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DO STOCK RETURNS HEDGE AGAINST HIGH AND LOW INFLATION? EVIDENCE FROM BRAZILIAN COMPANIES

TAUFIQ CHOUDHRY AND RENE COPPE PIMENTEL

Abstract. This paper investigates the relationship between stock returns and inflation using monthly data from ten Brazilian firms and the general Brazilian stock market. The period under investigation, 1986-2008, includes periods of unstable high inflation (1986-1994) and stable low inflation (1994-2008). Standard linear regressions are applied to estimate the relationship after testing first for the stochastic structure of the variables. Results indicate that stock returns do act as a hedge against high inflation but fail to act against low inflation. Variance decomposition tests indicate innovations to the inflation rate affect the movement of the stock returns during the total period and the high inflation period.

1. Introduction

To maintain the purchasing power of an investment it must attain returns which are above the inflation rate. If it fails to do this the investment becomes eroded over time. The Fisher effect (Fisher, 1930) attempts to explain the relationship between asset returns and inflation; according to the Fisher Effect the nominal interest rate fully reflects the available information concerning the possible future values of the rate of inflation. Thus it states that expected nominal rates of interest on financial assets should have a direct one-to-one relationship with the expected inflation. Over the years the Fisher Effect has also been extended to the stock market.[1] Empirical investigation of the Fisher effect for the stock market commonly finds that stock returns and the inflation rate have a negative relationship.[2] This negative relationship is surprising as stocks, as claims against real assets, should compensate for movement in inflation (Boudoukh and Richardson, 1993 and Boudoukh et al. 1994).[3] Bodie (1976) claims that there are two distinct ways to define stocks as a hedge against inflation: first, a stock is a hedge against inflation if it eliminates or at least reduces the possibility that the real rate of return on the security will fall below some specific floor value; second, it is a hedge if, and only if,

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Taufiq Choudhry is Professor of Finance at School of Management, University of Southampton, Highfield. Email: t.choudhry@soton.ac.uk. Phone: +440 2380599286.
Rene Coppe Pimentel is Senior Researcher at Foundation Institute of Accounting, Actuarial and Financial Research - FIPECAFI, Brazil.
Email: rene.pimentel@fipecafi.org. Phone:+551121842002.
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This paper is in final form and no version of it will be submitted for publication elsewhere.
[1]See Choudhry (2001) for citations.
[2]See Lintner (1975), Bodie (1976), Jaffe and Mandelker (1976), Nelson (1976), Fama and Schwert (1977), Kaul (1987), Marshall (1992), etc.
[3]Several reasons have been provided for the negative relationship so commonly found in the empirical literature. The errors in the measurement of expected inflation, negative correlation between the ex ante stock return and the expected rate of return etc. Also, if inflation and future expected output in the economy are negatively correlated, then inflation may proxy for future real output. This may lead to a (spurious) negative relationship between stock returns and inflation.

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its real return is independent of the rate of inflation. The negative relationship between stock returns and inflation suggests that the stock market is not even a partial hedge against inflation (Jaffe and Mandelker, 1976). A negative relationship implies that investors whose real wealth is diminished by inflation can expect this effect to be compounded by a lower than average return on the stock market.

This paper contributes to the literature by empirically investigating the relationship between stock returns and inflation using data from Brazilian companies and the general Brazilian stock market. Although there is a large repertoire of literature (both empirical and theoretical) already in this field, to our knowledge no other study exclusively investigates the Fisher effect for stock markets using company data from an emerging market. The period used here, 1986 to 2008, is also unique in that it contains both periods of unstable high inflation (1986-1994) and stable low inflation (1994-2008). This paper will thus investigate the ability of firm stock returns to act as a hedge against high and low inflation in the same market.[4] The empirical investigation is conducted by means of OLS and variance decomposition test. As claimed by Boudoukh and Richardson (1993) and Boucher (2006) the effect of inflation on the stock returns can not only be looked at from the view of the relationship between the two variables but from the significance that this relationship has within financial market trading. Knowledge of short and long-term inflation-stock return relationships helps to ensure good market positioning in the case of pending inflation surges or dips.

From 1986 to 1994, the yearly average inflation rate in Brazil was more than 500% per year. During this period Brazil tried several economic plans to control the high inflation, which included five different currencies (all plans based mainly on price freezing by the government). All of these plans failed to control the increasing inflation rates until the Real Plan was implemented in mid 1994. This plan changed the Brazilian currency to the Real in June 1994. The Real Plan was based on three key elements (Franco, 1995). Firstly, a fiscal strategy centered on the approval of the constitutional amendment, creating the Social Emergency Fund.[5] Secondly, a monetary reform process was to take place during the few months of voluntary adoption of a new unit of account (later to become the national currency). Thirdly, plans to open the economy with aggressive trade liberalization and a new foreign exchange policy. The Real Plan successfully reduced and stabilized the inflation rate. An estimation and comparison of the stock returns and inflation rate relationship for Brazil during the two periods makes an interesting empirical exercise and solid contribution to the literature. Results indicate that stock returns do act as a hedge against high inflation but fail to act against low inflation. Variance decomposition tests indicate innovations to the inflation rate affect the movement of the stock returns during the total period and the high inflation period.

2. The Fisher Effect for Stocks Returns

The following section relies heavily on Nelson (1976) in describing the relationship between the rate of return on a portfolio of stocks and the expected rate of inflation. The difference between the expected rate of return on stocks and the expected rate of inflation is defined as the ex ante real rate of return on stocks. Thus the ex ante real rate can be presented as:

$$r_t = E(R_t|I_{t-1}) - E(\pi_t|I_{t-1}) \tag{2.1}$$

[4] Nelson (1976) advocates the study of the relationship between stock returns and inflation for high inflation countries. Choudhry (2001) provides evidence of a positive relationship between stock return and inflation using the general stock market data from four high inflation countries. Henry (2002) provides a study of 21 emerging markets and shows that stock markets appreciate by an average of 24% in real dollar terms when countries attempt to stabilise high annual inflation rates of more than 40%.

