	revaluation (43 times – 66.2%)
Trend before Copom’s meeting	devaluation – 35 times – (53.8%)	11 meetings (16.92% occurrences) - unfortunate outcome –	24 meetings (36.92% occurrences) – mood reversal –
	revaluation – 30 times – (46.2%)	11 meetings (16.92% occurrences) - unpleasant surprise –	19 meetings (29.23% occurrences) – expectations fulfilled -

Considering that an appreciation of the Real after a Copom meeting denotes a satisfaction, since more US Dollars pour into Brazil, the market was pleased 43 times out of 65 (66.2%). The sample with 65 results allows a reliable hypothesis testing that the mean is above 50%, which would confirm that Copom tried not to upset the market. The standard error is .05867 (=square root ((.662*.338)/65)). The t ratio is 2.761 (=(.662-.5)/.05867). Since the sample is large (n greater than 30), the tail area above 2.761 in the normal curve gives a p-value of .003. Thus, sampling data show little credibility for the null hypothesis, once there would be only 0.3% probability that devaluation and revaluation would be equally likely after a Copom meeting.

A similar calculation would indicate that devaluation is more probable before a Copom meeting, although less likely compared to the situation described above, specially because of data in 2008 and 2009. Data from meetings between January 2003 until December 2007 (i.e. 52 meetings) do show that, during that period, devaluation of the Real before a Copom meeting was very probable (61.5%), which suggests that the market at that time either tried to embarrass the Copom or did not always trust that its decision would be certainly favourable. However, after 2008, devaluation before a Copom meeting became less likely. During the year 2009, except for the meeting held in January, all the four subsequent meetings from March to July were preceded and followed by revaluation of the Real. Therefore, the market increasingly trusted the outcome of Copom meetings chaired by Mr. Henrique Meirelles. Another evidence for this fact could be found in several comments published in the Brazilian press in mid 2009 conveying a certain fear as to what would happen when Mr. Meirelles leaves the BCB.

Actually, seldom was the weighted-average devaluation after a Copom meeting about or over -1%. Hence, a Copom decision rarely caused any real disappointment in the market, an additional evidence that Copom avoids thwarting the market. Moreover, these rare situations shed indeed a light on what kind of decisions the market was awaiting.

Lack of trust on whether Brazil's new government would conduct the Brazilian economy with austerity explains the disappointment with Copom's decision on January 22nd 2003 to raise the Selic interest rate by half a percentage point. This value seems to be low, when considering that at the Copom meeting in December 2002 the Selic increased by three percentage points, after a rise of one percentage point in November 2002 (Table 3) and three percentage points in October 2002. With the .7% revaluation before February's meeting, the market seemingly decided to give credit to Mr. Henrique Meirelles and the new Copom members. The Selic was kept at 26.5% for the following three months, and the financial turbulence diluted. From June 2003 until the end of that year, Copom managed to reduce the Selic to 16.50% without too much difficulty.

Table 3 – Copom's decisions and market reaction

meeting date		Nov 20 th 2002	Dec 18 th 2002	Jan 22 nd 2003	Feb 19 th 2003	Mar 19 th 2003	Apr 23 rd 2003
Selic	change	+1.00%	+3.00%	+.50%	+1.00%	.00%	.00%
	target	22.00%	25.00%	25.50%	26.50%	26.50%	26.50%
average exchange rate variation	before	1.12%	1.71%	-1.24%	.70%	-.11%	-.07%
	after	-.36%	.81%	-.85%	-.11%	.18%	.09%

Note: Explanation of how weighted averages for exchange rate variations were calculated are given on Table 1.

Two Copom meetings in March and April 2004 still managed to lower the Over-Selic rate by a quarter percentage point without triggering turmoil. However, when the key interest rate was kept at 16.00% on the 19th May 2004, the aftermath was a strong devaluation of the Real against the US Dollar (i.e. -2.4% and -7% in two consecutive days). Such noteworthy devaluation corroborated the great market displeasure with Copom's decision, which was also not unanimously approved within the Brazilian government, as reported by Filgueiras and Nucci (2004). The decision was puzzling, since an imminent increase of the FED's rate (at that time still 1.00%), albeit with an unknown speed, would reduce the spread between Brazil's and United States' key interest rates, henceforth named "the BCB-FED spread", which at that time was 14.85% $(= (1.16/1.01) - 1)$. As until then a reduction of the BCB-FED spread was mostly followed by a devaluation of the Real, although possibly with a time lag, the market was scared with the faltered Copom decision in May 2004.

