Eixo Temático: Estratégia e Internacionalização de Empresas

BRAZILIAN EXCHANGE TRADED FUNDS (ETFS) PRICING EFFICIENCY: LONG TERM ANALYSIS BASED ON COINTEGRATION WITH MARKOV REGIME SWITCHING

EFICIÊNCIA DE PRECIFICAÇÃO DE EXCHANGE TRADED FUNDS BRASILEIROS (ETFS): ANÁLISE DE LONGO PRAZO COM BASE NA CO-INTEGRAÇÃO DE MARKOV COM MUDANÇAS DE REGIME

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RESUMO

Os *Exchanged Traded Funds* (ETFs) se tornaram um veículo de investimentos amplamente difundido, com características únicas que não foram ainda suficientemente estudadas em mercados emergentes. Modelos de precificação de ativos consolidados não são suficientes para analisar profundamente a dinâmica da variação dos preços das ações e sua relação com o valor do patrimônio líquido e o mercado, uma característica especial de fundos de investimento com ações negociadas na bolsa. O objetivo deste estudo é analisar a eficiência de precificação dos ETFs brasileiros, com base na relação de longo prazo entre os preços de suas quotas e o índice de mercado, bem como os preços das quotas e o valor patrimonial líquido (NAV). Estimou-se a co-integração com Markov entre os preços das quotas de ETFs e o índice Ibovespa e a co-integração entre os preços das quotas dos ETFs e seu NAV, analisando seu comportamento durante o período de 2004 a 2012. O erro gerado pela cointegração é análogo às medidas tradicionais de desvio de preços. Nossos resultados apontaram que o erro da primeira estimação é estacionário, mas o segundo não, indicando que os preços das ações e a NAV não são co-integradas. Considerando que durante os períodos de crise os ETFs foram transacionados com descontos, mas eles são co-integrados com o mercado no longo prazo, é possível haver oportunidades de arbitragem das quais os investidores poderiam beneficiar-se, comprando os ETFs em períodos de crise e vendendo-os depois que o mercado se recuperar.

Palavras-chave: ETFs, Eficiência de Preços, Cointegração, Mercado Brasileiro.

ABSTRACT

Exchanged Traded Funds (ETFs) are a wide-spread investment vehicle, with characteristics that have not been sufficiently studied yet, especially in emerging markets. Consolidated asset pricing models are not enough to thoroughly analyze the dynamics of share prices variation and their relationship with net asset value and the market, a special feature of investment funds with exchange traded shares. The objective of this study is to analyze the pricing efficiency of Brazilian ETFs, based on the long-term relationship between share prices and the market index, as well as share prices and the ETFs net asset value (NAV). We estimated the cointegration with Markov switching between Brazilian ETFs share prices and Ibovespa index and the cointegration between Brazilian ETFs share prices and their NAV, analyzing their behavior during 2004-2012. The error generated by the cointegration is analogous to the traditional measures of pricing deviation. Our results pointed that the error of the first estimation is stationary, but the second is not, indicating that the share prices and the NAV are not cointegrated. Considering that during crisis periods the ETFs trade at discounts, but they are cointegrated with the market in the long run, there may be arbitrage opportunities that the investors could take benefit, buying the ETFs in crisis periods and selling them after that the market recover.

Keywords: ETFs, Pricing Efficiency, Cointegration, Brazilian Market.

1 Introduction

Exchanged Traded Funds (ETFs) have become a wide-spread investment vehicle, with unique characteristics that have not been sufficiently studied, especially when it comes to emerging markets ETFs. Also, consolidated asset pricing models are not enough to analyze the dynamics of a kind of fund that adds a different dimension in relation to conventional investment funds: the variation of share prices.

The traditional CAPM model, developed by Sharpe (1964), Lintner (1965) and Mossin (1966) was based on the relationship between risk and return, outlined by Markowitz (1952). Jensen (1967) applied the CAPM model to the mutual fund performance evaluation, calculating how much a mutual fund variation depends on the systematic (market) variation (Beta), how much is due to manager's ability (Alpha) and how much is due to idiosyncratic risk (residual). However, ETFs present considerable differences from traditional mutual funds, as traded shares. So, investors face the fact that its share price is different from its net asset value (NAV), an unadvised feature of this kind of investment.