[5] The Social Emergency Fund (now called the Fiscal Equalization Fund) was created with the aim of providing financial resources and economic stability for the Brazilian Federal Government during emergencies. The funding came from taxes that were allocated for states and cities. The majority of the funds are allocated for heath, education, and social assistance systems.

where r_t is the real rate of return on stocks, R_t is the actual rate of return, π_t is the rate of inflation, I_{t-1} is the set information available in time $t-1$ and E is the mathematical expectations operator. The differences between the actual and the expected value are the prediction errors. Thus,

$$R_t = E(R_t|I_{t-1}) + \mu_t \tag{2.2}$$

$$\pi_t = E(\pi_t|I_{t-1}) + \varepsilon_t \tag{2.3}$$

Where μ_t and ε_t are prediction errors which are uncorrelated with the predicted values.[6] The *ex ante* real rate of return can be separated into average and variable parts such that

$$r_t = r + \check{r}_t \tag{2.4}$$

where r is the average and $\check{r}_t$ is the variable part of the real rate of return. Using equations 1 to 4 the relationship between observed stock return and rates of inflation may be expressed as

$$R_t = r + \beta\pi_t + \eta_t \tag{2.5}$$

Where η_t is equal to $(\check{r}_t + \mu_t - \beta\varepsilon_t)$ and according to the Fisher effect β is equal to unity in equation 5. Boudoukh and Richardson (1993) claim that although the Fisher effect is *ex ante*, equation 5 can be interpreted in the context of the Fisher effect. The properties of the compound disturbance η_t will determine the properties of the least square estimates of r and β. According to Nelson (1976) the correlation between the inflation rate and each element of the error term is important for the relationship. There will be a positive correlation between the inflation rate and its prediction errors (ε). Correlation between the inflation rate and the unanticipated portion of the stock returns (μ) will depend on the correlation between μ_t and ε_t. The two will be correlated if stock prices react systematically to new information (represented by ε_t) about the inflation (Nelson 1976).[7] Finally, if the Fisher effect is to hold then $\check{r}_t$ and the inflation rate must be uncorrelated.[8]

Nelson (1976) and Jaffe and Mandelker (1976) claim that the negative relationship found in the empirical results can be eliminated if the contemporaneous rate of inflation is replaced by a past rate of inflation since past rates contain no new information for the market to react to.[9] In a test between the stock returns and past rates of inflation the estimate of the slope will depend on the strength of the correlation between the past rate and the expected rate of inflation at time t. Since the stated correlation should be positive, the slope coefficient of the regression between stock returns and past rates of inflation should be positive.[10] In this paper,

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[6]According to Taylor (1991) assumption of stationary forecasting errors implies that expectations of a time series are not hopelessly different from the actual outcome, even when the series has accelerated growth rates. The forecasting errors will only be stationary under backward-looking expectation formation, that is, adaptive expectations, when the process being forecast is integrated of the order one, I(1). Whereas in the case of forward-looking expectations, that is, rational expectations, the forecast errors are always stationary regardless of the order of integration of the process being forecasted.

[7]If the firms have assets and liabilities in nominal terms then based on classical valuation theory stock prices will respond to new information about inflation (Lintner, 1973).

[8]According to Lintner (1975) the invariance of real values means current money values will vary in direct proposition to inflation, making nominal capital gains on unlevered equity equal to the rate of inflation thus making β equal to unity and positive.

[9]Such a relationship may be tested by means of the following linear regression,

$R_t = r + \beta'\pi_{t-1} + \eta_t$ (2.5')

where each variable is defined as before. According to the generalized Fisher effect β' should be positive. Jaffe and Mandelker (1976) claim the actual theoretical value of β' is not known simply because the manner in which the market uses rates of past inflation to predict future inflation is unknown.

[10]Replacing the current inflation with lagged inflation may act as a specification test of the model as lagged inflation would not contain the current innovation in inflation.

we also test the relationship between stock returns and inflation rates lagged once. The results from these tests are not provided in order to save space but are available on request.

3. The Data and its Stochastic Structure

In this paper we apply monthly data from ten Brazilian companies and the general Brazilian stock market. The data range is from January 1986 to December 2008. This is a relatively short time period but the length of the data was dictated by its availability. The total period is then further divided into a high inflation period (1986-1994) and a low inflation period (1994-2008) based on the discussion provided earlier. The relationship is tested separately during the high and low inflation periods (along with the total period) and the results are then compared.

Stock returns are simply defined as the first difference of the log of the stock indices. Table 1 presents the names, sizes and industry sectors of the firms applied in the study. The firms are mostly in manufacturing industries and vary in size from small to relatively large. The availability of the data dictated the firms chosen. The general stock index is represented by the Bovespa Index (Ibovespa). "BM&F Bovespa" is the Sao Paulo Stock Exchange and the Bovespa Index is considered to be the oldest official stock index in Brazil. The Bovespa Index is the main indicator of the Brazilian stock market's average performance. This index's importance comes from two factors: it reflects the variation of the Bovespa stock exchange's most frequently traded stocks; and it has maintained the integrity of its historical series without any methodological change since its inception in 1968. All data are obtained from the Brazilian Central Bank and *Economatica*.

Table 2 contains the basic statistics of all the eleven stock returns and the inflation rate during all three periods. The basic statistics are quite standard as is expected of stock returns. The maximum rate of inflation is vastly different during the high and low inflation periods. The same is seen for the stock returns during the two periods. As expected the stock returns are found to be skewed and leptokurtic and thus are non-normal. Figure 1 presents the stock returns against inflation for three of the firms and the Bovespa index. Visual inspection of the graphs clearly shows the co-movement between the inflation rate and stock returns to be higher during the high inflation period (1986-1994) and low during the later period of low inflation (1994-2008). Both series seem to follow similar trends during the high inflation period. Figures of other firms are available on request.

Detecting whether a time series is nonstationary (contains a unit root) is extremely important regarding regression estimations. Granger and Newbold (1974, 1977) outline three major consequences of using nonstationary series in regression. First, estimates of the regression coefficient are inefficient; second, forecasts based on the regression equations are suboptimal; and third, the usual significance tests on the coefficients are invalid. For our purposes all stock returns and inflation rates need to be stationary in levels or lack unit root(s). Three different tests, the augmented Dickey-Fuller, the Philips-Perron and the KPSS, are applied to check for unit roots in the data. All unit root tests were conducted twice, with and without the trend. Figure 1 does indicate the presence of a potential trend in all series during the high inflation period (1986-1994). Results from all tests show that stock returns and the inflation rate are stationary in level and thus do not contain any unit roots during all three periods. This result implies that stock returns and the inflation rate can be applied in standard regressions. Only the results from the augmented Dickey-Fuller test, with and without the trend for all three periods, are presented in table 3 but results from the other tests are available on request. Results show that all variables are found to be stationary in all periods. The return from the company Cemig is found to be non-stationary during the high inflation period but the KPSS and the Philips-Perron tests indicate the series to be stationary. Results from the KPSS and Philips-Perron tests indicate all series to be stationary. Given the unit root test results, application of the linear regression seems quite appropriate.[11]

[11] Thus we do not apply the cointegration testing method.

