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Abstract

We examine the relationship between stock returns and foreign investment in Brazil, and find that the inflows of foreign investment boosted the returns from 1995 to 2005. There was a strong contemporaneous correlation, although not Granger-causality. Foreign investment along with the exchange rate, the influence of the world stock markets, and country risk can explain 73 percent of the changes that occurred in the stock returns over the period. We also find that positive feedback trading played a role, and that the market promptly assimilated new information.

Keywords: stock returns, foreign investment, Brazilian economy

JEL classification: F21, G12, E44

1. Introduction

Brazil is a favorite destination for foreign investment, and this fact has been reflected in its stock market. Foreign investors represented 34.7 percent of all the transactions carried out on the Sao Paulo Stock Exchange (Bovespa for short) in February 2008. This article evaluates to what extent the Brazilian stock returns were influenced by foreign investment inflows over the period 1995 to 2005. The relationship is theoretically expected, because increased foreign presence diversifies the risk and makes the stocks more liquid (Clark and Berko 1997). Lower total risk and higher liquidity are, in turn, positively related to current stock returns (Merton 1987, Hargis 2002). Not only foreign presence, but the exchange rate also changes; the world stock markets and country risk may play a role in explaining the returns.

One may expect a negative relationship between an appreciating currency and stock returns, as a rise in foreign prices relative to domestic prices may boost both domestic exports and profit prospects, thereby increasing the stock prices (Dornbush and Fischer 1980). Domestic stock returns may also be influenced by the extent to which an economy is globally integrated (Harvey 1995, Henry 2000, Bilson *et al.* 2001, Eizaguirre *et al*. 2009). A domestic stock market may be affected by shocks hitting the world stock markets (Gallagher 2000, Lin 2008). One may also expect a negative relationship between country risk and stock returns. Country risk can be gauged by the risk premium of government debt bonds; this measure may be more appropriate than the interest rate, for explaining returns, because it captures both the opportunity cost and the risk of investing in stocks abroad (Chen *et al.* 1986).

Most studies of the relationship between stock returns and portfolio investment commonly employ either correlation or vector autoregression (VAR) analysis (Errunza 2001). Few studies use linear regression, but these usually do not test whether the

explanatory variables are really exogenous (Clark and Berko 1997). Moreover, such studies do not consider data for the aftermaths of financial crises either. Here, we consider a period of the Brazilian economy plagued by financial crises, and still find a positive relationship between foreign investment inflows and Brazilian stock valuations, thereby, confirming a pattern already detected for the previous period, 1986 – 1998 (Tabak 2003). Using Johansen's methodology and testing for bicausality, Tabak has estimated a VAR with an error correction mechanism and has found that the daily inflows of portfolio investment and the Brazilian stock market co-integrate. Here, we find a strong contemporaneous correlation between such variables for the period from 1995 to 2005, but the Granger causality tests suggest the presence of positive feedback trading (Froot *et al.* 2001). We have also tested for exogeneity only to find that even though our model is useful for inference it is inappropriate for forecasting. Table 1 provides an overview of other previous literature.

The rest of this article is organized as follows. Section 2 presents data, Section 3 performs an analysis, and Section 4 gives the conclusion.

2. Data

Monthly returns of the closing quotes of the Bovespa index from January 1995 to December 2005 were taken from Ipeadata. To measure the foreign presence in Bovespa, we considered a composite series built from three other ones (Warther 1995, Clark and Berko 1997), namely, (1) the value of foreign portfolios in dollars; (2) the percentage of stocks in the foreign portfolios; and (3) the total Bovespa market capitalization in terms of dollars. We multiplied every data point of the first series by those of the second, and then divided the result by the data points of the third. The data were taken from the website of the Securities and Exchange Commission of Brazil (dubbed CVM). Foreign

presence is a stock variable, but the first differences in the series are the inflows and outflows of foreign investment. For the exchange rate for the Brazilian currency in US dollars we considered the closing Ptax rate, which is an average of the effective rates of dollar transactions occurring in the interbank market weighted by the volume of transactions. The data were taken from the Central Bank of Brazil. The global stock index considered was the Morgan Stanley Capital International (MSCI) World index. J.P. Morgan's Emerging Market Bond Indices Plus (EMBI+) tracked the total returns for traded external debt instruments in the emerging markets; thus, for the country risk we used EMBI + BR.