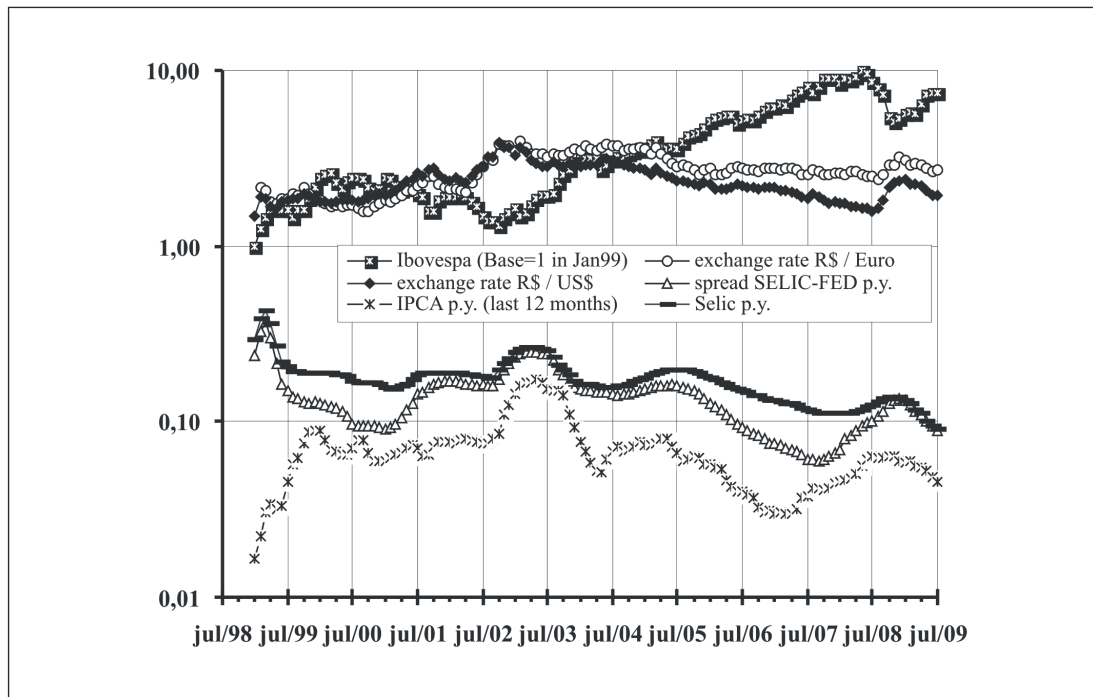
In the following month, Mr. Alan Greenspan and FOMC members did indeed start to raise the US key interest rate, softly nonetheless. Since the exchange rate remained fairly stable, Copom could delay for three months an increase of the Selic rate. On the meeting held on September 15th, Brazil's key rate became a quarter higher. The next monthly meetings would steadily increase the Selic rate until it reached its peak value of 19.75% on May 18th 2005. During all this period, there was a remarkable revaluation of the Brazilian Real towards the American

Dollar and the Euro, as well as the beginning of a notable soar of the main Brazilian stock market index (Ibovespa), which would reach astonishing levels during 2006 and 2007, as discussed next.

2.2. Evolution of Brazil's main economic variables – 10 years at a glance

Figure 2 brings together six main variables related to the Brazilian economy: the Ibovespa stock market index; two exchange rates (Real/US Dollar and Real/Euro); the Over-Selic interest rate; the BCB-FED spread; and the inflation index IPCA. The vertical axis in Figure 2 has a logarithmic scale in order to better apprehend how each variable increases and decreases with time.

Figure 2 – Evolution of financial variables in Brazil at a glance (January/1999 thru July/2009)



After the currency crash at the beginning of 1999, the BCB-FED spread reduced until 2001, whereas the exchange rates and specially the Ibovespa would change with high volatility, also due to troubles in the American stock market, and particularly with Nasdaq listed companies. The Ibovespa clearly slid back through the first three-quarters of 2001, while the exchange rates and the BCB-FED spread went up. A certain stability for the four variables occurred between the end of 2001 and the beginning of 2002, when there was a serious energy shortage in Brazil, and Argentina defaulted too. Thus, external turbulence together with domestic problems may account for the difficulties Brazil had to cope with in order to grow without volatility throughout those years.

During the second and third quarters of 2002, the Ibovespa tumbled and exchange rates soared, at the prospect of Mr. Luiz Inácio Lula da Silva election as president in October 2002, which did occur. The BCB-FED spread performed an odd evolution while the new Brazilian government gained international trust. From the last quarter of 2002 until mid 2003, the BCB-FED spread went up to come down again to the previous level in the last quarter of 2002. The resulting confidence in the monetary policy under Brazil's new president led to a steady increase of the Ibovespa, as well as to Real revaluation, which was significant towards the US Dollar, and less so against the Euro.