There are not enough studies regarding the relationship between ETF share price and NAV and their relationship with the market. A concise review of the recent developments is provided by Charupat and Miu (2012), who identify three main literature strands: (a) the ETFs pricing efficiency (how close ETFs prices are from their NAVs); (b) the ETFs tracking error/performance (how successfully are they achieving their objectives, measuring the difference between NAV returns and underlying index returns); (c) the effects of ETF trading on their underlying securities;

Exchange Traded Funds of emerging markets have received even less academic attention, although they have become increasingly important for investors, due to their fast growing economies. In an attempt to reduce this gap, the objective of this study is to analyze the pricing efficiency, based on their long-term relationship.

We analyze the pricing efficiency in long-term relationship of the ETF with the overall market (i.e., the systematic risk, as in the traditional model). Also, we verified if the ETF share price is adjusted with its NAV, generating an error term analogous to pricing deviation. So, we estimate the cointegration between Brazilian ETF share prices and their NAV, besides the cointegration between Brazilian ETF share prices and the Ibovespa index and analyze both error terms during the 2004-2012 range.

Our results point, basically, that ETFs share prices are more related to market returns than to their own NAVs. Also, that the subprime crisis caused a shift in this relationships. Section 2 highlights the Brazilian ETF market; Section 3 brings a brief theoretical review about earlier studies involving cointegration analysis applied to ETFs; Section 4 presents briefly the cointegration method; Section 5 discuses the results and Section 6 resumes the results and points out some conclusions.

2 The ETF's in Brazil

Exchange-traded funds (ETFs) are passive investment funds which have become increasingly popular in a relatively short period of time. Their main difference in relation to conventional index funds is that, similarly to individual stocks, ETFs can be bought and sold throughout the trading day in a stock exchange market. Over the past twenty years the number of ETFs has grown from zero to over 2000 in the United States, with aggregate assets under management higher than US$ 1.000 billion (Ferri, 2008). Studies that have examined the performance of ETFs that imitate U.S. equity indexes conclude that ETF performance is predictable to a high degree of accuracy, generally managing to stay close to their benchmark indexes with low levels of tracking error.

Brazilian ETFs were created in January 2002 by the instruction nº 359 of *Comissão de Valores Mobiliários* (CVM), a governmental institution that regulates Brazilian financial market. As international ETFs, they should track a reference index, commonly the Ibovespa Index, which represents Brazilian market. However, differently of US ETFs, they don't pay dividends to shareholders, reinvesting the stock dividends in their portfolios. Also, they are not subject to the creation/redemption process.

The instruction nº 359 of CVM determines that at least 95% of an ETF equity should be invested in assets traded in a stock exchange market or in other assets authorized by the CVM, in the same proportion that they integrate the fund reference index, or invested in index futures. This way, the ETF is assured to reflect its reference index variation. The remaining 5% of the fund equity can be invested in government bonds, fixed income bank investments, fixed income mutual funds, commitment transactions and derivatives (exclusively for risk management of the fund portfolio).

In the Brazilian market, the ETFs are one of the few kinds of investment funds that can trade shares at a stock exchange market, unlike the USA where this is available to other kinds of investment fund, such as the closed-end funds (CEFs) and the Real Estate Investment Trusts (REITs). Funds with traded shares puzzle the investors in the sense that their total share prices may represent a different value of their underlying fundamentals, i.e., their net asset values (NAVs). The difference between share prices and their NAVs is called Pricing Deviation and some studies as Berk and Stanton (2007) point out the discount persistence to explain share prices. But the discount and its persistence are not very well explained by the current literature and this kind of funds challenge conventional models of asset pricing. Section 3 presents a brief review of the late studies on this subject.

3 Theoretical Issues

Shin and Soydemir (2010) test the performance of ETF using Jensen's model and the dependence of discounts on their historical price movements by employing the serial correlation test and runs test and by observing how each market reacts to discrepancy. Their findings point that there are significant tracking errors between ETF and their benchmark. They also find that Asian ETFs appear to be noisier and more prone to momentum trading, meaning that an active management would be more appropriate for Asian markets than the U.S. markets.

Tse and Martinez (2007) analyze 24 ishares series from January 2, 2002 to December 31, 2004, mostly country index funds. Their results point out that ETFs do not trade at high premium or discount because the creation and redemption of ishares trough in-kind transactions keep the price closer to their NAV. International ishares have a high correlation with U.S. markets, resulting in limited diversification benefits.