Table 2 shows the descriptive statistics for the above-mentioned variables. Figure 1 shows that the currency crises of 1997 (East Asia), 1998 (Russia), and 1999 (Brazil) coincided with the periods of greater volatility in the variables "Bovespa returns", "foreign presence in the Brazilian market", and "country risk". The year prior to President Lula's election in 2002 also showed marked variability in both the exchange rate and country risk. Foreign presence receded from the second half of 1997 onward, being reverted by the second half of 2002. Phillips-Perron tests in Table 3 show that the series are stationary. For the exchange rate we also used the Perron (1997) test for series with structural breaks. The series continued to be stationary, which is in line with the previous work (Moura and Da Silva 2005).

3. Analysis

We estimated a single-equation model (as in Clark and Berko 1997), and then employed diagnostic tests to check whether the estimators were unbiased, efficient, and consistent. Then, we tested for the presence of serial autocorrelation, heteroskedasticity, proper functional form, omitted and irrelevant variables, exogeneity, and causality.

The correlations between the variables are displayed in Table 4. Foreign inflows show contemporaneous correlation with the Bovespa returns, twice as large as those of the series in the levels (which measures foreign presence). Table 5 shows the results of our estimation of the single-equation model, that is,

$$r_t = \beta_0 + \beta_1 f_t + u_t \tag{1}$$

where r_t stands for the Bovespa returns, and f_t is the foreign presence in the Bovespa. Equation (1) performed well as far as the diagnostic tests were concerned. However, we still had to assess causality and weak-exogeneity. Table 6 shows that one lag length was optimal according to the Schwarz criterion for the Granger-causality test. Table 7 shows the Bovespa returns Granger-caused foreign presence, and not the other way around. This result suggested that foreign investors considered past returns, that is, they behaved as positive feedback traders. To evaluate weak-exogeneity we considered a model that accounted for ARCH and MA in the residuals, that is,

$$f_t = \alpha_0 + \alpha_1 f_{t-1} + \alpha_2 f_{2_{t-2}} + \varepsilon_{f_t} + \alpha_3 \varepsilon_{f_{t-1}} + \alpha_4 \varepsilon_{f_{t-3}}, \tag{2}$$

and $h_t = \omega_0 + \omega_1 h_{t-1} + \omega_2 \varepsilon^2_{f_{t-1}}$. Table 8 shows that this model did not present either serial autcorrelation, heteroskedasticity, wrong functional form, or omitted and irrelevant variables. By inserting the conditional residual equation of r_t into the above-mentioned model (to test for variable redundancy) we found that the residual was not redundant for the marginal equation. Thus, the foreign presence in Bovespa was not weak-exogenous relative to the Bovespa returns (Table 9); the return estimation using only one equation

also ended up not being efficient. To circumvent this problem, we first carried out a VAR estimation between the foreign presence and returns through,

$$r_t = \theta_0 + \theta_1 r_{t-1} + \theta_2 r_{t-2} + \theta_3 f_{t-1} + \theta_4 f_{t-2} + \upsilon_{r_t} \quad (3)$$

$$f_t = \omega_0 + \omega_1 r_{t-1} + \omega_2 r_{t-2} + \omega_3 f_{t-1} + \omega_4 f_{t-2} + \upsilon_{f_t} . \quad (4)$$

However, this was not useful, as the variables were unrelated (Tables 10 and 11). We then resorted to extra explanatory variables: exchange rate changes e; global stock index g; and country risk b, along with the previous foreign presence in Bovespa (now in first differences, f_{-1}). The model then became

$$r_t = \beta_0 + \beta_1 f_{-1} + \beta_2 e_t + \beta_3 g_t + \beta_4 b_t + \varepsilon_{r_t} . \quad (5)$$

Table 12 shows that the residuals presented both heteroskedasticity and conditional heteroskedasticity. To fix the problem we estimated equation (5) using the maximum likelihood, that is,

$$r_t = \beta_1 f_{-1} + \beta_2 e_t + \beta_3 g_t + \beta_4 b_t + \beta_5 h_t + \varepsilon_{r_t} \quad (6)$$

where $h_t = \alpha_0 + \alpha_1 h_{t-1}$ was the conditional variance. Table 13 shows that the problem was finally corrected.