4. Empirical Tests Results of the Stock Returns and Inflation Relationship

Whether stocks act as a hedge against inflation is tested by means of equation 5, which includes a contemporaneous rate of stock return and inflation. In this test, based on the Fisher effect, a positive unit coefficient on the inflation rate is expected. A positive unit coefficient implies a direct one-to-one relationship between the contemporaneous rate of stock return and inflation. Tables 4, 5 and 6 present the estimates of the stock returns and inflation relationships for the ten firms and the general market during the total period (1986-2008), the high inflation period (1986-1994), and the low inflation period (1994-2008) respectively. As stated earlier these relationships are tested for both the nominal and the real rate of stock returns, but only the nominal results are presented due to lack of space.

Table 4 shows the results for the total period 1986-2008. In all eleven tests, results indicate a direct relationship between the stock returns and inflation. In all tests, the coefficient on the inflation rate is significant at the 1% level. The size of the slope coefficients (on the rate of inflation) range from 0.932 to 0.513. The size of the slope coefficient indicates the level of hedging of inflation by the stock return. For example, the smallest coefficient size implies that a 1% increase in the inflation pushes the stock returns by 0.51%, thus a stock return is only able to hedge half the inflation rate. For all companies except one the coefficient on the rate of inflation is found to be significantly different from unity by means of the F-test. The company Light S.A. is the only one with a slope coefficient of one. Evidence from the total period shows that stock returns of Brazilian firms and the general stock market do act as a hedge against inflation but not on a one-to-one basis.[12] The diagnostic statistics are quite standard. The range of the R^2 is from 0.14 to 0.26. The Durbin-Watson statistics indicate very little first order autocorrelation. Some regressions were corrected for serial correlation. There is no evidence of auto correlation at a higher lag or the ARCH effect.

The high inflation period (1986-94) provides similar results (table 5) to the total period. In all cases, the stock return is found to act as a hedge against inflation. Thus once again we find a positive relationship between the stock return and the rate of inflation for all companies. The size of the slope coefficient is found to be less than unity for all companies except Light S.A.. Thus, similar to the total period during the high inflation period, stock returns do not fully hedge against inflation. The R^2 are smaller in range compared to the total period ranging from 0.03 to 0.2. Once again the Durbin-Watson statistics indicate very little first order autocorrelation and some regressions were corrected for serial correlation. There is no evidence of auto correlation at a higher lag or the ARCH effect. The low inflation period (1994-2008) results are presented in table 6. The results fail to show any evidence of a significant relationship between the returns and the inflation. No evidence is found to show any of the firms or general stock returns hedge against inflation during the low inflation period. This result is opposite to that of the high inflation period and the total period results. The diagnostic statistics are again quite standard with the R^2 being smaller in size on average compared to the R^2 of the total period.

As stated earlier we also ran tests between the stock return and a past rate of inflation. Thus the contemporaneous rate of inflation is replaced by one time lagged rate of inflation in equation 5.[13] Results obtained are very similar to the contemporaneous rate of inflation results. For the total and the high inflation rate periods results show a direct relationship, although it is not quite one-to-one. This is true for all companies. During the low inflation period, the evidence is again very weak regarding the relationship. In only one test the relationship is found to be positive and significant. These results back up the results provided in tables 4, 5 and 6. These results are available on request.

As stated earlier, a security is an inflation hedge if, and only if, its real returns are independent of the inflation rate. This paper further investigates the relationship between the real rate of

[12] Similar results were also reported by Choudhry (2001).

[13] See footnote 8.

return on the Brazilian company stocks and the rate of inflation. The real rate replaces the actual rate in equation 5 in these tests.[14] Results obtained indicate a significant negative relationship between the real rate and inflation during the total period and the high inflation period. No significant relationship is found during the low inflation period. In absolute value the size of the slope coefficient is less than unity.

A negative relationship is possible between the expected real and nominal rate of returns with the expected and the unexpected rate of inflation (Lintner, 1975). According to Lintner (1975) companies could maintain their real growth and real profit margins, however, in order to maintain a high rate of growth in real terms a company's relative dependence on outside financing will necessary be higher. Thus, the higher the inflation rate, the higher the outside financing requirement, whether expected of unanticipated inflation. This higher relative dependence on outside financing require by an increase in realized inflation will necessarily reduce the value of outstanding equity, and consequently also reduce the real rate of return realized during the period. Thus, the additional outside financing requirement comes from the necessity of maintains a full rate of growth in real terms. Lintner (1975) demonstrates this by assuming that (1) capital stock and current rates of real investments are proportional to physical output and the depreciation is also proportional to capital stock and is taken at replacement cost for tax purposes. (2) Corporate profits are taxed at a fixed percentage rate, and dividends are fixed fraction of profits after tax. (3) Prices at all times provide a fixed percentage margin of gross operating profit over inventories value at replacement cost, and the dollar amount overheads, selling and all other costs are proportional to dollar sales. (4) Cash balances bear a fixed ratio to current "dollar" sales, that a fixed fraction of sales are made on credit and that there is a fixed collection period on receivables. (5) There is no interest income on cash and (6) terms on receivables are not adjusted for changes in the rate of inflation. According to the author theses assumptions are sufficient to make this additional demand for external funds some fixed fraction of the increases in current "dollar" sales. Additionally, high or increasing rates of inflation can also reduce equity values because of the anticipation of subsequent deflationary actions of the monetary or fiscal authorities. These results are available on request.

5. Variance Decompositions Results

We also apply the variance decomposition test to further investigate the relationship between the stock returns and the inflation rate. Variance decomposition offers a method of examining VAR system dynamics. This method gives the proportion of the movements in the dependent variables that are due to their own shocks versus shocks to the other variables (Brooks, 2002). Variance decomposition determines how much of the s-step ahead forecast error variance of a given variable is explained by innovations to each explanatory variables for each step ahead. According to Brooks (2002) it is usually observed that own-series shocks explain most of the forecast error variance of the series in a VAR.[15] In this paper, the variance decomposition helps determine what proportion of variation in stock prices is explained by the innovations of the inflation rate over a given period of time. The variance composition is only conducted for the total period (1986-2008) and the high inflation period (1986-1994). The low inflation period (1994-2008) fails to provide a significant relation between the inflation and stock returns for all series.