Hughen and Mathew (2009) compare the price transmission dynamics between closed-end country funds and Exchange-traded funds using a sample of funds that invest in foreign securities. With a sample period from March 31, 2000 to March 31, 2001, a vector autoregression model (VAR) is estimated. Their analysis shows that ETFs returns are more closely related to their portfolio returns than CEFs are. Innovations in the NAV explain 78% of the 5-day ahead forecast error variance for ETF share prices but only 54% of the forecast error variance for CEFs.

Kuok and Chu (2010) examine the short and long term price level linkages between the equity funds under the Hong Kong Mandatory Provident Fund scheme and the benchmark indexes designed by the Hong Kong investment fund association over the period 2001-2008. They use a cointegration test to identify if there is a long run relationship between the price levels and the stock market index and the Granger causality test to analyze short run. According to their findings, 56.43% of the equity funds have their price cointegrated with a stock market index. Granger test pointed that the price level of some funds have both long and short run comovements with the stock market, but other funds that have short run comovements don't present this feature in the long run. This may indicate that some fund managers are designing their portfolios trying to win the market.

Jiang et al. (2010) analyze the first Chinese ETF, the SSE 50, showing that the fund price and NAV are cointegrated, and there is unidirectional causality from price to NAV. The fund is priced closely to it's NAV with occasional short excursions away, particularly during the second semester of 2007, when the Chinese market experienced substantial volatilities, reflecting sudden increased market risks as a potential opportunity for arbitrage during financial instability.

Ivanov (2012) tests the "disintegration hypothesis" based on an REIT and two ETF's from Dow Jones, examining if their shares disintegrate from their underlying assets (NAV) during the subprime financial crisis. Their results failed to support the disintegration hypothesis between fund shares and NAV, but they found cointegration between the REIT and its benchmark index (MSCI US REITs index) before, during and after the crisis. It's also documented that the tracking error increases during the financial crisis.

Qadan and Yagil (2012) use the cointegration tests and the error correction model (ECM) to test the long-run relationship between domestic ETFs and the returns of their underlying indexes. They find that the discrepancies augmented considerably during the subprime crisis, what could lead to arbitrage opportunities. Co-integration isn't found in several banking and real estate ETF's, but it is very common among other kinds of ETF's.

4 Data and Method

Our data consists in three time series: ETF's share return, ETF's net asset value variation and the return of the Ibovespa index, used as a market proxy. The sample period vary from 02/08/2004 to 29/03/2012, with daily observations. The fund data was obtained from *Associação Brasileira das Entidades dos Mercados Financeiro e de Capitais* (ANBIMA), a non-profit institution of self-regulation of Brazilian investment funds. Ibovespa data was obtained from BM&FBOVESPA, the largest Brazilian stock market. The sample period was chosen according to ETF data availability.

Both share return and NAV variation series represent an average from all Brazilian ETFs, weighted by their own NAV. Since Brazilian ETFs do not pay dividends, ETF returns are exclusively share prices variation. All series were obtained as returns and then transformed into index series which imitate price series. This procedure was necessary because the methodology we used (cointegration analysis) presuppose the price analysis, due to the long-term relationship investigation.

This paper's objective is to analyze the pricing efficiency of Brazilian ETFs, based on their long-term relationship with the market. For this purpose, we use the cointegration analysis. However, this work differs because of the use of Markov's regime switching to distinguish market conjectures. Cointegration can be understood as a form of long-term relationship between two non-stationary variables, since the error generated by a regression between these two series is stationary, what makes the regression non-spurious.

The regression of a time series with unit root against another time series with unit root may produce a spurious regression unless the error generated by this regression is stationary

(Tsay, 2010). That is, it is possible that the linear combination of two non-stationary time series nullify their stochastic trends, featuring a stable long-term relationship. This can be illustrated by Equation [1].

$$Y_t = \beta_1 + \beta_2 X_t + \mu_t. \qquad [1]$$

Where Y_t and X_t are level variables (prices); β_1 and β_2 are parameters; μ_t is the regression error, which is stationary.