High sensitivity of the Bovespa returns to the global stock index provided a piece of evidence that the Brazilian stock market became more integrated to the

international markets. Country risk was negatively related to the returns (as in Nunes *et al.* 2005), and volatility was positively related to the returns. These variables jointly explained 73 percent of the Bovespa returns over the period 1995 to 2005. (We found similar results by replacing foreign presence with foreign investment, and also by replacing the ARCH (1) model of the variance with a GARCH (1,1)).

Then, we tested the causality and weak exogeneity of equation (6). The Schwarz information criterion suggested only one lag for input of the Granger causality test between Bovespa returns and the first differences of the foreign presence (Table 14). We considered one lag throughout, and found the Granger-causality from returns to either foreign presence or country risk (Table 15). This suggests that investors consider the past returns in their investment decisions. We are inclined to believe that the market rapidly assimilates new information because we have found a strong contemporaneous correlation, but a weak correlation between the same variables when lagged.

To check for weak exogeneity, we considered the extra variables in the equations below, that is,

$$f_{-1,t} = \beta_0 b_t + \varepsilon_{f_{-1},t} + \beta_1 \varepsilon_{f_{-1},t-1} \tag{7}$$

(and $h_t = \alpha_0 + \alpha_1 h_{t-1} + \alpha_2 \varepsilon^2_{f_{-1},t}$),

$$e_t = \delta_0 b_t + \delta_1 db_t + \varepsilon_{e,t} \tag{8}$$

(where d is a dummy that takes on the value of one between 1995:02 and 1998:12),

$$g_t = \lambda_0 b_t + \lambda_1 g_{t-15} + \lambda_2 \varepsilon_{g,t} + \lambda_3 \varepsilon_{g,t-15} \tag{9}$$

(and $h_t = \alpha_0 + \alpha_1 h_{t-1} + \alpha_2 \varepsilon_{g,t}^2$), and

$$b_t = \eta_0 b_{t-12} + \varepsilon_{b,t} + \eta_1 \varepsilon_{b,t-12}. \quad (10)$$

The estimation of the marginal equations of foreign presence, exchange rate changes, global stock market index, and country risk are in Tables 17 – 19, respectively. We considered country risk in (8) – (10) because it presented a correlation with the other variables to greater than 50 percent. (Multicolinearity was dismissed because the correlation was still less than 65 percent). Table 20 shows that the test of redundancy of $\varepsilon_{f_{-1},t}$, $\varepsilon_{e,t}$, $\varepsilon_{g,t}$ in explaining country risk, (equation (10)), pointed to the fact that this variable was weak-exogenous regarding foreign presence, exchange rate changes, and the global stock market index. Table 21 shows that insertion of $\varepsilon_{r,t}$ from the conditional equation (6) into the marginal equations (7) – (10) has allowed us to conclude that the first differences of foreign presence, exchange rate changes, global stock market index, and country risk are all weak-exogenous. Table 22 further shows that the variables "global stock market index" and "country risk" were even strongly exogenous. Thus, our linear regression estimation of model (6) could be justified. However, the model can be useful for inference, but unreliable for forecasting and policymaking.

4. Conclusion

Our results pointed to the conclusion that there was a positive relationship between foreign inflows and Bovespa returns over the period 1995 to 2005. Also, the global stock index showed a positive relation with the returns. Exchange rate changes and

country risk changes were negatively related to the returns. Jointly, such variables explained 73 percent of the Bovespa returns.

