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"STOCK FUTURES MARKETS: THE BRAZILIAN EXPERIENCE"

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I. INTRODUCTION

In the last decade the financial community has observed an expressive growth of futures markets. Prior to 1973 these markets were restricted to commodities but in this year the Chicago Mercantile Exchange launched its International Monetary Market (IMM), an exchange futures market. Futures trading was then extended to mortgages (GNMA's), Treasury Bills and Bonds and other financial assets. The volume of trading in these assets in the major exchanges now represents a significant proportion of their total volume.

It is interesting to observe that in the expanding US market futures trading has not yet reached stocks. Very recently, in February 1982, the Commodity Futures Trading Commission (CFTC) approved for trading contracts on stock indices at the Kansas City Board of Trade (Value Line Index), at the Chicago Mercantile Exchange (Standard and Poor's 500), at the New York Futures Exchange (New York Stock Exchange Index) and at the Chicago Board of Trade. However, it remains true that futures contracts on specific stocks are not traded in the U.S. nor elsewhere. Several reasons have been advanced for the non-existence of a stock futures market in the U.S. and probably an important reason is to avoid the complexity of the Securities and Exchange Commission's (SEC's) regulation requirements.

In early 1979 the Rio de Janeiro Stock Exchange (RJSE) initiated trading in stock futures. The Exchange opened all of its listed stocks for futures trading and the market grew very fast. The experience of the RJSE with its stock futures market seems significant for evaluating the contribution and efficiency of these markets in the U.S. and elsewhere.

This paper will examine some aspects of the RJSE's stock futures market. After reviewing the basic institutional aspects of the market, the paper proceeds to study the relationship between movements in the futures and spot markets drawing conclusions about the contribution of the market. Finally, the paper tests the weak

form efficiency of the futures market comparing the results with similar tests for the spot market.

II. THE INSTITUTIONAL ENVIRONMENT

In 1978 the Rio de Janeiro Stock Exchange (RJSE) decided to launch a stock futures market. Trading in stock futures started on January 15, 1979 and it was open for all stocks listed in the exchange[1]. This stock futures market has grown very fast since its creation. In 1979 it represented 32% of the total amount traded and this percentage grew to 84% in the last year (1981).

In 1979 contracts were traded with quarterly delivery: March, June, September and December. In 1980 and 1981, contracts were traded with bimonthly delivery: February, April, June, August, October and December. In the first semester of 1982 contracts were traded with delivery in every month but in the second semester the exchange returned to the prior bimonthly delivery. The exchange allowed simultaneous trading in contracts with delivery within a six month period. In 1979, with the quarterly system, only two consecutive contracts were simultaneously traded but, with the biomonthly system, up to three consecutive contracts were traded. Contracts always had a well defined delivery date[2]. Up until February 1980 delivery took place on the Wednesday the closest to the 15th of the delivery month. The delivery date of the subsequent contracts was set on the Monday the closest to the 15th of the delivery month.

Trading futures in the RJSE takes place in multiples of 10000 shares and are suject to margin requirements as well as brokerage and registration commissions. Brokerage commissions follow a progressive scale but have averaged to about 1%. Registration commissions amount to 0,1% and are collected by the Clearing Department of the RJSE. Margin requirements have varied substantially in the market.

At the beginning of trading margin requirements were set at 20% of which 5% had to be deposited in cash and 15% could be deposited in securities. In early March 1980 the RJSE raised the cash deposit requirement to 10%. Later, in the same month, the Comissão de Valores Mobiliários (CVM) - the Brazilian regulatory agency

equivalent to the Securities and Exchange Commission - raised the requirements to 25%, which should all be deposited in cash. In May 1980 the CVM raises again the margin requirements for trading in the three most active stocks (Petrobrás, Banco do Brasil and Vale do Rio Doce) to 33%, all in cash. In April 1981 the RJSE resumed responsibility for margin management and it was set between 10% and 50%, all in cash, depending upon the variability of prices.