Also according to Tsay (2010), there may be short term disequilibrium between two cointegrated series (equilibrium error), but the long-term disequilibrium is corrected by the error correction mechanism. The error of Equation [2] can be used to connect the short-term behavior of Y with its long term value, correcting the short term imbalances. The error correction mechanism shows that Y depends on X and also the error of the previous period, according to Equation [2].

$$\begin{cases} \Delta Y_t = \alpha_0 + \alpha_1 \Delta X_t + \alpha_2 \mu_{t-1} + \varepsilon_t, \\ \Delta X_t = \alpha_3 + \alpha_4 \Delta Y_t + \alpha_5 \mu_{t-1} + v_t. \end{cases} \qquad [2]$$

Where ΔY_t is the price variation of Y_t; ΔX_t is the price variation of X_t; α_3, $\alpha_4$and α_5 are parameters; v_{t-1} is the error of Equation [1] lagged in a period; ε_t is the error in Equation [2].

According to Tsay (2010), equation [2] shows that ΔY_t depends on ΔX_t and also on an equilibrium error term. If ΔX_t is zero and μ_{t-1} is positive, then Y_t is too high to be in equilibrium. α_2 is expected to be negative and thus $\alpha_2 \mu_{t-1}$ should be negative, so that ΔY_t will be negative to restore balance. That is, if Y_t is above its equilibrium value, it will fall in the next period to correct the balance error, hence the name Error Correction Mechanism. Thus, the error correction mechanism corrects short-term imbalances in the system of equations [2], both when ΔX_t is the dependent variable as Y when ΔY_t is.

Given that prices are long-term memory processes (Granger and Terasvirta, 1993), the cointegration can explain their long term behavior. According to Alexander and Dimitriu (2004), the logic of constructing portfolios based on cointegration relationship with a benchmark finds support in two main aspects: firstly, the price difference between the benchmark and the portfolio is, by definition, stationary and implies that the tracking portfolio will be "tied" to the benchmark over the long term. Second, the weights of the shares, based on a long history of price stability will be established. These properties are the result of making full use of the information contained in stock prices before removing its trend.

It is possible that the cointegration vector doesn't always move to the long term equilibrium, but only when the deviation from equilibrium exceeds a critical threshold. This possibility was raised by Balke and Fomby (1992), who argue that cointegration can be "turned on" or "off" as the price varies. Balke and Fomby (1992) examine the return series of U.S. government bonds and its discount rate, the search for a cointegration with thresholds, which are nothing more than limits within different regimes can happen. Their results were positive: there is no cointegration within a certain price range, but there is out of it. Thresholds analysis is important because it allows a better understanding of the price behavior, knowing that the relationship between two variables change in different market conditions.

However, the thresholds analysis isn't the only way to find out regime changes. The Markov regime changes focus, instead of using boundaries, the use of probability to find regime changes in non-linear time series. This idea was discussed by Tong (1983) and applied by Hamilton (1989), considering an autoregressive model with non-periodic regime changes. According to Tsay (2010), a time series that presents two regime changes Markov satisfies Equation [4].

$$y = \begin{cases} c_1 + \sum_{i=1} p\emptyset_{1,i} x_t + a_{1,t} & if \quad S_t = 1, \\ c_2 + \sum_{i=1} p\emptyset_{2,i} x_t + a_{2t} & if \quad S_t = 2. \end{cases} \qquad [3]$$

Where S_t that takes values 1 or 2 in a Markov chain of first order, with transition probabilities given by Equation [4].

$$P = \begin{cases} P(S_t = 1|S_{t-1} = 1) = p_{11} \\ P(S_t = 2|S_{t-1} = 1) = 1 - p_{11} \\ P(S_t = 2|S_{t-1} = 2) = p_{22} \\ P(S_t = 1|S_{t-1} = 2) = 1 - p_{22} \end{cases} \qquad [4]$$

The innovation series of $a_{1,t}$ and a_{2t} are white noise sequences, independent of each other. A small e_i coefficient means that the model tends to remain in the *i*th state with expected duration of $^1/_{e_i}$. The probability to stay on state 1 is given by p_{11}; the probability to change from state 2 to state 1 is given by p_{21}. The probability to change from state 1 to state 2 is given by p_{12}. The probability to stay on state 2 is given by p_{22}.

By definition, the MSA model (Markov Switching autoregressive) uses a hidden Markov chain to govern the transition from one conditional mean function to another. Thus, in this model there is never certainty about which state x_t belongs. Tsay (2010) also argues that the MSA model can be easily generalized to cases with more than two states.