These findings resulted from a linear regression estimation approach that resorted to insertion of extra variables into a previously unsatisfying single-equation model. The VAR estimation was dismissed, as we found a low significant correlation between foreign presence and lagged returns.

The returns Granger-caused foreign presence, but the reverse causality was not found. This suggests that positive feedback trading played a role, and that the market promptly assimilated the relevant new information that arrived. Finally, the first differences of foreign presence, exchange rate changes, global stock market index, and country risk were weak-exogeneous.

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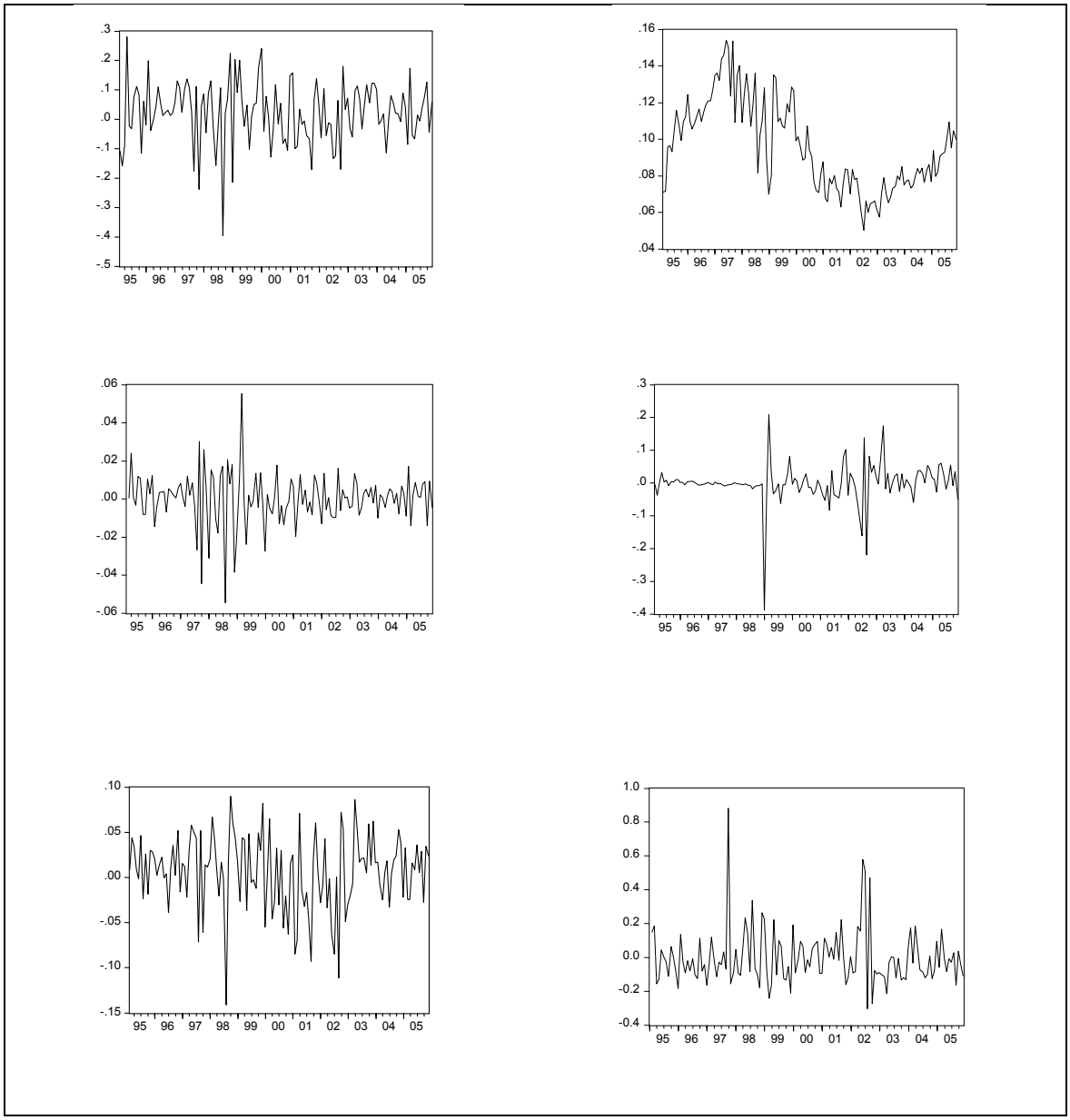

