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On the Normality of Stock Return Distributions: Latin American Markets, 2000-2007*

by

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Abstract

An increasing amount of empirical research conducted at different times and in different geographical settings challenges the traditional assumption of the normal distribution of stock returns evident in the main body of financial theory. This article involved testing the normality assumption for the behavior of market returns in the main Latin American stock markets. Normality tests were applied to daily market returns for the period 2000 to 2007 for the main security markets of Peru, Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela. The normality hypothesis is rejected for all these markets. The article also involved testing the normality assumption for market returns over longer periods, considering specifically blocks of 5, 20, 60, and 120 consecutive market days between 2000 and 2007. In general, the behavior of the returns approaches a normal distribution as the length of time increases.

Keywords: distribution of market returns, nonnormality, Latin American stock markets.

On the Normality of Stock Return Distributions: Latin American Markets, 2000-2007

The assumption of a normal distribution for the behavior of stock market returns is commonplace in the theory of finance, financial models, and security valuation methodologies. A normal distribution is a two-parameter distribution that consists of the expected value and its variance; thus, the distribution is completely determined by its first two moments. The first moment, the expected value of the return, relates to the return of the security, and the square root of the second central moment, the standard deviation, relates to the risk for the security.

The two moments are evident in the mean-variance model of Markowitz (1976) and the valuation of options described by Black and Scholes (1973). The literature survey on option pricing by Broadie and Detemple (2004) contains further reference to the two moments of a normal distribution. However, after the research efforts of Mandelbrot (1963) and Fama (1965), a mounting quantity of empirical evidence exists against the normality assumption.

If the normality assumption is wrong, many of the models and methodologies applied in the valuation of securities could misestimate the appropriate price of those securities. Misestimating is especially relevant if the appropriate distributions involve three or more parameters. In such cases, the association of the standard deviation with a measure of risk could be misleading.

In terms of the normality assumption, the association of risk with the standard deviation of the distribution implies that consideration of risk is related to return deviations from the mean. For a nonnormal fat-tail distribution, however, risk could relate to the possibility of extreme events. Investors may be perfectly comfortable with return behavior that fluctuates relatively close to its mean value and only become worried when extreme negative values occur. If the normality assumption is incorrect, considering only the standard deviation as a measure of risk is not appropriate.

Given the importance of a better knowledge of the distribution of stock market returns, many researchers have directed their attention to exploring the normal distribution assumption with respect to stock markets after the turn of the century (Aggarwal, Inclan, & Leal, 2001; Ané & Labidi, 2001, 2004; Aparicio & Estrada, 2001; Arbeláez, Urrutia, & Abbas, 2001; Balaban, Ouenniche, & Politou, 2005; Blenman, Chatterjee, & Ayadi, 2005; Chen, Gupta, & Troskie, 2003; Harris & Kucukozmen, 2001; Malevergne, Pisarenko, & Sornette, 2005; Ortiz & Arjona, 2001; Tolikas & Brown, 2006; Wilkens, 2005).

The central limit theorem is the basis of the normality assumption for stock behavior. Many transactions occur on a given day for a specific stock. If price variations between transactions belong to independent identical distributions, a basis exists for the hypothesis of a normal distribution for the daily returns in terms of the central limit theorem. However, to apply the central limit theorem, one must consider additional elements.

The assumption of normality holds that information arrives uniformly at the market and that the investors react uniformly to the arrival of the information (Aparicio & Estrada, 2001). Whether the two conditions are true is questionable. For a normal distribution, the independent identical distribution generating the price changes in the stock must be of finite variance. Where the latter is not true, a normal distribution cannot be established or assumed.

This article involved testing the normality assumption for daily stock market returns of six Latin American stock markets for the period 2000 to 2007. The research included applying several normality tests. For all of the tests, the normality assumption was rejected for all of the markets considered at demanding levels of statistical significance.

Section 2 includes a presentation of the data used and the preliminary findings against which the normality assumption was tested. Section 3 contains the results of applying the normality tests of Shapiro-Wilk, Jarque-Bera, Pearson chi-square, Shapiro-Francia, and Kolmogorov-Smirnov to the empirical data and an analysis of the findings. A discussion of the discrepancies between the empirical data and adjusted normal distributions appears in Section 4. Section 5 includes a report of the findings for market returns for longer periods, specifically time blocks of 5, 20, 60, and 120 consecutive market days. Summarized in Section 6 are the main conclusions of the article. Appendix A and B graphically illustrate the data analyzed.