The two exchange rates and the Selic interest rate remained fairly stable, from January until September 2004, when Selic started to go up again. Both the Copom and the FMOc rose interest rates in a way that the BCB-FED spread increased. As a result, the Real showed again a strong appreciation towards the US Dollar and the Euro all through the last quarter of 2004 until mid 2005. The Ibovespa stayed pretty volatile without a vigorous growth. However, by that time, it became crystal clear that the Copom and the Brazilian government would rather adopt a tight and predictable monetary policy. Such belief allowed a new continuous plunge of the BCB-FED spread. Falling interest rates made the Ibovespa soar from mid 2005 until May 2008 approximately, when two major international rating agencies (Fitch Ratings and Standard & Poor's) assigned 'investment grade' to Brazil. The Euro did devalue slightly towards the Real, although not as much as the American Dollar. The torrential capital inflow also skyrocketed Brazil's reserve, according to data published in *Conjuntura Econômica* (2009).

Although currency revaluation together with falling interest rates is rather abnormal world-wide, a similar situation actually happened in Germany in 1998. Despite the fact that the German central bank at that time was cutting its key domestic interest rate, the German currency revalued. Porfírio (2003) explained that this happened due to a "widespread belief of the market that the German central bank would not hesitate to intervene to avoid an overheating of its economy, which could trigger inflationary tensions". Hence, the financial market may accept a lower Selic, as well as a smaller BCB-FED spread, as long as it trusts that there will be no surprises, and that other profitable kinds of financial gains are possible within a certain acceptable risk.

From September 2007 until March 2008, the Selic target rate was maintained at 11,25% p.y. Although nominal and effective interest rates were still among the highest in the world, both were very low for Brazilian standards. Nevertheless, the BCB-FED spread increased, since the interest rates in the USA were falling in line with the development of the mortgage crisis in that country.

The description above reveals that expectation is actually the underlying – and most likely the main – variable not obviously shown in Figure 2. Nevertheless, expectations strongly influence the change in the exchange rate, as already discussed with results on Table 2. Therefore, a currency appreciation reveals satisfaction and confidence, whereas depreciation indicates fear and mistrust.

2.3. The relationship between inflation and interest rates in Brazil

Table 1 brings data of a speculative attack before a Copom's meeting on the 20th October 2004. On that evening, the Over-Selic rate went up by a half percentage point, as predicted by the most conservative estimate, despite the fact that inflation in Brazil was decreasing at that time. Such outcome was odd to the established popular wisdom, but the Selic rate rose sufficiently to stop a capital flight and a significant devaluation of Brazil's currency.

Three months later, the Selic target rate continued to climb steadily, even though inflation was going up too. Nevertheless, Copom's minutes from December 2004 stated that "In order to ensure the convergence of inflation to the targeted path, the Copom members determined that the gradual interest rate adjustment process should continue at the originally foreseen pace". What actually happened was that the IPCA, which Copom apparently looked after, still increased to a peak in May 2005, when Copom also stopped rising the Selic rate. Thus, the link between the Over-Selic rate and Brazil's main inflation index IPCA requires a closer scrutiny.

Figure 2 shows that during the beginning of 1999, after a serious currency crisis, the IPCA inflation index increased, and the BCB-FED spread went down, which may also appear awkward to common sense. Actually, the BCB-FED spread gradually declined during that period because such a high Over-Selic rate was not necessary anymore. There was no longer a capital flight, since the financial community and the International Monetary Fund (IMF) did bail out Brazil (BLUSTEIN, 2002). A new, realistically devalued level for Brazil's currency was established after the overshooting. Given that normally overshooting do boost inflation rates, initially by means of the so-called "*pass through*", a surge of the inflation index IPCA after a severe financial crisis is clearly an expected outcome, which can hardly be bridled. Thus, no possible link between the inflation index IPCA and the Over-Selic interest rate could be identified during the first semester of 1999.

As the so-called "inflation-targeting regime" was established in June 1999, when the Brazilian economy was again stable, only data after July 1999 should be considered to discuss the effectiveness of this monetary policy. With the data sequence for the IPCA inflation index and for the BCB-FED spread, the correlation coefficient for these two data series from July 1999 to July 2009 is .87, which being very close to 1 definitely indicates a positive linear relation of the IPCA and the BCB-FED spread. With the Selic rate sequence, replacing the BCB-FED spread data, the correlation coefficient is slightly lower, being .82. The long data series demonstrate that the "inflation-targeting regime" may actually beget domestic inflation, specially when Brazil's interest rates rise, as already pointed out by Henriques de Brito (2003).