Tables 7 and 8 present the variance decomposition results for the total period and high inflation period, respectively. The first column is the number of steps ahead in months. Results for 1 to 12 months ahead and the 24th month ahead are presented. The remaining columns present the error variance attributed to shocks to individual stock returns by the innovations of the inflation rate. By construction, the percentage of the error variance attributable to shocks

[14] The real rate is defined as $(1 + R)/(1 + \pi) - 1$.

[15] In variance decomposition tests ordering of the variables may substantially influence the results. But in this paper given there are only two variables ordering of the variables is not a problem.

by inflation rate in the first step is 0 %. Thus, in the first step the error variance attributed to own shocks for the stock return is 100 %. The behaviour then immediately settles down to a steady state. During the total period (table 7) for most of the firm stock returns after the 4th step more than 10% of the error variance in the returns is attributable to the innovations of the inflation rate. For a few firms it is almost 20% during the later step numbers. Within the high inflation results (table 8) the inflation rates seem to explain smaller percentages of the variation of the returns. Even in these tests for many firms the innovations of the inflation rates explains more than 10% of the error variance in the returns. These results provide further evidence of the significant effect of the inflation rates on stock returns during high inflation periods.

6. Conclusion and Implications

One of the controversial empirical findings in finance is the negative relationship between stock returns and inflation. A negative relationship implies that investors whose real wealth is diminished by inflation can expect this effect to be compounded by a lower than average return on the stock market. This paper empirically investigates the relationship between stock returns and inflation for ten Brazilian firms and the general Brazilian stock market. The stated relationship is tested by means of linear regressions once it is confirmed that all stock returns and the inflation rate involved are mean reverting in levels. The empirical investigation is conducted for the period 1986-2008, which includes an unstable high inflation era (1986-1994) and a stable low inflation era (1994-2008). This paper thus checks whether company stock returns hedge against high and low inflation in the same market during short periods of time. The firms used are mostly in manufacturing industries and vary in size from small to relatively large. The availability of the data dictated the firms chosen. The general stock index is represented by the Bovespa Index (Ibovespa)

Results show a direct relationship (as indicated by the theory) between the stock returns and the rate of inflation during the total period (1986-2008) and during the high inflation period (1986-1994). But the size of the effect is less than unity in the large majority of the relationships. Thus evidence from these periods shows that stock returns of Brazilian firms and the general stock market do act as a hedge against inflation but not on a one-to-one basis. However, no significant evidence is found for the relationship during the low inflation period (1994-2008) thus there is no evidence that stock returns hedge against inflation during a low inflation period. This result is opposite to that of the high inflation period and the total period results. We then conduct the variance decomposition test to check the amount of movement in stock returns that is due to innovations of the inflation rate. During both the total and high inflation periods, innovations of the inflation rate seem to influence more than 10% of the error variance in the stock returns. These results are more evident during the total period.

In this paper we conduct two other tests between the stock return and a past rate of inflation. Results obtained are very similar to the contemporaneous rate of inflation results. For the total and the high inflation rate periods, results show a direct but not a one-to-one relationship. This is true for all companies. During the low inflation period, the evidence is again very weak regarding the relationship. We then investigate the relationship between the real rate of stock return and the rate of inflation. Results obtained indicate a significant negative relationship between the real rate and inflation during the total period and the high inflation period. No significant relationship is found during the low inflation period. A negative relationship is possible between the expected real rate of returns with the expected and the unexpected rate of inflation.

The results presented here indicate a pragmatic consequence for portfolio managers and investors, since a group of stocks can act as an effective hedge in high inflation conditions in short and long-run perspectives, however, in stabilized inflation, their hedge effectiveness diminishes. In periods when some central banks are increasing their inflation expectation for the next year, this can be helpful information for managers and investors. Given the contrasting results presented here compared to previous studies this paper advocates further research in the area of the Fisher effect for risky assets.

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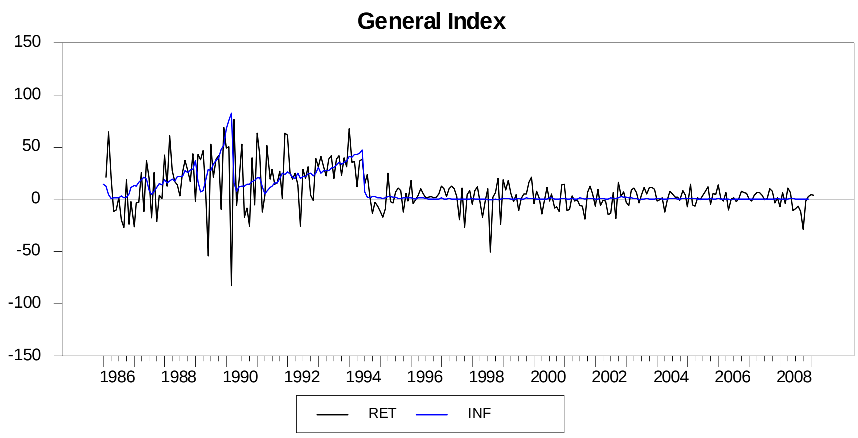
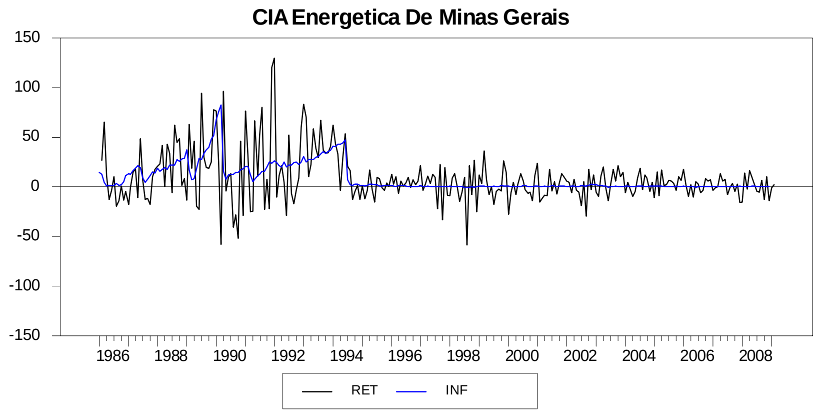
Appendix