When discussing the Stock Futures market one cannot forget that capital gains are not taxed in Brazil. All gains in the stock market (futures and spot) are thus non - taxable. The gains from fixed income securities are taxed, in general, at the regular income tax rates, moreover these gains are subject to withholdings of 10% of the interest earned. The only exception are Treasury Bills with maturities longer than 90 days, the interest earned on these bills is not taxable.

Finally, it should be noted that the purchaser of a futures contract is protected against the distribution of rights. If stock splits, stock dividends or subscription rights are distributed, then the purchaser can exercise his rights at the delivery date. If dividends are distributed then the price is adjusted upon delivery. More precisely, the price the purchaser of the stock futures pays upon delivery is reduced by the amount of dividends. The contract is thus protected against the amount of dividends even though it is not protected against the time value of these dividends[3].

III. THE RELATIONSHIP BETWEEN THE FUTURES AND SPOT MARKETS

When considering the idea of launching a stock futures market one has to consider the nature of its relationship with the spot market. If movements in the two markets are perfectly correlated then the stock futures market will not offer any contribution to allocation efficiency in capital markets.

This paper proceeded to determine daily rates of return on stocks and their associated futures contracts testing the significance of correlation in the two series. The results of such tests for a sample of stocks are shown in Table 1. If should be noted that the stocks in this sample represented over 90% of the total amount traded in the stock futures market in the period[4]. The table shows the results of tests of the significance of correlation coefficients (ρ) relative to the null hypotheses that $\rho = 0$ and $\rho = 1$.

The results lead to two major conclusions: in general, correlation coefficients are positive[5] and significantly different from zero and one. Movements in the prices of stock futures are correlated, but not perfectly so, with movements in stock prices. The creation of a stock futures market in Brazil thus appear to have contributed to the overall allocation efficiency of the market[6]. Moreover, the significant correlation coefficients are evidence of the hedging opportunities offered by the stock futures market.

TABLE 1

Correlation between rates of returns on stocks and stock futures

STOCK	CONTRACT		ρ	t_0	t_1
ACES OP	June	79	0,387	2,376[b]	3,759[a]
	December	79	0,794	10,267[a]	2,672[a]
	February	80	0,399	2,788[a]	4,196[a]
	April	80	0,456	2,856[a]	3,402[a]
	June	80	0,763	6,679[a]	2,073[b]
	August	80	0,357	2,324[b]	4,188[a]
	October	80	0,270	1,457	3,939[a]
	October	81	0,829	6,941[a]	1,436
BB PP	June	79	0,741	8,951[a]	3,137[a]
	September	79	0,509	5,352[a]	5,167[a]
	December	79	0,888	17,455[a]	2,209[b]
	February	80	0,870	15,753[a]	2,362[b]
	April	80	0,846	11,894[a]	2,158[b]
	June	80	0,864	14,261[a]	2,243[b]
	August	80	0,865	14,538[a]	2,265[b]
	October	80	0,796	9,940[a]	2,542[b]
	December	80	0,876	14,830[a]	2,109[b]
	February	81	0,813	11,509[a]	2,649[b]
	April	81	0,733	6,820[a]	2,481[b]
	June	81	0,877	12,630[a]	1,776
	August	81	0,813	11,581[a]	2,671[a]
	October	81	0,799	9,202[a]	2,317[b]
	December	81	0,926	10,374[a]	0,824
BELG OP	June	79	0,547	4,133[a]	3,422[a]
	September	79	0,511	3,257[a]	3,116[a]
	December	79	0,828	10,399[a]	2,147[b]
	April	80	0,676	5,183[a]	2,489[b]

TABLE 1 (continuation)