Figure 1. Display of the monthly data for the period 1995 to 2005 of the Brazilian economy: Bovespa returns (top left); foreign presence in the Bovespa market capitalization in levels (top right) and first differences (middle left); exchange rate changes (middle right); MSCI World returns (bottom left); and country risk changes (bottom right).

Table 1. Selected previous literature

Author	Variables	Data set	Frequency	Time period	Results
Froot *et al.* (2001)	Returns; Portfólio investment	44 (developed and emerging) countries	Daily	1994-1998	Inflows stationary; Inflows persistence greater than that of returns; Past returns influence inflows; Return forecastability from past inflows; Positive relationship between past inflows and current returns
Tabak (2003)	Returns; Portfólio investment	Brazil	Daily	1986-1998	Bicausality
Clark and Berko (1997)	Returns; Foreign presence in Stock; Exchange capitalization	Mexico	Monthly	1989-1996	Foreign presence surprises affect returns favorably
Henry (2000)	Returns; Capital markets liberalization	12 emerging countries	Monthly	Distinct	Liberalization causes abnormal monthly returns (3.3%) eight months later
Errunza (2001)	Portfolio investment; GDP growth; Market capitalization/GDP; Trade volume/GDP; Market turnover; Number of companies involved in transactions	31 emerging countries	Monthly Annual	Distinct	Portfolio investment liberalization helps develop capital markets, boosts efficiency, and reduces capital costs
Bekaert *et al.* (2005)	Portfolio investment; Per capita GDP; Government expenditure/GDP; Literacy; Population growth; Life expectancy; World interest rate; Trade flows/GDP; Inflation; Black market premium; Fiscal deficit; Private credit/GDP; Legal system; Corruption; Bureaucracy; Creditor rights; Accounting standards	95 countries	Annual	Distinct	Liberalization raises economic growth (1%)

Table 2. Descriptive statistics

	Foreign presence in Bovespa (first differences)	Bovespa returns (buy and hold strategy)	Ptax exchange rate changes	MSCI World returns	Country risk changes (EMBI+BR)
Average	0.000223	0.020863	–0.005917	0.006294	0.005275
Median	0.000954	0.024386	–0.005936	0.012111	–0.029703
Maximum	0.055212	0.280238	0.199071	0.089822	1.337171
Minimum	–0.054514	–0.395536	–0.390530	–0.141503	–0.303716
Standard deviation	0.013590	0.103621	0.057381	0.041209	0.198070
Skewness	–0.485625	–0.547109	–2.236599	–0.692655	3.360039
Kurtosis	6.912094	4.313365	20.24712	3.778578	20.21293
Jarque-Bera	88.00894	15.95055	1732.872	13.78375	1863.717
p-value (Jarque-Bera)	0.000000	0.000344	0.000000	0.001016	0.000000
Sum	0.028951	2.733057	–0.775100	0.824501	0.690974
Sum of the squared deviations	0.023824	1.395856	0.428039	0.220763	5.100138
Number of observations	130	131	131	131	131

Table 3. Unit root tests

Variable	Bandwidth	Exogenous variable	Phillips-Perron*	Critical values			*p*-Value**
				1%	5%	10%	
Foreign presence in Bovespa	5	Constant Trend	–4.3369	–4.0301	–3.4447	–3.1472	0.0038
Foreign presence in Bovespa (first differences)	15	None	–18.4195	–2.5828	1.9433	–1.6150	0
Bovespa returns	5	None	–11.6412	–2.5828	1.9433	–1.6150	0
Exchange rate changes	1	None	–11.4392	–2.5828	1.9433	–1.6150	0
MSCI World returns	1	None	–10.7628	–2.5828	1.9433	–1.6150	0
Country risk changes	1	None	–11.6804	–2.5828	1.9433	–1.6150	0