Figure 1. Stock Returns and Inflation




CIA Energetica De Minas Gerais
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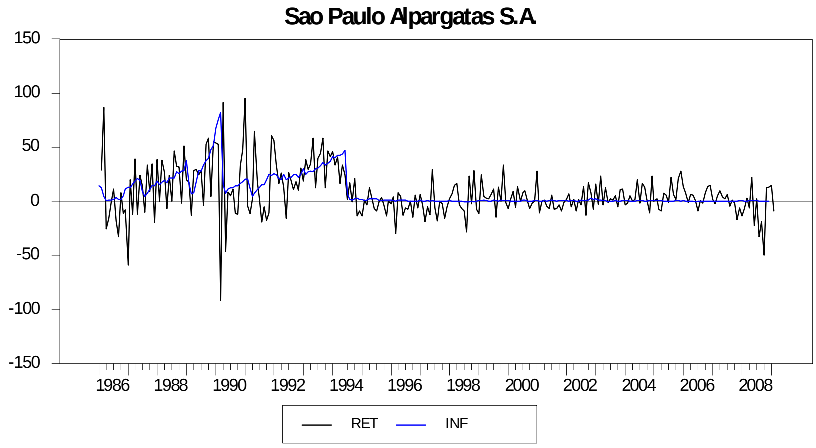
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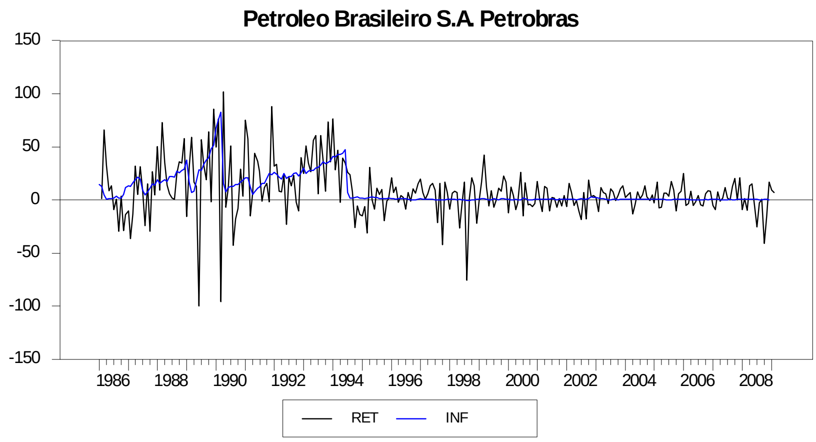
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Table I. Company Details

CODE	Name of Company	Industruy Classification	SIZE (Market Capitalization by December 2008, in thousand USD)
ALPA4	Sao Paulo Alpargatas S.A.	Textiles, Apparel And Footwear / Footwear	290,673
ARCZ6	Aracruz Celulose S.A.	Wood And Paper / Pulp And Paper	1,409,159
BRKM5	Braskem S.A.	Chemicals / Petrochemicals	1,206,697
CMIG4	Cia Energetica de Minas Gerais – CEMIG	Utilities / Electric Utilities	6,123,138
FJTA4	Forja Taurus S.A.	Machines And Equipments / Weapons And Munitions	146,722
LIGT3	Light S.A.	Electric Utilities / Electric Utilities	1,907,571
LAME4	Lojas Americanas S.A.	Retail / Diversified Retailers	1,915,374
PETR4	Petroleo Brasileiro S.A. – PETROBRAS	Oil, Gas And Biofuels / Exploration And Refining	95,845,519
CRUZ3	Souza Cruz S.A.	Tobacco / Cigarette And Tobacco	5,768,478
VALE5	Cia Vale do Rio Doce (Vale)	Mining / Metallic Minerals	60,142,348
IBOV	Bovespa Stock Index (general)		
IPCA	National inflation index to consumer expanded (in monthly %)		

Table II. Basic Statistics

FULL PERIOD							
	Inflation	IBOV	ALPA4	ARCZ6	BRKM5	CMIG4	CRUZ3
Mean	0.0874	0.0817	0.0757	0.0789	0.0784	0.0867	0.0876
Median	0.0099	0.0521	0.0275	0.0435	0.0347	0.0442	0.0500
Maximum	0.8239	0.7620	0.9540	1.1701	1.0986	1.2972	1.0574
Minimum	-0.0051	-0.8248	-0.9163	-0.9666	-0.8587	-0.5853	-0.8845
Std. Dev.	0.1387	0.2061	0.2219	0.2357	0.2378	0.2586	0.2070
Skewness	2.1150	0.3718	0.5372	0.6754	0.7032	1.3933	0.9347
Kurtosis	8.3588	5.0807	6.0050	7.8535	5.1573	6.6535	7.2858
Jarque-Bera	534.060	55.942	116.697	290.825	75.991	241.924	250.512
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sum	24.031	22.454	20.830	21.697	21.555	23.833	24.078
Sum Sq. Dev.	5.274	11.641	13.487	15.227	15.499	18.327	11.744
Observations	275	275	275	275	275	275	275

Table II. Basic Statistics (continued)

FULL PERIOD						
	Inflation	FJTA4	LAME4	LIGT3	PETR4	VALE5
Mean	0.0874	0.0748	0.0865	0.0824	0.0863	0.0869
Median	0.0099	0.0488	0.0591	0.0404	0.0645	0.0402
Maximum	0.8239	0.7419	0.9220	1.0430	1.0152	0.8317
Minimum	-0.0051	-0.6931	-0.7985	-0.6210	-0.9983	-0.9027
Std. Dev.	0.1387	0.2116	0.2397	0.2537	0.2496	0.2280
Skewness	2.1150	0.1501	0.6538	0.9173	0.2150	0.3779
Kurtosis	8.3588	4.3353	4.7808	4.9832	6.5364	4.9467
Jarque-Bera	534.060	21.307	55.928	83.635	145.420	49.971
Probability	0.000	0.000	0.000	0.000	0.000	0.000
Sum	24.031	20.421	23.799	22.646	23.734	23.895
Sum Sq. Dev.	5.274	12.181	15.741	17.640	17.068	14.242
Observations	275	275	275	275	275	275