STOCK	CONTRACT		ρ	t_0	t_1
MANM OP	June	79	-0,378	2,043	7,445[a]
	September	79	0,401	2,516[b]	3,755[a]
	December	79	0,664	7,381[a]	3,731[a]
	February	80	0,514	3,737[a]	3,541[a]
	April	80	0,711	6,995[a]	2,850[a]
	June	80	0,717	6,818[a]	2,695[b]
	August	80	0,816	9,895[a]	2,226[b]
	October	80	0,657	5,516[a]	2,876[a]
	December	80	0,590	3,999[a]	2,783[a]
	August	81	-0,227	1,018	5,494[a]
	October	81	0,503	3,079[a]	3,043[a]
PETR PP	March	79	0,788	6,268[a]	1,687
	June	79	0,693	7,980[a]	3,538[a]
	September	79	0,672	8,217[a]	4,011[a]
	December	79	0,761	11,490[a]	3,611[a]
	February	80	0,772	10,872[a]	3,206[b]
	April	80	0,846	12,993[a]	2,363[b]
	June	80	0,927	20,301[a]	1,611
	August	80	0,929	20,894[a]	1,591
	October	80	0,899	16,506[a]	1,864
	December	80	0,905	17,266[a]	1,816
	February	81	0,900	11,136[a]	1,907[b]
	April	81	0,828	11,264[a]	2,333[b]
	June	81	0,808	10,063[a]	2,397[b]
	August	81	0,845	13,042[a]	2,388[b]
	October	81	0,906	14,804[a]	1,541

NOTES: (1) ρ indicate the correlation coefficient,

(2) t_0 and t_1 indicate the t-valves associated with the null hipotheses that $\rho = 0$ and $\rho = 1$, respectively,

(3) a and b indicate significance at the 1% and 5% levels, respectively.

IV. THE WEAK FORM EFFICIENCY OF THE MARKET

The efficiency of pricing is relevant when examining the Brazilian stock futures market. In an efficient market investors should not get abnormal returns. As shown by Fama [3], under certain conditions[7], this abstract concept can be reduced to testable hypotheses. In particular, random rates of return are consistent with the weak form efficiency of the market.

After obtaining the time series of rates of return on all stock futures contracts the paper proceeded to test its weak form efficiency thought autocorrelation and run tests[8]. Two kinds of run tests were performed, the first was the usual run test considering the signs of the time series of rates of return. This test is defined as the absolute run test. The second run test considered the signs of deviations of rates of return from its sample mean. This test is more adequate for testing the randomness of a stochastic process with a non-zero mean[9] and is defined as the relative run test.

The autocorrelation tests were performed up to the 10th lag and the test of each lag included all contracts that showed at least 20 pairs for estimating the autocorrelation. The run tests were performed for all contracts that had at least 30 observations of daily rates of return and at least 15 equal signs to allow the use of large sample procedures. All contracts traded up until September 1981 were considered and the final structure of the sample for both tests in shown in Table 2.

The results of the autocorrelation tests are shown in Table 3 for all lags and for significance levels of 5% and 1%. In general, at the 1% level very few contracts reject the null hypothesis of independence for all lags and in all years. This is also true for the 5% level with the exception of first-order serial autocorrelation in 1980 when 7 out of 47 contracts showed significance[10].

TABLE 2

The sample for each test

YEAR	SERIAL AUTOCORRELATION[1]		RUN TEST	
	Stocks	Contracts	Stocks	Contracts
1979	9	23	9	19
1980	10	47	10	39
1981[2]	9	26	7	19
1979/81[2]	12	96	11	84

NOTES: (1) The sample shown is associated with the first-order autocorrelation tests,

(2) The sample in 1981 considered only the contracts traded up until September.

TABLE 3

The tests of serial autocorrelation

YEAR	LEVEL	LAG										K^2
		1	2	3	4	5	6	7	8	9	10	
1979	5%	0	2	1	1	0	0	1	0	2	2	23
	1%	0	1	0	0	0	0	0	0	0	0	
1980	5%	7	3	0	1	2	3	1	1	0	2	47
	1%	2	0	0	0	0	0	0	0	0	0	
1981[1]	5%	1	0	1	1	0	0	1	5	0	1	26
	1%	0	0	0	0	0	0	0	1	0	0	
1979/81[1]	5%	8	6	2	3	3	3	3	6	2	6	96
	1%	3	2	0	0	0	0	0	1	0	0	

NOTES: (1) The sample in 1981 considered only the contracts traded up until September,

(2) Nº of contracts in the sample for the tests of first-order autocorrelation.