Notes: Number of observations: 130 (and 129 for the first differences)
All variables are *I*(0)
* Bartlett-Kernel spectral estimation and Newey-West bandwidth
** MacKinnon single-tailed value

Table 4. Correlation matrix

	Bovespa returns	Foreign presence	Foreign presence (1st diff.)	Exchange rate changes	Returns of the global stock market index	Country risk changes
Bovespa returns	1					
Foreign presence	0.3524	1				
Foreign presence (1st diff.)	0.7186	0.2738	1			
Exchange rate changes	0.2568	0.1807	0.3660	1		
Returns of the global stock market index	0.6780	0.3471	0.4912	0.3487	1	
Country risk changes	–0.71320	–0.2556	–0.6314	–0.5556	–0.6018	1

Table 5. Estimation of equation (1) by ordinary least squares

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
β_0	–0.121685	0.034654	–3.511453	0.0006
Foreign presence	1.500399	0.350794	4.277153	0.0000
Number of observations	131			
R^2	0.124201			
Schwarz	–1.773504			
Durbin-Watson	1.965635			
RESET(2)	1.339919			0.511729
Jarque-Bera	28.748760			0.000001
ARCH(2)	0.298078			0.861535
Breusch-Godfrey(2)	0.329575			0.848074
White's heteroskedasticity	1.674374			0.432927

Table 6. Lag length selection through Schwarz information criterion

Endogeneous variables: Bovespa returns and foreign presence in Bovespa							
Lag	0	1	2	3	4	5	6
Schwarz	–6.3719	–8.2974*	–8.1823	–8.1514	–8.0363	–8.0438	–7.9184

Note: Number of observations: 123
* chosen lag

Table 7. Granger-causality test

Null hypothesis	*F* Statistic	*p*-Value
Foreign presence in Bovespa does not Granger-cause Bovespa returns	0.18912	0.66439
Bovespa returns do not Granger-cause foreign presence in Bovespa	12.1922	0.00066

Note: Number of observations: 130

Table 8. Estimation of equation (2) by Marquardt maximum likelihood

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
α_0	0.096143	0.011499	8.360645	0.0000
f_{t-1}	1.649702	0.111342	14.81648	0.0000
f_{t-2}	–0.665063	0.109134	–6.094018	0.0000
ε_{t-1}	–1.087106	0.080529	–13.49960	0.0000
ε_{t-3}	0.305664	0.060514	5.051117	0.0000
Variance equation				
ω_0	4.61E-06	5.26E-06	0.875988	0.3810
h_{t-1}	0.303113	0.129939	2.332732	0.0197
$\varepsilon^2_{f,t-1}$	0.696242	0.111403	6.249766	0.0000
R^2	0.768996			
Schwarz	–6.090759			
Durbin-Watson	2.179928			
Jarque-Bera	1.612064			0.446625
ARCH(2)	0.022802			0.988664

Note: Number of observations: 129

Table 9. Weak exogeneity from foreign presence to returns in Bovespa

Redundant variable	*t*-Test*	*F* Statistic*	Log likelihood ratio*
u_t	0.0004	0.315798	0.000151

Note: Number of observations: 129
* *p*-Value

Table 10. Correlation matrix between returns (r) and foreign presence in Bovespa (f)

	r	r_{t-1}	r_{t-2}	f	f_{t-1}	f_{t-2}
r	1.000000	–0.082724	–0.040199	0.338316	–0.068734	–0.032928
f	0.338316	0.136241	0.070248	1.000000	0.841614	0.769451

Table 11. Estimation of a VAR between returns and foreign presence in Bovespa

	r_{t-1}	r_{t-2}	f_{t-1}	f_{t-2}	θ_0/ω_0	R^2	Schwarz
r	–0.04442	–0.05253	–0.45487	0.31152	0.04031	0.01082	–1.55598
	(0.13594)	(0.10176)	(–111.363)	(–109.535)	(0.03960)		
	[–0.32681]	[–0.51621]	[–0.40846]	[0.28440]	[1.01800]		
f	–0.03350	–0.02293	0.80665	0.11205	0.00932	0.74214	–5.78034
	(0.01644)	(0.01231)	(0.13472)	(0.13251)	(0.00479)		
	[–2.03709]	[–1.86324]	[5.98764]	[0.84563]	[1.94628]		