Table II. Basic Statistics

PERIOD 1986-1994							
	Inflation	IBOV	ALPA4	ARCZ6	BRKM5	CMIG4	CRUZ3
Mean	0.2258	0.1992	0.1858	0.2042	0.2023	0.2100	0.1985
Median	0.2072	0.2279	0.1974	0.1886	0.2258	0.1823	0.1865
Maximum	0.8239	0.7620	0.9540	1.0674	1.0986	1.2972	1.0574
Minimum	0.0078	-0.8248	-0.9163	-0.8914	-0.8587	-0.5798	-0.8845
Std. Dev.	0.1485	0.2763	0.3011	0.2868	0.3053	0.3648	0.2854
Skewness	1.3911	-0.6444	-0.3445	-0.1558	-0.1278	0.4813	-0.1222
Kurtosis	6.1508	3.9211	4.2540	4.7447	4.0114	3.0594	4.6761
Jarque-Bera	74.352	10.561	8.615	13.218	4.580	3.914	12.074
Probability	0.000	0.005	0.013	0.001	0.101	0.141	0.002
Sum	22.806	20.116	18.765	20.623	20.431	21.206	20.053
Sum Sq. Dev.	2.205	7.635	9.063	8.227	9.321	13.311	8.146
Observations	101	101	101	101	101	101	101

Table II. Basic Statistics (continued)

PERIOD 1986-1994						
	Inflation	FJTA4	LAME4	LIGT3	PETR4	VALE5
Mean	0.2258	0.1730	0.2065	0.2325	0.1999	0.1988
Median	0.2072	0.1823	0.2151	0.2007	0.1931	0.2153
Maximum	0.8239	0.7419	0.9220	1.0430	1.0152	0.8317
Minimum	0.0078	-0.6931	-0.7985	-0.5621	-0.9983	-0.9027
Std. Dev.	0.1485	0.2771	0.2845	0.3056	0.3422	0.3145
Skewness	1.3911	-0.6481	0.0505	0.3920	-0.4839	-0.6358
Kurtosis	6.1508	3.8644	3.8782	3.1905	4.4852	3.6001
Jarque-Bera	74.352	10.013	3.288	2.739	13.225	8.321
Probability	0.000	0.007	0.193	0.254	0.001	0.016
Sum	22.806	17.125	20.861	23.482	20.188	20.076
Sum Sq. Dev.	2.205	7.524	8.097	9.338	11.712	9.893
Observations	101	101	101	101	101	101

Table II. Basic Statistics

PERIOD 1994-2008							
	Inflation	IBOV	ALPA4	ARCZ6	BRKM5	CMIG4	CRUZ3
Mean	0.0070	0.0134	0.0119	0.0062	0.0065	0.0151	0.0231
Median	0.0051	0.0213	0.0009	0.0118	-0.0124	0.0224	0.0252
Maximum	0.0684	0.2470	0.3375	1.1701	0.4554	0.3584	0.3882
Minimum	-0.0051	-0.5034	-0.4934	-0.9666	-0.4076	-0.5853	-0.1970
Std. Dev.	0.0076	0.1020	0.1200	0.1612	0.1468	0.1223	0.0971
Skewness	3.7220	-1.0304	-0.2161	0.7510	0.2955	-0.7206	0.3974
Kurtosis	26.5368	6.3648	4.7746	24.4296	3.4715	5.8410	4.1068
Jarque-Bera	4418.122	112.873	24.186	3345.761	4.144	73.574	13.462
Probability	0.000	0.000	0.000	0.000	0.126	0.000	0.001
Sum	1.225	2.338	2.065	1.074	1.124	2.627	4.025
Sum Sq. Dev.	0.010	1.801	2.491	4.494	3.727	2.589	1.632
Observations	174	174	174	174	174	174	174

Table II. Basic Statistics (continued)

PERIOD 1994-2008						
	Inflation	FJTA4	LAME4	LIGT3	PETR4	VALE5
Mean	0.0070	0.0189	0.0169	-0.0048	0.0204	0.0219
Median	0.0051	0.0235	0.0162	-0.0009	0.0313	0.0159
Maximum	0.0684	0.3828	0.8812	0.4224	0.4220	0.6931
Minimum	-0.0051	-0.3402	-0.5268	-0.6210	-0.7538	-0.3982
Std. Dev.	0.0076	0.1352	0.1758	0.1649	0.1381	0.1166
Skewness	3.7220	-0.0448	0.4617	-0.2811	-1.3048	0.8681
Kurtosis	26.5368	2.8786	5.9362	4.7288	8.6651	8.8546
Jarque-Bera	4418.122	0.165	68.687	23.960	282.052	270.357
Probability	0.000	0.921	0.000	0.000	0.000	0.000
Sum	1.225	3.296	2.938	-0.836	3.546	3.819
Sum Sq. Dev.	0.010	3.160	2.938	4.704	3.298	2.351
Observations	174	174	174	174	174	174

Table III. ADF Unit Root test Results for Stock Returns

Variables	**Intercept and Trend**	**Intercept**
1986-2008		
SP Alpargatas	-3.8173**	-3.1974**
Aracruz Celulose	-5.1551***	-3.6472***
Braskem SA	-4.9713***	-3.6922***
Cemig	-3.9493***	-3.3168**
Forjas Taurus SA	-4.7516***	-4.2639***
Light SA	-4.3900***	-3.4364**
Lojas Americana SA	-4.8693***	-4.1746***
Petrobras	-4.5509***	-3.9143***
Souza Cruz SA	-4.4272***	-3.0783**
Cia Vale Do Rio Doce	-4.4414***	-3.6009***
Bovespa Index	-3.7348**	-2.8477*
Inflation Rate	-3.8490**	-2.6104*
1986-1994		
SP Alpargatas	-3.1821**	-2.6667*
Aracruz Celulose	-3.9160**	-3.5001***
Braskem SA	-3.9459**	-3.5472***
Cemig	-2.9534	-2.4911
Forjas Taurus SA	-3.6950**	-2.9164**
Light SA	-3.4512**	-3.1401**
Lojas Americana SA	-3.8068**	-3.1243**
Petrobras	-3.8207**	-2.8580*
Souza Cruz SA	-3.2572*	-3.1072**
Cia Vale Do Rio Doce	-3.4358*	-2.9837**
Bovespa Index	-3.4358*	-2.2854
Inflation Rate	-3.6472*	-2.9507**

Note: ***, **, & * imply rejection of the null of nonstationarity in levels at the 1%, 5% & 10% level respectively.