The results of run tests as well as a summary of the results of first-order autocorrelation tests are shown in Table 4. The proportion of significant deviations from the null hypothesis of randomness is large in large in the absolute run test. The proportion of deviations in the initial year of 1979 is large in both run tests. In the recent years of 1980 and 1981 very few contracts showed significance. These results are consistent with the results of autocorrelation tests, the only exception is that in these tests 1980 was the year with the largest proportion of significant deviations.

It is interesting to compare these results with similar tests for the spot market. The efficiency of the Brazilian stock market was initially examined by Errunza [2]. More recently, Brito and Menezes [1] also examined its efficiency with a comprehensive and complete sample. A summary of the results of their first-order autocorrelation tests is shown in Table 5 and a summary of their run tests is shown in Table 6. The proportion of deviations is in general smaller in the stock futures markets. The average first-order autocorrelation coefficients of rates of return on futures contracts were smaller, in absolute value, than the average coefficients observed for rates of return on stocks. These results suggest that the futures market has been more efficient than the spot market. They probably should be associated with the leverage obtained in the futures market where only margin requirements are deposited.

TABLE 4

Comparing the results of autocorrelation and run tests

	RUN TESTS								SERIAL AUTOCORRELATION (first order)			
	Absolute[1]				Relative[1]							
YEAR	1%	Proportion	5%	Proportion	1%	Proportion	5%	Proportion	1%	Proportion	5%	Proportion
1979	2	10,52	2	10,52	2	10,52	3	15,78	0	0	0	0
1980	1	2,56	4	10,25	0	0	2	5,12	2	4,25	7	14,89
1981	0	0	2	10,52	0	0	2	10,52	0	0	1	3,84
1979/81	3	3,57	8	9,52	2	2,38	7	8,33	3	3,12	8	8,33

NOTES: (1) The 1% and 5% columns indicate the nº of contracts that showed significance at these levels

(2) The proportion of significant contracts is expressed as a percentage of the total nº of contracts in each year

TABLE 5

Comparing first-order serial autocorrelation in the spot and futures market

	Stocks/ Contracts[1]	Year	Coefficients		Significant[2]		Negative[3]	
			Mean	Std.Dev	Nº	%	Nº	%
Spot Market	135	1973	-0,102	0,199	49	36,3	98	72,6
	112	1974	-0,180	0,161	56	50,0	99	88,4
	91	1975	-0,139	0,136	35	38,5	80	87,9
	95	1976	-0,208	0,208	61	64,2	86	90,5
	96	1977	-0,119	0,165	39	40,6	72	75,0
	94	1978	-0,082	0,201	29	30,9	62	66,0
	82	1979	-0,052	0,189	24	29,3	54	65,9
	81	1980	-0,064	0,214	26	32,1	49	60,5
	237	1973-80	-0,118	0,180	117	49,4	180	76,0
Futures Market	23	1979	-0,015	0,173	0	0	13	56,6
	47	1980	-0,009	0,228	7	14,9	23	48,9
	26	Jan./Sept.81	-0,009	0,186	1	3,8	12	46,2
	96	Jan.79/Sept.81	-0,020	0,200	8	8,3	47	49,0

Notes: (1) Nº of stocks for the spot market and nº of contracts for the futures market,

(2) Nº and proportion of significant coefficients,

(3) Nº and proportion of negative coefficients.

TABLE 6

Run tests in the spot market

	1979				1980			
	1%	Proportion	5%	Proportion	1%	Proportion	5%	Proportion
Absolute Tests	5	8,9	10	17,9	11	21,2	16	30,8
Relative Tests	7	12,5	13	23,2	7	13,5	12	23,1

Note: These results were obtained from Brito and Menezes [1].