At that time, the author explained that higher interest rates would raise financial costs, which in turn would trigger price adjustments, specially of those goods with a less elastic demand, which are normally selected to calculate the inflation rate. Moreover, a cash flow discounted with a higher capital cost would have a lower present value. To offset this reduction, net cash flow streams should increase, which in turn means that sale prices should be higher, whenever possible, hence fostering inflation. Consequently, raising the domestic interest rates may worsen inflation,

rather than contributing for its control or reduction. On the other hand, a lower interest rate is possible, provided the currency does not devalue with the outcome of a higher inflation rate, as aforementioned. Indeed there is a certain interest rate level, which is appropriate for a given inflow of hard currency.

Furthermore, although unusual, a remarkable net inflow of capital may engender a constant currency revaluation, which decreases both inflation and the key interest rate, as it happened in Brazil during 2006. On the other hand, a stronger Real, resulting from the above-mentioned revaluation, reduced export income. If less hard currency came to Brazil, smaller were the chances that a currency revaluation could counterbalance higher prices of imported goods. During 2007 in particular, several price changes in the global environment affected Brazil's domestic inflation, and importation costs rose with higher prices for oil and tradable goods. The revaluation of the Real could not endlessly offset the world-wide advance of inflation at that time.

Raising domestic interest rates may hardly avoid inflation resulting from multinational pricing policies. Using mathematical models and long strings of data for "The Big Mac Index" from the newspaper "The Economist", as well as data from the UBS study "Prices and Earnings around the Globe", Henriques de Brito (2008) explained that: "multinationals' subsidiaries try to strive for an annual price readjustment in US Dollars at least equal to an international average, without bothering whether prices in US Dollars for identical goods are the same world-wide". This statement holds, regardless whether the goods, or just their parts, are traded in foreign markets or are simply for domestic businesses. This struggle to readjust local prices throughout the world in a similar way can not be knocked over by local interest rates.

Actually, interest rates are just another type of price (i.e. the "cost of money"). Thus, knowing that each society has a certain price structure and that the markets are interconnected due to globalisation, when there is a generalised price increase throughout the world, there is natural pressure for a broad domestic price raise, including a stimulus to inflate the cost of money. Indecision or inability to adjust interest rates according to the circumstances may cause harmful economic imbalances. As follows, an interest rate surge may shun a noteworthy capital flight and its damaging consequences, notably currency overshooting with its malign influence on inflation.

Foreign money left Brazil during the second semester of 2008 – not because of the circumstances in Brazil, but rather due to financial distress abroad. The exchange rates soared and the Ibovespa plunged, in a similar way to what had happened during the second and third quarters of 2002 (see Figure 2), albeit the causes were completely different. Despite the severe financial world crisis, which did restrain capital inflow to emerging countries, Brazil was still able to hold reserves with almost the same amount of US Dollars that it owned. Moreover, during 2008, Brazil had to raise its key interest rate by only 2.50 p.p., a small increase compared to other countries.

In March 2009, the target Selic interest rate (11,25% p.y.) was again the same as in March 2008. In addition to the interest rate reduction around the world, the very positive outlook for Brazil's development enabled that comeback. This achievement should be attributed to the fact that markets were confident about financial gains in Brazil and did not fear significant and unforeseen losses due to currency devaluation. Thus, developing trust with foreign investors who seek a safe haven in an unstable world may, quickly and effectively, lower the interest rates and inflation altogether.

2.4. The impact of exchange rate variation on investment decisions

Brazil offers several investment possibilities to foreign investors, notably opportunities in the fixed income and stock exchange markets. The best way to distinguish financial yields offered by these two different kinds of markets may consist of comparing the mean expected amounts of these two different types of investments, whose accrued earnings are related to specific, distinct benchmarks. The selected benchmark rate for accrued earnings in the capital markets may be the evolution of the main stock market index in Brazil (Ibovespa). The benchmark rate for earnings of fixed income securities in Brazil may be considered to be the "DI" (an Overnight Interbank Deposit Rate), which is computed by CETIP, an Over-The-Counter Clearing House for operations with fixed income securities and OTC derivatives in Brazil.

Despite the fact that in the short term earnings of a certain investment may stay well above (or below) the average, earnings in the long run may be alike since the "regression to mean" principle may be verified with investments (as described by MALKIEL, 1999 and BERNSTEIN, 1996). Moreover, a direct comparison of accrued earnings resulting from the two different benchmark rates may point out during which periods a certain kind of investment is more profitable than the other.