Data

Measuring daily market returns involves considering the daily variations of the stock market indices. Specifically, the following market indices were considered: Indice del Mercado de Valores de Argentina (IMERVAL), Argentina; Indice de la Bolsa de Valores de Sao Paulo (IBOVESPA), Brazil; Indice General de Precios de Acciones (IGPA), Chile; Indice General de la Bolsa Colombiana (IGBC), Colombia; Indice de Precios y Cotizaciones (IPC), Mexico; Indice General de la Bolsa de Valores de Lima (IGBVL), Peru; and Indice Bursatil de Caracas (IBC), Venezuela. These markets will hereafter be referred to by their respective countries: IMERVAL is Argentina (ARG), IBOVESPA is Brazil (BRA), IGPA is Chile (CHI), IGBC is Colombia (COL), IPC is Mexico (MEX), IGBVL is Peru (PER), and IBC is Venezuela (VEN).

Table 1 presents a summary of macroeconomic data for the countries considered, including the gross domestic product (GDP) in 2007, rate of growth of the GDP, and the inflation rate in the period under study. The data show the size and performance of the economies for the period 2000 to 2007. In addition, the table indicates the total amount traded in stocks in 2007 for each market and the yearly average of traded amount of stocks for the period considered.

All the countries considered in the study are emerging economies; nevertheless, as evident in Table 1, the countries showed great diversity in the size of their economies. With respect to the GDP of 2007, the smallest economy was Peru with a GDP of \$102 billion, and the biggest economy was Brazil with a GDP of \$1,295 billion, a ratio of 1 to 12.7. For the period under study, all the countries experienced growth, with average yearly rates varying from 2.9% for Mexico to 4.8% for Peru. Except for Venezuela, all the countries experienced relatively low levels of inflation. The last two columns show the size of the countries' stock markets, all of which are small markets. The biggest market was Brazil with a total traded amount of \$608 billion, and the smallest market was Venezuela with \$1.1 billion of total transactions in 2007.

The time-series returns were defined as $R_t = (\ln(I_t) - \ln(I_{t-1}))$, where R_t is the return on day t; $\ln(I_t)$ is the natural logarithm of I_t; and I_t is the stock market index at the end

Table 1
Figures for the Period 2000-2007

Market	GDP[a] 2007 (billion $)	Real growth of GDP 2000-07 (yearly average rate)	Inflation[b] 2000- 07 (yearly average rate)	Total traded amount of stocks in 2007 (million $)	Yearly average of traded amount of stocks[c] 2000-07 (million $)
ARG	248	3.1%	9.2%	7,372	5,874
BRA	1,295	3.3%	7.0%	608,432	174,931
CHI	161	4.5%	3.4%	49,900	16,939
COL	172	4.1%	6.3%	16,857	5,446
MEX	886	2.9%	4.9%	123,914	59,641
PER	102	4.8%	2.2%	11,247	3,311
VEN	227	4.3%	19.5%	1,106	1,167

Note. [a]From International Monetary Fund. Retrieved March 3, 2008, from http://www.imf.org/external/index.htm. [b]From Instituto Nacional de Estadistica y Censos de Argentina and Instituto de Pesquisa Economica Aplicada de Brazil. Retrieved March 6, 2008, from http://www.indec.gov.ar/ and http://www.ipeadata.gov.br. From Bancos Centrales de Chile, Colombia, Mexico, Peru, and Venezuela. Retrieved March 4, 2008, from http://www.bcentral.cl, http://www.banrep.gov.co, www.banxico.org.mx, http://estadisticas.bcrp.gob.pe, and http://www.bcv.org.ve. [c]From Federacion Iberoamericana de Bolsas. Retrieved March 6, 2008, from http://www.fiabnet.org/es/index.asp.g

of day t. Thus, R_t corresponds to a continuously compounded rate. The sample period consisted of all the daily returns generated by the stock markets from January 1, 2000, to December 31, 2007. Each country's stock market website provided the data.

Appendix A (see Figures A1-A14) illustrates the behavior of each stock market index and its respective return. The behavior over time of the returns is given in terms of standardized returns, in other words, in terms of units of standard deviations with respect to the mean. The figures show some variations in the size of the return fluctuations, especially for Argentina. The variations signal possible heteroscedasticity. In the case of the statistics for Argentina, the heteroscedasticity is clear: High variations in the period from the last semester of 2001 to the first semester of 2002 were apparent and may be due to the economic crisis experienced by Argentina.