Notes: Values in ( ) are the standard-errors, and in [ ] are the *t*-Statistics
Number of observations: 129

Table 12. Estimation of equation (5) by ordinary least squares

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
β_0	0.016449	0.004851	3.390678	0.0009
Foreign presence (1st diff.)	2.943015	0.462241	6.366837	0.0000
Exchange rate changes	–0.378945	0.098485	–3.847737	0.0002
Return of the global stock market index	0.807297	0.147436	5.475564	0.0000
Country risk changes	–0.245287	0.046168	–5.312913	0.0000
R^2	0.725264			
Schwarz	–2.836371			
Durbin-Watson	1.988413			
RESET(2)	4.904476			0.086101
Jarque-Bera	3.237568			0.198139
ARCH(2)	11.97625			0.002508
Breusch-Godfrey(2)	0.065675			0.967696
White's heteroskedasticity	30.07851			0.000205

Notes: Number of observations: 130

Table 13. Estimation of equation (6) by maximum likelihood (ARCH-BHHH)

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
Foreign presence (1st diff.)	2.889578	0.413663	6.985343	0.0000
Exchange rate changes	–0.273597	0.095492	–2.865127	0.0042
Global stock market index	0.861440	0.145322	5.927805	0.0000
Country risk changes	–0.207945	0.048512	–4.286452	0.0000
h_t	6.181726	1.632346	3.787020	0.0002
Variance equation				
α_0	0.001840	0.000314	5.862184	0.0000
h_{t-1}	0.340851	0.132800	2.566648	0.0103
R^2	0.733667			
Schwarz	–2.857875			
Durbin-Watson	2.035821			
Jarque-Bera	2.114236			0.347456
ARCH(2)	0.213532			0.898736

Notes: Starting values: $C(1) = 0$, $C(2) = 0$, $C(3) = 0$, $C(4) = 0$, $C(5) = 0$, $C(6) = 0.00186$, $C(7) = 0.17143$
Bollerslev-Wooldridge's standard-error and robust covariance
Number of observations: 130

Table 14. Lag length selection by Schwarz information criterion

Lag length	Foreign presence (1st diff.)	Exchange rate changes	Global stock market index	Country risk changes	All endogenous variables
0	–8.128464	–4.522096*	–5.873698*	–3.169981*	–17.04118*
1	–8.224214*	–4.431050	–5.725396	–3.016749	–16.75142
2	–8.203568	–4.276428	–5.573509	–2.867777	–16.34725
3	–8.134684	–4.130390	–5.453193	–2.712149	–15.69035
4	–8.071936	–3.984175	–5.320496	–2.575290	–14.99361
5	–7.996232	–3.909132	–5.257504	–2.461167	–14.32471
6	–7.847238	–3.787295	–5.130061	–2.315573	–13.54278

Note: Number of observations: 118 (foreign presence), and 119 (others)
* chosen lag length

Table 15. Granger-causality tests

Null hypothesis	*F* Statistic	*p*-Value
Foreign presence (1st diff.) does not Granger-cause the Bovespa returns	0.00424	0.94818
The Bovespa returns do not Granger-cause foreign presence (1st diff.)	9.47024	0.00256
Exchange rate changes do not Granger-cause the Bovespa returns	0.54571	0.46144
The Bovespa returns do not Granger-cause exchange rate changes	7.33601	0.00769
The global stock market index does not Granger-cause the Bovespa returns	0.73180	0.39391
The Bovespa returns do not Granger-cause the global stock market index	0.09741	0.75548
Country risk changes do not Granger-cause the Bovespa returns	0 .58171	0.44706
The Bovespa returns do not Granger-cause country risk changes	0 .34027	0.56071