Equation 1 gives the future value (FV) of an investment (PV) beginning in January 1999 and ending in a certain month "end" at the Brazilian stock exchange. The ratio between the average stock market indexes for two different months will define the expected amount in the Brazilian currency Real for the selected period.

$$FVBV_{R\$} \Big|_{J99-end} = PV_{BVR\$} \Big|_{J99} * \frac{Ibovespa|_{end}}{Ibovespa|_{J99}} \quad \text{Equation 1}$$

Equation 2 shows the future value of an investment with accrued interest related to the DI (which is actually Brazil's counterpart to Libor and Euribor):

$$FVDI_{R\$} \Big|_{J99-end} = PV_{DI_{R\$}} \Big|_{J99} * (1 + i_{DI} \Big|_{J99-end}) \quad \text{Equation 2}$$

where the global interest rate for a period beginning in January 1999 ($i_{DI} \Big|_{J99-end}$) results from several monthly accumulated DI rates except the DI rate for the month that ends the analysed period, as given by Equation 3:

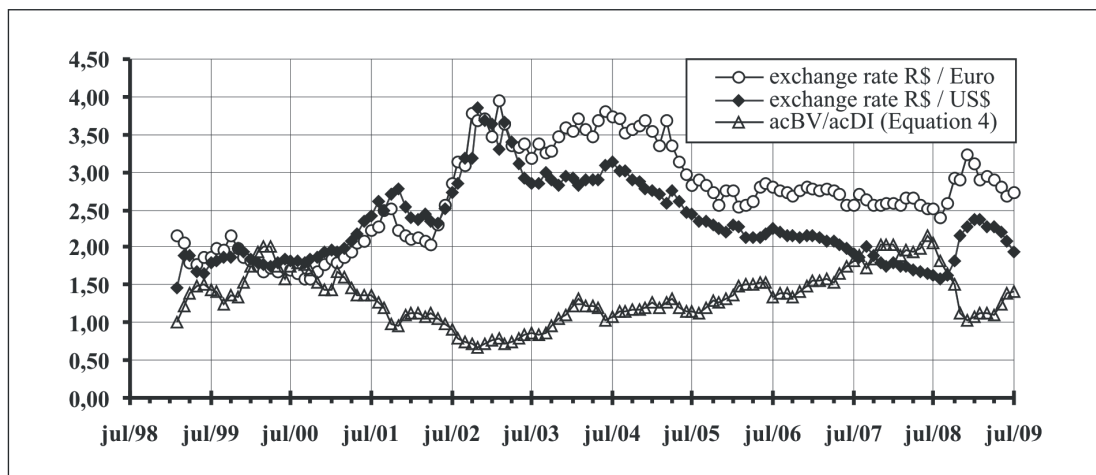
$$\left(1 + i_{DI} \Big|_{J99-end} \right) = \left(1 + i_{DI} \Big|_{J99} \right) * \left(1 + i_{DI} \Big|_{F99} \right) * \dots * \left(1 + i_{DI} \Big|_{end-1} \right) \quad \text{Equation 3}$$

The ratio $acBV/acDI$ (as defined by Equation 4) expresses the ratio between the amounts given by Equation 1 and by Equation 2, requiring the principal to be the same in both cases. This ratio signals if an investment in the Brazilian stock market was on the average financially more attractive than a fixed income investment in Brazil.

$$\frac{acBV}{acDI} \Big|_{J99-end} = \frac{FVBV}{FVDI} \Big|_{J99-end} = \frac{\frac{Ibovespa|_{end}}{Ibovespa|_{J99}}}{(1+i_{DI}|_{J99-end})} \quad \text{Equation 4}$$

Figure 3 shows how the ratio given by Equation 4 changes with time. A table with numerical data from January 1999 to July 2009 is in the Appendix. Although the suggested method in this work employs the month as the time unit, nothing hinders an analysis on a daily basis. Nevertheless, the tax system levied on fixed income investments in Brazil does restrain daily short term investing. Hence, an analysis spanning over many years may be more suitable to detect investment guidelines.

Figure 3 – Comparing the evolution for the exchange rates and the ratio of Equation 4



During the last ten years, there were periods when accumulated earnings in the Brazilian stock exchange were greater than accumulated earnings with fixed income securities. However, when the ratio given by Equation 4 is very close to the unit (as in September 2001, May 2002, September 2003, May 2004, and, years later, in November 2009), the investment yield is almost independent of the investment type. Thus, an investment beginning in January 1999 with earnings adherent to one of the above mentioned benchmark rates would yield about the same amount in Reais, as obtained with the other benchmark rate. This fact also indicates the validity of the “regression to mean” principle for investments, as expected. In any case, while earnings through investments in the stock exchange normally oscillate, sometimes with an unpredictable pattern, a fixed income investment having the DI as the benchmark rate assured regular earnings in Reais with a mean value of 1.3%p.m. or 17%p.y., using CETIP data from January 1999 to July 2009.