Table 2 provides a summary of the empirical distributions of the stock market returns considered. The statistics include the mean (M), the standard deviation (SD), the minimum and the maximum values, and the coefficients of skewness and kurtosis. With the exception of Argentina, all markets exhibited negative coefficients of skewness, signaling the possibility of left asymmetric distributions and a mean value lower than the mode and the median. The lowest coefficient of skewness corresponded to the stock market of Venezuela. Negative skewness means a higher probability of extreme negative returns relative to

Table 2
Sample Moments of the Distributions of Daily Returns

Market[a]	*M*	*SD*	Min return	Max return	Skewness	Kurtosis
ARG	0.000689	0.021548	-0.112907	0.161165	0.183990	4.970798
BRA	0.000665	0.018219	-0.096286	0.073356	-0.254298	0.943668
CHI	0.000503	0.006120	-0.038535	0.027785	-0.396688	3.225253
COL	0.001157	0.013888	-0.110519	0.146880	-0.051487	14.830800
MEX	0.000706	0.013974	-0.082673	0.070199	-0.116522	2.806384
PER	0.001131	0.011340	-0.078929	0.082050	-0.329385	6.379885
VEN	0.001020	0.016077	-0.206580	0.131632	-0.560760	24.30553

Note. Skewness refers to a standardized third central sample moment, and kurtosis refers to a standardized fourth central sample moment.

[a]Daily observations obtained from Bolsa de Valores de Argentina (http://www.merval.sba.com), Brazil (http://www.bovespa.com), Chile (http://www.bolsadesantiago.com), Colombia (http://www.bvc.com), Mexico (http://www.bmv.com), Peru (http://www.bvl.com), and Venezuela (http://www.bolsadecaracas.com).

Table 3
Standardized Skewness and Kurtosis

Market	*N*	Skewness	Standardized skewness	Kurtosis	Standardized kurtosis
ARG	1,978	0.183990	3.340665	4.970798	45.126711
BRA	1,982	-0.254298	-4.621894	0.943668	8.575615
CHI	1,992	-0.396688	-7.227994	3.225253	29.383449
COL	1,944	-0.051487	-0.926767	14.830800	133.477202
MEX	2,013	-0.116522	-2.134294	2.806384	25.701793
PER	1,995	-0.329385	-6.006197	6.379885	58.167274
VEN	1,908	-0.560760	-9.999787	24.305530	216.714840

Note. Standardized skewness is computed based on zero mean and variance of $6/N$; standardized kurtosis is computed based on zero mean and variance of $24/N$.

extreme positive returns, which is in contrast to the prediction of symmetric distributions such as the normal distribution that shows equal probabilities for extreme cases. The asymmetrical behavior evident for returns implies serious shortcomings when considering the standard deviation as the sole measure of risk.

Table 2 shows that for all the markets, values for kurtosis were well above zero, pointing toward a nonnormal distribution. The lowest kurtosis corresponded to Brazil and the highest to Venezuela. The values for kurtosis relate to leptokurtic distributions, which exhibit fat tails and high peaks with respect to normal distributions. When considering a possible nonnormal distribution characterized by negative asymmetry and fat tails, a situation of higher probabilities for extreme negative returns emerges than would in the case of a normal distribution. Leptokurtic distributions severely restrict the appropriateness of using the standard deviation of a distribution as the sole means of identification of risk.

For a normal distribution, the coefficients of skewness and kurtosis are asymptotically normally distributed with an expected value of zero and a variance of $6/N$ and $24/N$ respectively, where N is the sample size. Values for the standardized coefficients outside the range of -1.96 and 1.96 would signal a departure from a normal distribution at the $p < .05$ significance level. Table 3 indicates the standardized values for skewness and kurtosis.

All the markets but Colombia reflected levels of skewness significantly different from zero, and only Argentina showed a positive skewness. With respect to kurtosis, all the markets demonstrated leptokurtic distributions. The histograms in Appendix B (see Figures B1-B7) illustrate the results along with the normal standardized distributions corresponding to the samples' means and variances. The following section involves a discussion of the rejection of the normality assumption using the five statistical tests mentioned previously.