Considering the important comparative advantages of using cointegration instead of correlation for the optimization of portfolios of assets, it would be possible to explore, if found, a long-term relationship between asset prices and market indexes to build strategies for buying and selling shares. This is evidenced by Alexander et al. (2002) who investigate the performance of different long-short strategies developed with SP100 stocks. Its application entailed extensive research about a large number of portfolios based on cointegration relationships and optimizations with different model parameters (such as training period, target tracking error and number of assets in portfolio) for the best long-short combination. Their results, even based on a black-box algorithm, indicate that optimization of co-integration can ensure a stable linear coefficient, with low volatility and non-correlation with market returns. Section 5 brings the results of the test and the estimated cointegration coefficients

5 Results

We begin the results presentation with the summary statistics, shown in Table 1.

	Mean	Minimum	Maximum	Standard Deviation	Skewness	Excess Kurtosis
Share return	0.0748	-12.1520	15.1120	1.9136	0.1666	6.7908
NAV variation	-0.0093	-12.1350	15.0050	2.0201	0.0101	6.4680

Ibovespa return	0.0518	-12.0960	13.6780	1.9044	-0.0711	5.8798

Table 1 – Summary statistics of variables Price (Share return), NAV (net asset value) and Ibovespa (market proxy).

The share return (price variation) mean is positive (0.0748) but the net asset value (NAV) variation mean is negative (-0.0093), indicating that during this period the share price increased, but the value of the fund portfolio decreased. The variable Ibovespa presents positive mean return, providing evidence that the fund managers, in average, failed to follow the market variation, since NAV decreased while the market increased. Minimum and maximum points show that Ibovespa's return amplitude is smaller than share return and NAV variation, which was expected, because Ibovespa's return, as a market proxy, represents maximum diversification. Because of the same reason, the standard deviation is smaller for Ibovespa. The NAV variation is exposed to a higher standard deviation than share and Ibovespa return, indicating that the fund portfolio may be exposed to a risk which is higher than the market and the own share risk. So, the investor may be assuming a higher risk than he expects.

Ibovespa's negative skewness indicates that there is a larger probability of extreme negative values than to extreme positive values. Although NAV, for example, reached a smaller mean return than Ibovespa, its probability of extreme negative values is smaller, due to the positive skewness coefficient. The high excess kurtosis is a common feature on financial time series.

Our first analysis regards the pricing deviation generated by the cointegration between share prices and the market proxy. Firstly, we test the cointegration hypothesis without regime switching, but we did not find a stationary error term. After, we performed the Linearity LR-Test, which rejected the null hypothesis of a single regime. Then, we estimated the cointegration with three regimes. A KPSS test was performed to verify the series error stationarity, which did not reject the null hypothesis of stationarity. So, the series are cointegrated, i.e., there's a long-term relationship between them, if regime switching is considered. The high AIC and Log-Likelyhood coefficients evidence the good model adjustment. Table 2 presents the estimated coefficients.

	Coefficient	Standard Error	t-value	t-prob
Constant(0)	-0.6643	0.0143	-46.4	0.0000
Constant(1)	-1.5115	0.0101	-150.0	0.0000
Constant(2)	0.3723	0.0234	15.9	0.0000
ln_i(0)	1.1675	0.0027	439.0	0.0000
ln_i(1)	1.3352	0.0019	710.0	0.0000
ln_i(2)	1.0106	0.0043	237.0	0.0000
sigma(0)	0.0210	0.0006	37.6	0.0000
sigma(1)	0.0141	0.0005	27.7	0.0000
sigma(2)	0.0182	0.0006	31.8	0.0000
Log-Likelyhood				4860.6840
AIC.T				-9695.3680
AIC				-5.1380
Lienarity LR-Test Chi^2 Test				5403.9000

Table 2 – Estimated Coefficients of long term relationship between share price and market proxy, with three different regimes. There is a linear term, an angular term and an error term for each one of regimes 0, 1 and 2. All coefficients are significant, at the 5% significance level.