The exchange rates R\$ per US\$ and R\$ per Euro are also plotted on Figure 3. It is possible to clearly notice that when a revaluation of the Brazilian Real towards both the US Dollar and the Euro occurs, the ratio $acBV/acDI$ (given by Equation 4) increases, meaning that investment in the Brazilian stock exchange becomes attractive. On the other hand, a devaluation of the Brazilian currency turns fixed income investment more appealing, since the ratio $acBV/acDI$ lowers.

Table 4 gives the different correlation coefficients for data resulting from Equation 4 and each type of exchange rate, considering furthermore three different periods, after the enactment of the so-called "inflation-targeting regime". Even though all three periods are fairly long, the quite dissimilar figures when using the R\$ per Euro exchange rate do evidence that the Euro moves independently from the US Dollar, specially after 2003. Nevertheless, all numbers on Table 4 are negative, which clearly indicates a negative linear relation of the data from Equation 4 and data from both exchange rates. Moreover, Equation 4 tend to generate stable data when the exchange rates are rather steady, as in the beginning of 2009. This knowledge may be useful to decide how to invest, specially if a reliable forecast of the R\$ per US\$ exchange rate variation is available.

Table 4 – Correlation coefficients for the evolution of the exchange rates and the ratio of Equation 4

	period		
	from July 1999 to July 2009	from July 1999 to December 2002	from January 2003 to July 2009
R\$ / US\$	-0.86	-0.88	-0.85
R\$ / Euro	-0.55	-0.84	-0.73

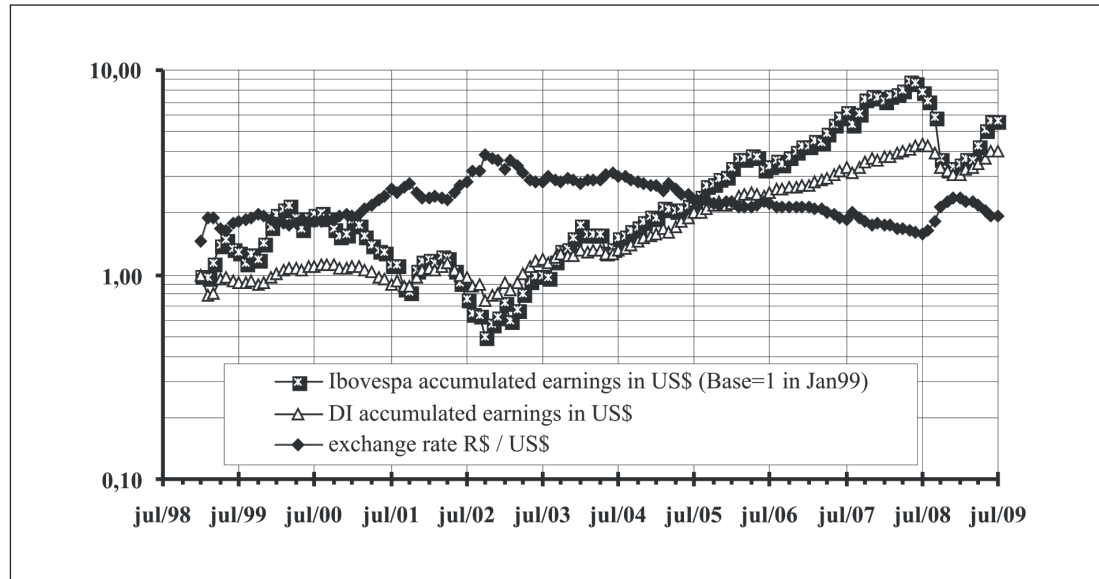
Indeed, the R\$ per US\$ exchange rate variation during the investment period does modify the amount foreign investors receive in US Dollars. Thus, the amount to be repatriated, given by Equation 1 or Equation 2, must actually be multiplied by a factor which accounts for the exchange rate variation. This factor is actually equal to the ratio of the exchange rate in January 1999 (e_{J99}) divided by the exchange rate in the month "end" (e_{end}), as shown below:

$$FV_{US\$} \Big|_{J99-end} = FV_{R\$} \Big|_{J99-end} * \left(1 + \phi_{c_{nominal}} \right) = FV_{R\$} \Big|_{J99-end} * \frac{e_{J99}}{e_{end}}$$

Equation 5

Figure 4 exposes the accumulated benchmark earnings in US Dollars. Clearly, the revaluation of Brazil's currency from January 2004 to the beginning of 2008 was very suitable for investments in Brazil, specially on the stock exchange. This situation occurred again in the first semester of 2009, almost in the same way. Conversely, the devaluation of the Real did reduce gains or even impinge losses, usually abruptly, as for an investment beginning in January 1999 that would end in October 2002, for example.