Table III. ADF Unit Root test Results for Stock Returns (continued)

Variables	**Intercept and Trend**	**Intercept**
1994-2008		
SP Alpargatas	-3.1172	-3.2335**
Aracruz Celulose	-4.5626***	-4.4962***
Braskem SA	-4.2398***	-4.4962***
Cemig	-5.6409***	-5.6913***
Forjas Taurus SA	-4.0604***	-4.1124***
Light SA	-4.4916***	-4.5075***
Lojas Americana SA	-4.4919***	-4.4967***
Petrobras	-5.3154***	-5.4090***
Souza Cruz SA	-6.2840***	-6.2572***
Cia Vale Do Rio Doce	-4.0118**	-4.1370**
Bovespa Index	-5.2632***	-5.2700***
Inflation Rate	-3.2256**	-3.0896**

Table IV. Total Period: 1986-2008

Company Name	Constant	Slope Coefficient	F-test: Slope coefficient=1
Alpargatas S.A.	1,5919 (1.2573)	0.6771***(8.7091)	17.2574[a]
R^2 = 0.17, DW= 1.93[z], SSE= 20.18, L-Q(4) = 1.90, ARCH(3) = 0.017			
Aracruz Celulose S.A	1.2470 (1.0118)	0.7574*** (9.9861)	10.2230[a]
R^2 = 0.21, DW= 1.93[z], SSE= 21.05, L-Q(4) = 1.51, ARCH(3) = 0.238			
Braskem S.A.	1.9855 (1.2695)	0.6697*** (7.0122)	11.9566[a]
R^2 = 0.15, DW= 2.16, SSE= 21.93, L-Q(4) = 3.53, ARCH(3) = 0.008			
Energetica de Minas	2.258 (1.3295)	0.7333*** (7.0700)	6.6077[b]
R^2 = 0.15, DW= 2.04, SSE= 23.82, L-Q(4) = 1.34, ARCH(3) = 1.98			
Forja Taurus S.A.	1.5930 (1.0312)	0.6588*** (7.0557)	13.3573[a]
R^2 = 0.20, DW= 1.98[z], SSE= 19.83, L-Q(4) = 0.165, ARCH(3) = 1.284			
Light S.A.	0.0895 (0.0574)	0.9321*** (9.7876)	0.5078
R^2 = 0.26, DW= 1.97, SSE= 21.87, L-Q(4) = 3.44, ARCH(3) = 3.275			
Lojas Americanas S.A.	1.9729 (1.2850)	0.7646*** (8.1539)	6.3050[b]
R^2 = 0.19, DW= 1.95, SSE= 21.53, L-Q(4) = 2.31, ARCH(3) = 0.054			
Petroleo Brasileiro S.A.	2.5877* (1.8012)	0.6944*** (7.8732)	12.003[a]
R^2 = 0.14, DW= 1.95[z], SSE= 23.14, L-Q(4) = 1.290, ARCH(3) = 1.483			
Souza Cruz S.A.	2.8500*** (3.003)	0.6714*** (11.4680)	31.5142[a]
R^2 = 0.26, DW= 2.02[z], SSE= 17.83, L-Q(4) = 1.433, ARCH(3) = 0.0.161			
Vale do Rio Doce	2.4948* (1.8863)	0.7224*** (8.9058)	11.7092[a]
R^2 = 0.19, DW= 1.92[z], SSE= 20.53, L-Q(4) = 2.49, ARCH(3) = 5.202			
Bovespa Stock Index	2.681**(2.0089)	0.6276***(7.7000)	20.880a
R2 = 0.18, DW= 2.18, SSE= 18.17, L-Q(4) = 3.50, ARCH(3) = 1.032			

Note: ***, ** & * imply significance at the 1%, 5% & 10% level, respectively, a and b imply rejection of the slope coefficient = 1 at the 1% and 5% level. DW = Durbin-Watson, SSE = Standard error of estimate, L-Q (4) = Ljung-Box Q statistics at 4 lags, ARCH = test for ARCH lags 3 chi-squared, z = regression corrected for serial correlation.

Table V. High Inflation Period: 1986-1994

Company Name	Constant	Slope Coefficient	F-test: Slope coefficient=1
Alpargatas S.A.	6.3775 (1.3915)	0.5312*** (3.1033)	7.5000^a
R^2 = 0.06, DW= 1.92^z, SSE= 29.12, L-Q(4) = 2.89, ARCH(3) = 0.258			
Aracruz Celulose S.A	7.512** (2.050)	0.5705** (4.1527)	9.7729^a
R^2 = 0.14, DW= 1.91^z, SSE= 26.05, L-Q(4) = 4.25, ARCH(3) = 0.032			
Braskem S.A.	10.9314** (2.5135)	0.4274*** (2.6268)	12.3893^a
R^2 = 0.07, DW = 1.82^z, SSE= 28.94, L-Q(4) = 0.526, ARCH(3) = 0.315			
Energetica de Minas	9.6783 (1.5071)	0.5044** (2.1100)	4.2970^b
R^2 = 0.03 , DW= 1.94, SSE= 35.70, L-Q(4) = 1.63, ARCH(3) = 0.251			
Forja Taurus S.A.	2.2456 (0.4314)	0.6410*** (3.3500)	3.5175^c
R^2 = 0.12, DW= 1.96^z, SSE= 25.85, L-Q(4) = 0.384, ARCH(3) = 0.235			
Light S.A.	7.7520 (1.4986)	0.6958*** (3.6132)	2.4946
R^2 = 0.11, DW= 1.98, SSE= 28.76, L-Q(4) = 1.83, ARCH(3) = 0.045			
Lojas Americanas S.A.	6.3600 (1.3114)	0.6276*** (3.4763)	4.2543^b
R^2 = 0.10, DW= 2.06, SSE= 26.96, L-Q(4) = 1.06, ARCH(3) = 0.237			
Petroleo Brasileiro S.A.	8.9720* (1.7079)	0.4982** (2.5392)	6.5403^b
R^2 = 0.04, DW= 1.92z , SSE= 33.39, L-Q(4) = 1.519, ARCH(3) = 0.002			
Souza Cruz S.A.	8.7937** (2.5129)	0.4867*** (3.7073)	15.2905^a
R^2 = 0.16, DW= 2.03^z, SSE= 26.09, L-Q(4) = 1.3281, ARCH(3) = 0.013			
Vale do Rio Doce	7.8094 (1.4272)	0.5362*** (2.6321)	5.1839^b
R^2 = 0.06, DW= 2.18, SSE= 30.11, L-Q(4) = 2.579, ARCH(3) = 0.23			
Bovespa Stock Index	12.8029** (2.6135)	0.3150* (1.7272)	14.1080^a
R^2 = 0.20, DW= 2.20, SSE= 27.23, L-Q(4) = 2.03, ARCH(3) = 0.007			

See note at the end of table 4.