All estimated coefficients are significant, at the 5% significance level. It's interesting that in regimes 0 and 1 the constant term coefficient is negative, but it is positive in regime 2. The angular term (beta) is higher at regime 1, where the linear coefficient is lower, and lower at regime 2, where the linear coefficient is higher. It is clear that during regime 1 the ETF returns are more susceptible to the market returns, while during regime 2, they are less susceptible. Concerning the error variance coefficients, regime 0 present higher coefficients, indicating that this is the period when the pricing deviations are higher. Table 3 presents the Regime Transition probabilities.

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.9943	0.0076	0.0000
Regime 1,t+1	0.0057	0.9868	0.0034
Regime 2,t+1	0.0000	0.0056	0.9966

Table 3 – Regime transition probabilities. There is a small chance of regime switching, meaning that the regimes are stable.

Table 3 shows that there is a small probability of regime switching. The largest probability supports continuity of each regime, meaning that the regimes are stable. Figure 1 shows the long-term relationship between the share prices and the market proxy index.

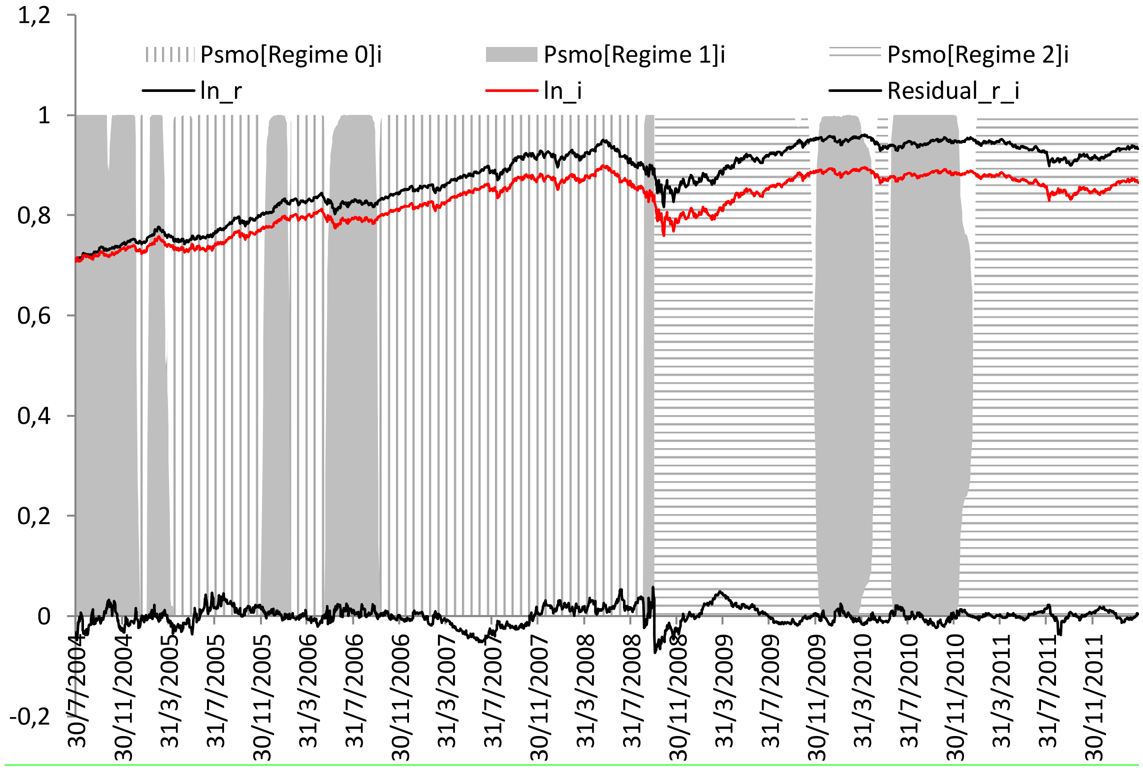

Figure 1 – Long-term relationship between share prices (black line) and market proxy index (red line). There are three well-defined regimes, but in all of them the share price is higher than the net asset value.

Figure 1 shows the long-term relationship between share prices (black line) and market proxy index (red line). There are three well defined regimes but in all of them the share price is higher than the net asset value. Regime 0 (vertical stripes) is clearly a -prior subprime crisis pattern, while Regime 2 is typical of the subprime crisis. Among them, there is Regime 1 (grey) which happened during intermediate periods and separates regimes 0 and 2. A closer look at Regime 1 reveals that it may be connected with periods when the price stops to grow or simply fall, while during Regime 0 and Regime 2 there is mainly a growing trend. Figure 1 also shows that the variance error (pricing deviation) remains near to zero and relatively stable during the analyzed period, indicating that, although the pricing is nearly efficient, there are arbitrage opportunities.

