E C O N O M I C S   B U L L E T I N

Evaluating Brazilian mutual funds with stochastic frontiers

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Abstract

We evaluate the performance of 307 Brazilian stock mutual funds employing stochastic frontiers. We list the top ten actively managed funds and the bottom ten for the period April 2001−July 2003, and show that a fund's efficiency increases with management skill to beat the market. We also find that portfolios with low volatility tend to be more efficient. Yet we find no relationship between fund size and performance, though this might be blurred by a survivorship bias.

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1. Introduction

Actively managed mutual funds by professional managers are generally viewed as unable to beat on average either a benchmark (the market) or passively managed funds (e.g. Annaert, Van De Broeck, and Vennet 2003). This is in line with the efficient market hypothesis. Active funds can be perceived to beat the benchmark only due to large sampling noise in standard performance measures; and this should not be mistaken with superior management (Kothari and Warner 2001).

So active management of funds can at best match the performance of an efficient mix of passive portfolios. Investors will not chase greater profitability; rather, they can do better by looking for relief from the burden of managing a diversified portfolio (Annaert, Van De Broeck, and Vennet 2003). Managing funds this way reaches the efficient frontier, where expected returns are maximized given the risk (variance of portfolio returns).

Departures from the efficient frontier can be imagined if its nature is seen as stochastic (Aigner, Lovell, and Schmidt 1977, Battese and Corra 1977, Meeusen and Van De Broeck 1977). To get an efficiency measure that is not blurred with noise one can take (1) a one-sided distribution (such as a seminormal distribution) to model the efficiency term, and (2) a normal distribution to model the measurement noise. A clear-cut measure then emerges, which can relate efficiency to particular fund characteristics, such as size. When deviations from this frontier are unequivocally attributable to a fund's inefficiency, the frontier is called deterministic.

We employ the stochastic frontier approach to track the leaders of Brazilian stock mutual funds from April 2001 to July 2003. Our technique will identify the funds' features that can be unambiguously attributable to efficiency. Section 2 elaborates further on the methods of evaluating mutual fund performance. Section 3 describes data. Section 4 presents results and discusses their implications. Section 6 concludes.

2. Alternative evaluation methods

To rank funds according to their performance, returns should be corrected for risk. Sharpe (1966) suggests dividing a fund's excess return by the standard deviation of its return, thereby correcting for total risk. Here the excess return is given by the difference between actual return and a risk-free rate, such as that of government bonds.

As people diversify their investments, correcting for nondiversifiable risk (rather than total risk) stands as more appropriate. Here a fund's CAPM beta can be employed (Treynor 1965). Alternatively one can take the difference between actual and expected excess returns (Jensen 1968). Jensen alpha is

$$\alpha_p = R_p - E(R_p) \tag{1}$$

where R_p is average actual excess return of fund p, and $E(R_p)$ is expected excess return. In a time-series setting, for the basic CAPM

$$\alpha_p = R_p - \beta_p E(R_m) \tag{2}$$

where $E(R_m)$ is expected excess return on the market portfolio.

Performance as measured by Jensen alpha might be plagued by sampling noise. Some funds can be found to outperform the benchmark, even when their managers have no real ability to outperform it. So equation (2) needs to be extended to take account of this. One way of doing that is including a compound error component, following the stochastic frontier approach. One term tracks efficiency (ξ_p), and one captures the measurement error (v_p), i.e.

$$R_p = \hat{\gamma}_p + \hat{\beta}_p R_m - \xi_p + v_p \tag{3}$$

where R_p is the fund's excess return, R_m is the excess return on market portfolio, and (nonnegative) ξ_p and (zero-mean) v_p are assumed to be IID both between one another and across the funds. Nonnegativity of ξ_p follows from the evidence that most actively managed funds cannot systematically outperform the benchmark. From this it follows that the stochastic upper bound is at $\hat{\gamma}_p + \hat{\beta}_p R_m + v_p$. The efficiency term captures the ability in managing a fund whereas the measurement error tracks out-of-control shocks interfering with efficiency. A useful efficiency index is $(\hat{\gamma}_p + \hat{\beta}_p R_m - \xi_p + v_p)/(\hat{\gamma}_p + \hat{\beta}_p R_m + v_p)$, which ranges from zero to unity (full efficiency).