Figure 4 – Accumulated benchmark earnings in US Dollars (January/1999 thru July/2009)



A way to circumvent the restriction given by Equation 4 that an investment should necessarily begin in January 1999 requires the assumption that an investment may result from two consecutive periods. Thus, the amount previously obtained is immediately reinvested. There is an intermediate month “int” that establishes both the end of the first investment period beginning in January 1999 and the beginning of the succeeding period. Equation 4 may be rewritten as Equation 6:

$$\frac{FV_{BV} |}{FV_{DI} |_{J99 - end}} = \frac{\frac{Ibovespa |_{int} * Ibovespa |_{end}}{Ibovespa |_{J99} Ibovespa |_{int}}}{(1+i_{DI} |_{J99 - int}) * (1+i_{DI} |_{int - end})}$$

Equation 6

On the right hand side of Equation 6 there are in fact two ratios of amounts related to two different investments. Simple mathematical operations lead to Equation 7:

$$\frac{acBV |}{acDI |_{int - end}} = \frac{FV_{BV} |}{FV_{DI} |_{int - end}} = \frac{\frac{FV_{BV} |}{FV_{DI} |_{J99 - end}}}{\frac{FV_{BV} |}{FV_{DI} |_{J99 - int}}} = \frac{acBV / acDI (end month)}{acBV / acDI (initial month)}$$

Equation 7

A basic message conveyed by Equation 7 is that stock exchange investment should be more profitable than fixed income investment as long as the ratio given by Equation 4 increases, regardless whether initial or end values are both greater or less than 1. For example, from October 2002 until September 2003, the ratio given by Equation 7 is 1.443 ($= .968/.671$, using the values on the table in the appendix). During that period, earnings at the stock exchange were on the average higher than accrued earnings with a fixed income investment following the benchmark rate DI.

A further calculation is to check with Equation 5 whether the exchange rate variation would offset financial gains. In fact, the revaluation of the Real from October 2002 to September 2003 did enhance the gains. On the other hand, between January 2000 and October 2002 an investor in the fixed income market would on average be better off compared to an investment following the Ibovespa, since the value resulting from Equation 7 is .345 ($= .671/1.941$). However, the significant devaluation of the Brazilian currency would impinge losses in US Dollars.

From the discussion above, one can reject the belief that profitable investment requires a sound knowledge or a special feeling as to which would be the appropriate days to buy and then to sell stock. Actually, there are several periods during which stock exchange investment may be better than fixed income investment. Such decision depends strongly on how foreign capital pours into Brazil, causing a revaluation of the country's currency. On the other hand, the process of currency devaluation favours fixed income investment for Brazilian investors, but might impinge losses on foreign investors, who expect significant yields in their currency. Changes on the Brazilian tax law may influence investment selection, notably when investment yields are not hefty.

3. Conclusions

This work brought several ten-year long sequences of data, which reveal how investments in Brazil are affected by financial market expectations, which are numerically translated by changes of the exchange rates. Remarkable daily variations may occur close to the Copom meetings, which decide the level of key interest rates in Brazil. Data from the last sixty-five Copom meetings indicate that its decision rarely thwarts the market, constantly considers the trend for the exchange rate variation, and particularly avoids devaluation of the Brazilian Real. Hence, the long sequences of data do point out that Brazil's Central Bank is really concerned about preventing a devaluation of the Brazilian currency so as not to frustrate foreign investors, who bring hard currency, and hence contribute to the country's economy and balance of payments stability.

It is challenging to avoid currency devaluation without running into a certain revaluation, given the difficulty to stay exactly on the borderline. Furthermore, the revaluation of the Brazilian currency, together with a reduction of Brazil's key interest rate, was possible during a period when both financial markets trusted Brazil's Central Bank and high liquidity was available internationally. This favourable environment fuelled Ibovespa – Brazil's main stock market index – and also caused the Brazilian foreign reserve to soar, besides hindering domestic inflation.