V. CONCLUSIONS

This paper examined some key aspects of the stock futures market of the Rio de Janeiro Stock Exchange (RJSE). When examining the institutional aspects of the market, the existence of some attrition between the Exchange and the Comissão de Valores Mobiliários (CVM) - the Brazilian regulatory agency equivalent to the American SEC - had to be noticed. This process led to some instability in the institutional environment and supports the worries of American Exchanges of being subject to SEC's regulatory requirements.

The tests of correlation coefficients between movements in stock futures prices and stock prices indicate that these coefficients are significantly different from zero and from one. These results provide evidence of the hedging opportunities offered by the stock futures market. Moreover, they suggest that this market has contributed to the overall allocation efficiency of capital markets.

Finally, the paper examined the weak form efficiency of the stock futures market through autocorrelation and run tests. Even though deviations from the joint hypothesis of stationarity and efficiency were observed, one has to notice that the proportion of deviations was smaller in the stock futures market than in the spot market. The results thus suggest that the stock futures market is more efficient than the stock market. This greater efficiency could be attributed to the higher leverage offered by the futures market.

FOOTNOTES

(1) From May to August 1980, the Brazilian regulatory agency (CVM) restricted trading in the futures market to the stocks included in the RJSE Index. These restrictions were temporary and all stocks are open for futures trading since they were lifted.

(2) I. e., delivery takes place on a well defined day of the contract month. Recall that most futures contracts call for delivery on any day of the contract month, at the option of the seller.

(3) Notice that the purchaser only gets the dividend on the delivery date and not upon its distribution.

(4) The tests covered all stocks and the futures contracts that were traded from the creation of the market up until September 1981. A minimum of 20 simultaneous rates of return on stocks and contracts were required for testing the correlation. For simplicity, Table 1 reports only the results for a reduced but representative sample of contracts and their stocks. The results for the other contracts and stocks were entirely similar.

(5) Only one contract in the sample showed a negative sample correlation: the June 79 contract on MANM OP. Since it was not significantly different from zero one can not conclude that the population correlation was negative.

(6) More generally, the contribution of the stock futures market to allocation efficiency should be evaluated to the set of all assets traded. I. e., if the results of stock futures can be replicated though a linear combination of existing assets then its contribution to allocation efficiency is null. The results of the correlation tests thus should not be considered as final. For a discussion of allocation efficiency see Hirshleifer [4].

(7) Fama [3] shows that if distribution of returns are stationary then one can proceed to tests of weakform efficiency.

(8) The autocorrelation tests are parametric tests involving the additional assumption of normalit- of distributions.

(9) For example, if rates of return follow the process

$$\tilde{r}_t = \mu + \tilde{\varepsilon}_t,\ E(\tilde{\varepsilon}_t) = 0\ \text{Cov}\ (\tilde{\varepsilon}_t, \tilde{\varepsilon}_{t-1}) = 0$$

then the relative run test is more adequate.

(10) As shall be seen later, even this abnormally high proportion of deviations (15%) is much smaller than the proportion of deviations in the spot market.

BIBLIOGRAPHY:

[1] BRITO, N. e MENEZES, J. "A Eficiência Informacional Fraca no Mercado à Vista da Bolsa de Valores do Rio de Janeiro no Período 1973-80", Revista Brasileira de Mercado de Capitais, Vol.8, nº 23, maio 1982

[2] ERRUNZA, V. "Efficiency and the Program to Develop Capital Markets: The Brazilian Experience", Journal of Banking and Finance, Vol. 3, nº 4, December 1979.

[3] FAMA, E. "Efficient Capital Markets: A Review of Theory and Empirical Work", Journal of Finance, Vol. 25, nº 2, May 1970.

[4] HIRSHLEIFER, J. Investment, Interest and Capital, Prentice Hall, New Jersey, 1970.