Following Battese and Coeli (1992), here we estimate technical efficiency assuming a seminormal distribution and defining

$$\log L(\gamma_0, \gamma_1, \sigma, \delta) = -\frac{N}{2}\left(\ln 2\pi + \ln \sigma^2\right) + \sum_{i=1}^{N} \ln \phi\left(-\left[\frac{e_p}{\sigma}\right]\sqrt{\frac{\delta}{1-\delta}}\right) - \frac{1}{2\sigma^2}\sum_{i=1}^{N} e_p^2 \tag{4}$$

where $\log L(\cdot)$ is the maximum log-likelihood function, σ_ξ^2 and σ_v^2 are variance of ξ and v respectively, $\delta = \sigma_\xi^2 / \sigma^2$ (where $\sigma^2 = \sigma_\xi^2 + \sigma_v^2$ and $\delta \in [0,1]$), $e_p = R_P - \left(\hat{\gamma}_p + \hat{\beta}_P R_m\right)$ is compound error, and ϕ is the cumulative normal density function. (An unbalanced panel data is also employed.)

3. Data

We take 307 actively managed Brazilian stock funds, and get their monthly return series net of management fees, dividends, bonuses, and splits. Time period ranges from April 2001 to July 2003, and we consider the Bovespa stockmarket index as the benchmark. The funds are evaluated with and without leverage. Excess returns are calculated using the Brazilian CDI OVER rate. And the LIMDEP software (www.limdep.com) is employed to estimate the stochastic frontiers through maximum likelihood.

Table 1 shows cross-section statistics for equation (3). Jansen alpha averages 0.05 percent, showing no evidence of the funds to outperform the benchmark (for the sample as a whole). Monthly fund returns vary 0.19 percent on average, from –45.09 to 37.42 percent. And the Bovespa index return (not shown) averages 0.18 percent (standard deviation of 9.06 percent). This reinforces the fact that the funds cannot outperform the passive benchmark. The betas are mostly near unity, thereby justifying the use of the Bovespa index for benchmark.

4. Results

One cannot take the efficient market hypothesis for granted, however. Indeed Table 2 displays variances for the compound error. Both errors are significant at the one percent level; and this justifies employing the stochastic frontier. So departures from efficiency can occur and funds can be ranked according to our efficiency index.

Table 3 ranks the top ten funds as far as efficiency is concerned. Variables are estimated using equation (3). As can be seen, no fund reaches one (as expected from non-deterministic frontiers). The top ten funds all outperform the benchmark. The winning fund over the period is Hedging Griffo Skopos HG with an index of 0.923. Jensen alphas are all positive (there is a positive difference between the funds' returns and market return weighted by the beta), though some fail to be statistically significant.

By contrast, the least efficient funds in Table 4 cannot beat the benchmark. These also present greater volatility than the winning funds (standard deviation of 10.39 and 8.21 percent respectively).

Table 5 shows Pearson correlation matrix of the variables for the entire sample. The efficiency index is strongly correlated with Jansen alpha (as one might expect) and negatively related to standard deviation. So both superior management skill to beat the benchmark and low volatility boost a fund's efficiency. Yet fund size is not related to performance. This might probably occur thanks to a survivorship bias (Elton, Gruber, and Blake 1996). This bias is due to the fact that smaller firms face a higher probability to disappear. Indeed some funds in our sample have appeared while others disappeared over the period.

5. Conclusion

We list top and bottom ten Brazilian mutual funds for the period April 2001–July 2003. This is done to a sample of 307 stock mutual funds with the help of a stochastic frontier approach. The estimated variances of the efficiency and measurement errors are both significant, a fact that justifies the use of stochastic frontiers.

We thus are able to rank funds according to an efficiency index. Doing so we find that the top ten funds outperform the benchmark and thus violate the efficiency market hypothesis. Performance is dependent on superior management skills. We also find that portfolios with low volatility tend to be more efficient. Yet we find no relationship between fund size and performance, though this might be blurred by a survivorship bias.