Besides hampering business investment and economic growth, an increase of Brazil's key interest rate may actually foster the inflation index IPCA, once the long data series beginning in June 1999 - when the so-called "inflation-targeting regime" was officially established - demonstrate that inflation and the BCB-FED spread are positively and highly correlated (.87). Therefore, Copom may avoid magnifying the target Selic rate, and hence domestic inflation, if it is possible to assure foreign investors that their financial gains will not be overshadowed by losses due to unexpected, significant and appalling taxes or devaluation of the Brazilian Real.

The forecast for the exchange rate evolution has also an important impact on which type of investment to carry out in Brazil. A suggested method in this work with Equation 4 and Equation 7 points out, in a simple way, when accumulated earnings with the Brazilian stock exchange index (Ibovespa) were greater (or smaller) than accumulated earnings with a fixed income investment, considering the "Overnight Interbank Deposit Rate in Brazil - DI" as the benchmark rate. The latter type of investment tends to be less attractive than the former when there is a revaluation of Brazil's currency. Two numerical examples show why the expectation of the exchange rate variation is so important for foreign investments in Brazil.

Regardless the contribution of the presented method with Equation 4 and Equation 7, personal factors must also be considered all along when making investment decisions. Thus, the following important, recurring message from Graham (2006) in his famous book "The Intelligent Investor" may not be overlooked: "The kind of securities to be purchased and the rate of return to be sought depend not on the investor's financial resources but on his financial equipment in terms of knowledge, experience, and temperament".

Hopefully, this work will contribute to broaden the knowledge about the dynamics in the Brazilian capital and financial markets. There are indeed interesting investment opportunities available for pension funds and insurance companies, including reinsurance companies which, since January 2008, may run their businesses in a more active and independent way in Brazil.

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Data for the Selic interest rate and for the exchange rates were obtained at www.bcb.gov.br (Brazil's Central Bank). Data for the Ibovespa index were obtained at www.bovespa.com.br (BOVESPA Brazil's stock exchange, which actually merged in 2008 with the Brazilian Mercantile & Futures Exchange, resulting in the "BM&FBovespa"). Data for the IPCA inflation index were obtained at www.ibge.gov.br (IBGE). Data for the DI rate were obtained at www.cetip.com.br (CETIP). All these sites were accessed several times until the beginning of September 2009.

Data for Federal Funds interest rates and for Brazil's domestic and external debt were available on several issues of *Conjuntura Econômica* published by FGV (see above).

5. Appendix

Table A – Values calculated with Equation 4 using data from CETIP and BOVESPA

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dez
1999	1.000	1.232	1.388	1.484	1.516	1.441	1.407	1.251	1.369	1.347	1.541	1.744
2000	1.941	2.005	2.005	1.747	1.589	1.752	1.799	1.781	1.707	1.522	1.439	1.447
2001	1.664	1.599	1.463	1.357	1.366	1.365	1.265	1.199	0.970	0.949	1.093	1.122
2002	1.116	1.079	1.124	1.064	0.985	0.909	0.791	0.737	0.717	0.671	0.723	0.770
2003	0.802	0.709	0.731	0.797	0.848	0.859	0.845	0.853	0.968	1.050	1.104	1.215
2004	1.325	1.226	1.214	1.193	1.018	1.076	1.144	1.157	1.165	1.184	1.201	1.262
2005	1.193	1.272	1.316	1.195	1.143	1.155	1.128	1.189	1.292	1.277	1.309	1.376
2006	1.476	1.516	1.507	1.54	1.521	1.349	1.378	1.387	1.340	1.415	1.493	1.555
2007	1.544	1.590	1.534	1.659	1.751	1.815	1.887	1.731	1.852	2.046	2.027	2.041
2008	1.895	1.971	1.927	1.989	2.150	2.053	1.810	1.662	1.497	1.116	1.04	1.077
2009	1.117	1.128	1.097	1.243	1.387	1.410	1.410	–	–	–	–	–

Note: An update of the table above, just using data for the previous and the new month, requires the following equation, which applies the concept presented when developing Equation 4:

$$\frac{acBV}{acDI} \Big|_{j99-end} \Big|_{new\ month} = \frac{acBV}{acDI} \Big|_{j99-end} \Big|_{previous\ month} * \frac{\frac{Ibovespa \Big|_{average\ new\ month}}{Ibovespa \Big|_{average\ previous\ month}}}{(1 + i_{DI} \Big|_{previous\ month})}$$

Example: Given the value for the ratio acBV/acDI in January 2009 (=1.117); the monthly accumulated DI in January 2009 (=1.04% p.m.) and the average values for the Ibovespa in January (=39438.15) and February (=40242.72), the value for the ratio acBV/acDI in February 2009 is hence: 1.128 (=1.117*{[40242.72 / 39438.15]/[1+0.0104]}).

This work was concluded at the end of September 2009.