The cointegration between share price and net asset value was also tested, but the KPSS test rejects the null hypothesis that the error series is stationary, meaning that the series are not cointegrated, at the 5% significance level. The LR test rejects the hypothesis that there is only one regime, so we estimated the cointegration coefficients considering three regimes. However, the KPSS test rejected the null hypothesis of stationarity of the error term. So, the share price and the net asset value are not cointegrated, even though there are three well-defined regimes. Table 4 presents the estimation coefficients.

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	8.0367	0.3191	25.2	0.0000
Constant(1)	-0.8209	0.0768	-10.7	0.0000
Constant(2)	1.6631	0.1286	12.9	0.0000
ln_p(0)	-0.7265	0.0737	-9.86	0.0000
ln_p(1)	1.4562	0.0173	84.4	0.0000
ln_p(2)	0.9804	0.0290	33.8	0.0000
sigma(0)	0.1136	0.0045	25	0.0000
sigma(1)	0.0826	0.0022	37.6	0.0000
sigma(2)	0.1241	0.0030	41.1	0.0000
Log-Likelyhood				1570.0520
AIC.T				-3118.1040
AIC				-1.6524
Lienarity LR-Test Chi^2 Test				4717.0000

Table 4 - Estimated Coefficients of long term relationship between share price and net asset value (NAV), with three different regimes. There is a linear term, an angular term and an error term for each one of regimes 0, 1 and 2. Although all coefficients are significant, at the 5% significance level, we can not consider that there is a long-term relationship among both price series because the error series generated by this regression is not stationary.

All coefficients are significant, at a 5% significance level, but the regression is considered spurious, since the error term is not stationary. The error variance coefficient shows that regime 1 presented the smallest pricing deviation, while regime 2 presented the highest. The regime transition probability is presented in Table 5.

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.9968	0.0000	0.0000
Regime 1,t+1	0.0032	0.9986	0.0000
Regime 2,t+1	0.0000	0.0014	1.0000

Table 5 – Regime transition probability for the long-term relationship between share prices and net asset value.

As presented in Table 3, probabilities point out that the regimes tend to remain. It is more probable that one regime keep it up than the regime change. The error series demonstrate a very distinct behavior in each regime, but the lack of stationarity in each regime determined its non-stationarity. Figure 2 presents the long-term relationship between prices and net asset value.