Table 1. Cross-section statistics for 307 Brazilian mutual funds, April 2001–July 2003

	Mean	Median	Standard Deviation	Minimum	Maximum
Monthly Return (%)	0.19	–0.38	8.37	–45.09	37.42
Alpha (%)	0.05	0.11	1.19	–10,22	7.80
Beta	0.88	0.92	0.31	–1.04	2.91
R Squared	0.87	0.94	0.20	0.0002	0.997

Table 2. Compound error's estimated variance parameters

Parameter	Coefficient	Standard Error	t Statistics
$\sigma^2(\xi)$	0.0745	–	–
$\sigma^2(v)$	0.1002	0.05145	194.705*
$\sigma^2(\xi)/\sigma^2(v)$	0.0042	0.00121	3.521*

* Significant at one percent

Table 3. Top ten stock mutual funds

Fund	Time Period	Return (%)	Standard Deviation (%)	Alpha (%)	Beta	Efficiency Index
HEDGING GRIFFO SKOPOS HG	May 2001–Mar 2003	118.18	8.65	3.56**	0.55*	0.923
HEDGING GRIFFO CAMINO FIA	Apr 2001–Jul 2003	110.90	3.76	1.30***	0.06N	0.905
COINVALORES COIN FATOR FIA	Apr 2001–Jul 2003	69.99	9.35	2.07*	0.94*	0.897
FATOR PLURAL JAGUAR FIA	Apr 2001–Jul 2003	56.74	9.47	1.88*	1.01*	0.891
HEDGING GRIFFO CSAM KITE FIA	Apr 2001–Sep 2001	13.18	4.77	1.24N	0.52N	0.881
BCN ACTIVE FIA	Apr 2001–Jul 2003	38.00	9.55	1.43*	1.02*	0.879
PROSPER ADVINVEST FIA	Apr 2001–Jul 2003	43.61	7.20	0.96N	0.70*	0.878
ITAU INSTITUCIONAL ONIX FIA	Apr 2001–May 2003	26.37	9.66	1.05N	0.74*	0.877
MELLON BRASCAN ARX FIA	Jul 2001–Jul 2003	34.28	9.51	1.37**	0.94*	0.876
BRADESCO BRAM FIA IBOVESPA ALAVANCADO	Jun 2002–Jul2003	43.03	10.17	2.13N	0.82*	0.874

* Significant at one percent
** Significant at 5 percent
*** Significant at 10 percent
N Not significant

Table 4. Bottom ten stock mutual funds

Fund	Time Period	Return (%)	Standard Deviation (%)	Alpha (%)	Beta	Efficiency Index
MULTISTOCK MAXIMA MARKET PORTFOLIO	May 2001–Jan 2003	–90.28	16.23	–10.22**	0.02N	0.315
JP MORGAN BASE FIA	Dec 2001–Sep 2002	–60.15	15.14	–2.84N	1.24**	0.740
MELLON BRASCAN ORYX FIA	Apr 2001–Jul 2003	–40.42	9.66	–1.56**	0.99*	0.744
COMPACTA CL	Apr 2001–Jul 2001	–35.77	8.53	–7.16N	1.04N	0.763
MELLON BRASCAN SANTA FÉ SCORPIUS FIA	Apr 2001–Jul 2003	–33.42	9.78	–1.15***	1.01*	0.769
GERAÇÃO FUTURO BNL CHIUSO 157	Apr 2001–Jul 2003	–31.01	9.19	–1.17 ***	0.94*	0.774
PACTUAL ASSET FIA INSTITUCIONAL X	Feb 2002–Jul 2003	–23.49	9.9	–1.79**	0.99*	0.775
QUALITY HAMBURG FIA	Jul 2001–Jul 2003	–27.74	8.91	–2.55*	0.89*	0.782
LATINVEST FIA FC	Apr 2001–Jun 2003	–28.13	7.62	–1.28**	0.78*	0.783
UNIBANCO QUALIFICADO FIA	Apr 2001–Jul 2003	–27.23	8.89	–0.97*	0.96*	0.784

* Significant at one percent
** Significant at 5 percent
*** Significant at 10 percent
N Not significant

Table 5. Pearson correlation matrix

	Efficiency Index	Beta	Alpha	Standard Deviation	Fund Size
Efficiency Index	–				
Beta	–0.012N	–			
Alpha	0.702*	0.351*	–		
Standard Deviation	–0.286*	0.537*	0.097N	–	
Fund Size	0.034N	0.031N	0.031N	0.02N	–

* Significant at one percent
** Significant at 5 percent
*** Significant at 10 percent
N Not significant

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