Table 16. Estimation of equation (7) by maximum likelihood (BHHH)

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
Country risk changes	–0.021763	0.004189	–5.194849	0.0000
$\varepsilon^2_{f_{-1},t}$	–0.617220	0.056118	–10.99866	0.0000
Variance equation				
α_0	3.36E-06	3.03E-06	1.108371	0.2677
h_{t-1}	0.231192	0.099818	2.316142	0.0206
$\varepsilon^2_{f_{-1},t}$	0.743572	0.085947	8.651544	0.0000
R^2	0.392164			
Schwarz	–6.388078			
Durbin-Watson	1.730512			
Jarque-Bera	2.246325			0.325250
ARCH(2)	0.151927			0.926850

Note: Number of ofservations: 130

Table 17. Estimation of equation (8) by ordinary least squares

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
Country risk changes	–0.334216	0.029463	–11.34377	0.0000
$d \times b$	0.319198	0.045246	7.054708	0.0000
R^2	0.499571			
Schwarz	–3.471620			
Durbin-Watson	1.979765			
RESET(2)	1.617165			0.445489
Jarque-Bera	3314.713			0
ARCH(2)	2.468870			0.290999
Breusch-Godfrey(2)	0.626252			0.731158
White's heteroskedasticity	4.150835			0.385977

Note: Number of observations: 130

Table 18. Estimation of equation (9) by (Marquardt) maximum likelihood

Variable	Coefficient	Standard error	*t*-Statisitc	*p*-Value
Country risk changes	–0.161921	0.013752	–11.77430	0.0000
Global stock market index ($t-1$)	–0.652043	0.179971	–3.623052	0.0003
$\varepsilon_{g,t-15}$	0.819026	0.128412	6.378115	0.0000
Variance equation				
α_0	0.000137	0.000223	0.615315	0.5383
h_{t-1}	0.141073	0.130481	1.081173	0.2796
$\varepsilon^2_{g,t}$	0.726690	0.294100	2.470898	0.0135
R^2	0.388783			
Schwarz	–3.840085			
Durbin-Watson	1.730512			
Jarque-Bera	4.233525			0.120421
ARCH(2)	4.490237			0.105915

Note: Number of observations: 130

Table 19. Estimation of equation (10) by ordinary least squares

Variable	Coefficient	Standard error	*t*-Statistic	*p*-Value
Coutry risk changes ($t-12$)	0.729967	0.066063	11.04962	0.0000
$\varepsilon_{b,t-12}$	–0.931558	0.027374	–34.03130	0.0000
R^2	0.120980			
Schwarz	–0.804831			
Durbin-Watson	1.961206			
RESET(1)	2.039921			0.153218
Jarque-Bera	177.1085			0
ARCH(2)	2.868164			0.238334
Breusch-Godfrey(2)	0.678860			0.712176

Note: Number of observations: 119

Table 20. Weak exogeneity test

Redundant variable	*t*-Test*	*F* Statistic*	Log likelihood ratio*
$\varepsilon_{f_{-1},t}$	0.8486	0.852829	0.850643
$\varepsilon_{e,t}$	0.5399	0.548665	0.542672
$\varepsilon_{g,t}$	0.4756	0.478489	0.471901

Notes: Number of observations: 119
* *p*-Value

Table 21. Weak exogeneity test

Variables	*t*-Test*	*F* Statistic*	Log likelihood ratio*
Foreign presence (1st diff.)	0.9363	1	0.935102
Exchange rate changes	0.2645	0.264458	0.257954
Global stock market index	0.9866	0.986561	0.986228
Country risk changes	0.5447	0.555521	0.549594

Notes: Number of observations: 130 (119 for country risk changes)
* *p*-Value

Table 22. Strong exogeneity test from the Bovespa returns

Variables	Weak exogeneity	Granger causality	Strong exogeneity
Foreign presence (1st diff.)	Yes	Yes	No
Exchange rate changes	Yes	Yes	No
Global stock market index	Yes	No	Yes
Country risk changes	Yes	No	Yes