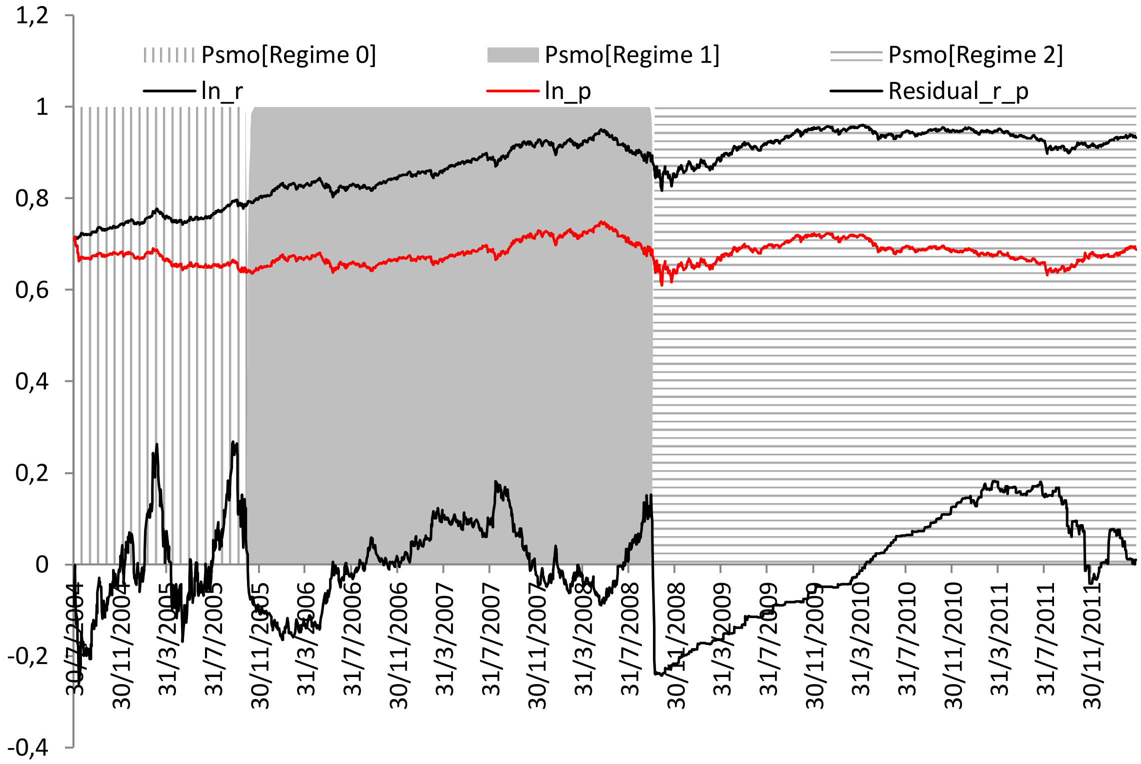

Figure 2 – long-term relationship between share prices and net asset value. Although they are not cointegrated, there are very well defined regimes.

Figure 2 shows that there are three very well defined regimes. Regime 0 happened before October 2005, when the ETFs were on a very primitive period of their existence, since they were recently released in Brazil. Regime 1 occurs between the end of this primitive period and the beginning of the subprime crisis and Regime 1 happened after the beginning of subprime crisis. The error term, analogously, the pricing deviation, presented very distinct behaviors during the three regimes. The most interesting is that after the beginning of subprime crisis, the pricing deviation dropped heavily, from nearly 0,15 to less than -0,2, showing that the share prices reduced more than the NAV during certain period. During subprime crisis, the ETFs traded at discounts, presenting an interesting investment opportunity.

However, there is a clear trend of rise in the pricing deviation after that point, until July 2011, when it begins to decrease again. This decrease may be linked with the beginning of euro zone debt crisis. So, considering that during crisis periods the ETFs trade at discounts, but they cointegrated with the market in the long run, there may be arbitrage opportunities that the investors could take benefit, buying the ETFs in crisis periods and selling them after that the market recover.

6 Conclusions

The objective of this study was to analyze the pricing efficiency of Brazilian ETFs, based on their long-term relationship with the market and with their own NAV. To perform the analysis, we estimated cointegration between share prices and the Ibovespa Index, besides cointegration between share prices and NAV, showing that the share price is cointegrated with the market index, but not with the NAV. Also, it is possible to identify regime changes in both estimations.

We showed that there is a long-run relationship between ETF share prices and the market index, i.e., the share prices move jointly with the market in the long run. But since the share prices and the ETFs NAV are not cointegrated, the ETF share price do not have a long-term relationship with the portfolio held by itself. This means, to the investor point of view, that ETFs are not an efficient alternative to diversify investments, because their return will move, in the long-term, jointly with the overall market, what ratifies, in some manner, Ivanov (2012) and Qadan and Yagil (2012), but oppose Jiang et al. (2010).

There are three regimes in the cointegration between share price and market index. One that predominates before the subprime crisis, and another after that, with a transition regime which appears to be connected to periods when the prices stop to grow or even fall. Regarding the cointegration between share price and net asset value, it was possible to identify three regimes too, although the cointegration was not confirmed. The first of the three regimes can be associated with the primitive period when the ETFs were recently released; the second regime refers to the period before the primitive one and the beginning of the subprime crisis; finally, the third regime happened after the subprime crisis.

In the first estimation, we pointed that the error term is small, indicating that the ETFs present a good pricing. But when we analyzed the relationship between share price and the NAV, we perceive that the error term is non-stationary. Leaving aside the first regime, which is related to a primitive period of the Brazilian ETFs existence, we showed that after subprime crisis and after the beginning of euro zone debt crisis, the share prices decreased to a level under the NAV, presenting arbitrage opportunities. Considering that share prices are cointegrated with the market in the long run, the arbitrage opportunity consists in buying the ETFs in crisis periods and selling them after that the market recover.

7 References

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