Table VII. Variance Decomposition Results for the Total Period

S steps	ALPA4	ARCZ6	BRKM5	CMIG4	FJTA4	LIGT3	LAME4	PETR4	CRUZ3	VALE5
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	5.075	15.027	0.865	4.078	5.816	4.660	1.464	1.114	6.823	1.326
3	5.793	5.222	1.120	8.484	7.354	7.129	4.144	3.315	6.924	3.584
4	6.102	10.813	3.587	11.561	8.463	11.039	6.347	6.333	10.113	6.749
5	6.552	12.068	5.720	12.761	9.136	12.063	7.682	8.767	11.386	9.435
6	8.087	13.422	7.578	13.536	10.016	13.003	8.905	10.436	12.387	11.323
7	9.136	14.273	8.898	14.308	10.773	13.674	10.032	11.712	13.382	12.692
8	10.035	15.139	9.967	15.131	11.441	14.554	11.010	12.748	14.129	13.757
9	10.666	15.859	10.874	15.864	11.982	15.224	11.817	13.645	14.814	14.679
10	11.331	16.461	11.657	16.456	12.446	15.802	12.509	14.412	15.390	15.488
11	11.865	16.960	12.335	16.934	12.841	16.235	13.104	15.055	15.874	16.802
12	12.371	17.382	12.919	17.338	13.184	16.624	13.613	15.595	16.291	17.321
24	15.027	19.445	16.036	19.424	14.968	18.576	16.209	18.191	18.414	19.934

Table VI. Low Inflation Period: 1994-2008

Company Name	Constant	Slope Coefficient	F-test: Slope coefficient = 1
Alpargatas S.A.	0.2738 (0.2000)	1.3600 (0.8946)	-
R^2 = -0.001, DW= 2.00, SSE= 12.04, L-Q(4) = 1.97, ARCH(3) = 1.45			
Aracruz Celulose S.A	-0.7777 (-0.4236)	2.0333 (0.9966)	-
R^2 = -0.004, DW= 2.00, SSE= 16.16, L-Q(4) = 2.85, ARCH(3) = 0.181			
Braskem S.A.	-0.4719 (-0.2376)	1.2060 (0.5604)	-
R^2 = 0.04, DW= 2.04^{z}, SSE= 14.14, L-Q(4) = 2.25, ARCH(3) = 0.049			
Energetica de Minas	0.6796 (0.6000)	1.0030 (0.7784)	-
R^2 = 0.04, DW= 1.94^{z}, SSE= 11.91, L-Q(4) = 3.54, ARCH(3) = 2.387			
Forja Taurus S.A.	2.4729 (1.4198)	-1.0700 (-0.5576)	-
R^2 = 0.01, DW= 2.04^{z}, SSE= 13.45, L-Q(4) = 2.59, ARCH(3) = 0.210			
Light S.A.	-1.5620 (-0.8407)	1.3180 (0.6380)	-
R^2 = -0.004, DW= 2.00, SSE= 16.35, L-Q(4) = 2.78, ARCH(3) = 4.759			
Lojas Americanas S.A.	-0.2039 (-0.0917)	2.9563 (1.2028)	-
R^2 = 0.01, DW= 2.03^{z}, SSE= 17.55, L-Q(4) = 3.6406, ARCH(3) = 0.372			
Petroleo Brasileiro S.A.	1.6884 (1.0796)	0.3160 (0.1818)	-
R^2 = -0.005, DW= 2.11, SSE= 13.76, L-Q(4) = 2.97, ARCH(3) = 2.421			
Souza Cruz S.A.	1.6017c (1.6629)	0.9325 (0.0.8534	-
R^2 = 0.015, DW= 2.01^{z}, SSE= 9.64, L-Q(4) = 0.99, ARCH(3) = 0.033			
Vale do Rio Doce	1.6569 (1.2492)	0.6896 (0.4679)	-
R^2 = -0.005, DW= 2.23, SSE= 11.65, L-Q(4) = 1.30, ARCH(3) = 0.389			
Bovespa Stock Index	0.1575 (0.1362)	1.6576 (1.2900)	-
R^2 = 0.004, DW= 1.97, SSE= 10.61, L-Q(4) = 2.95, ARCH(3) = 4.272			

See note at the end of table 4.

Table VIII. Variance Decomposition Results for the High Inflation Period

S steps	ALPA4	ARCZ6	BRKM5	CMIG4	FJTA4	LIGT3	LAME4	PETR4	CRUZ3	VALE5
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	8.365	3.612	1.203	5.688	10.089	4.338	3.202	0.513	6.590	0.745
3	8.257	4.625	1.333	8.247	11.425	5.593	5.323	3.858	6.377	4.734
4	8.247	12.400	2.974	10.426	11.573	9.362	6.388	5.417	9.714	6.638
5	7.934	12.513	3.921	10.795	11.640	9.385	6.456	7.979	9.845	8.772
6	8.643	12.758	4.525	10.849	11.709	9.400	7.045	9.054	9.893	9.363
7	8.734	12.756	4.760	10.886	11.774	9.486	7.363	9.611	10.003	9.710
8	8.882	12.762	4.860	10.932	11.825	9.488	7.484	9.863	10.016	9.829
9	8.875	12.763	4.919	10.966	11.854	9.491	7.509	9.954	10.037	9.912
10	8.947	12.765	4.957	10.982	11.870	9.504	7.571	10.011	10.045	9.968
11	8.955	12.765	4.984	10.988	11.879	9.504	7.619	10.035	10.048	10.014
12	8.982	12.766	5.002	10.990	11.884	9.504	7.629	10.470	10.050	10.045
24	9.007	12.766	5.030	10.994	11.891	9.506	7.654	10.055	10.052	10.093