Normality Tests

The following tests of normality were applied to the time-series data: Shapiro-Wilk, Jarque-Bera, Pearson

Table 4
Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
Market	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
ARG	0.9416	0.0000	2,035	0.0000	228	0.0000	0.9402	0.0000	0.0722	0.0000
BRA	0.9927	0.0000	94	0.0000	56	0.0410	0.9921	0.0000	0.0282	0.0009
CHI	0.9697	0.0000	910	0.0000	86	0.0000	0.9687	0.0000	0.0388	0.0000
COL	0.8701	0.0000	17,719	0.0000	340	0.0000	0.8673	0.0000	0.0964	0.0000
MEX	0.9680	0.0000	660	0.0000	146	0.0000	0.9671	0.0000	0.0522	0.0000
PER	0.9283	0.0000	3,395	0.0000	271	0.0000	0.9266	0.0000	0.0803	0.0000
VEN	0.8249	0.0000	46,808	0.0000	447	0.0000	0.8215	0.0000	0.1077	0.0000

Note. Statistics estimated from stock market returns.

chi-square, Shapiro-Francia, and Kolmogorov-Smirnov. Table 4 shows the results.

Evident in Table 4, the hypothesis of normality was rejected at the $p < .05$ significance level for all the markets for all the tests performed. Furthermore, with the exception of Brazil, the rejection of the normality assumption was apparent at a $p < .01$ significance level. For all the tests conducted, p values were zero up to the fourth decimal place for all the markets except Brazil. Brazil showed a p value of 0.0410 for the Pearson chi-square test; thus, the null hypothesis of normality could be rejected at a $p < .05$ significance level but not at a $p < .01$ significance level.

Discrepancies between Empirical Data and Adjusted Normal Distributions

The previous section indicated significant departures from the norm expected for stock returns. This section involves estimating the size of the errors when assuming a normal distribution for the returns of the stock markets under study. For this purpose, for each market, the empirical distribution was compared with a normal distribution, with both distributions obtained from the empirical data. The normal distributions were generated by adjusting the first two central moments to the sample estimates in accordance with the empirical data.

Table 5 shows the probability discrepancies between an adjusted normal distribution of returns and the empirical distribution for different return intervals. Definition of the return intervals involved considering the length of one unit standard deviation. The first column in the table presents the return intervals considered, the second column shows the theoretical probability of occurrence for a normal distribution, and the remaining columns illustrate the empirical probability of the occurrence based on the relative frequency in the empirical data.

Comments will be restricted to intervals corresponding to returns lower than the sample mean in the first half of Table 5. Barring aspects related to features of asymmetry, the same comments could apply to intervals of returns higher than the sample mean. The comparison between the theoretical and empirical probabilities clearly showed a leptokurtic empirical distribution.

Thus, the theoretical probability corresponding to the interval between the sample mean and 1 standard deviation below was lower than the corresponding empirical probabilities for each country. Empirical distributions suggest higher frequencies of occurrence of events near the sample mean than does normal distribution, signaling a peaked distribution relative to the Gaussian curve. In the adjacent interval, or returns 1 and 2 standard deviations below the sample mean, the inverse was apparent: A higher normal theoretical probability relative to each empirical probability for each country was apparent. The following adjacent interval, or returns 2 to 3 standard deviations below the sample mean, illustrated a normal theoretical probability higher than the empirical probabilities for Argentina, Chile, Colombia, Peru, and Venezuela and lower than the empirical probabilities for Brazil and Mexico. For the next adjacent interval, or returns falling 3 and 4 standard deviations below the sample mean, except for Venezuela, all countries reflected higher empirical probabilities than those predicted by a normal distribution. In the two extreme intervals, shown in the table, which corresponded to returns between 4 and 5 and between 5 and 6 standard deviations below the sample mean, all the coun-

Table 5
Probability Discrepancies Between Adjusted Normal Distribution and Empirical Distribution

Stock return interval	Normal theoretical probability	ARG	BRA	CHI	COL	MEX	PER	VEN
[R^e - 5S, R^e – 6S]	0.00000	0.00051	0.00050	0.00100	0.00154	0.00050	0.00050	0.00105
[R^e - 4S, R^e – 5S]	0.00003	0.00253	0.00050	0.00050	0.00103	0.00149	0.00201	0.00262
[R^e - 3S, R^e – 4S]	0.00131	0.00657	0.00303	0.00703	0.00566	0.00447	0.00602	0.00105
[R^e - 2S, R^e – 3S]	0.02136	0.01820	0.02472	0.01657	0.01646	0.02235	0.01855	0.01101
[R^e - S, R^e - 2S]	0.13585	0.08544	0.11504	0.10643	0.06533	0.09836	0.06667	0.06027
[R^e, R^e – S]	0.34144	0.38170	0.34309	0.36245	0.40226	0.35221	0.42155	0.44759
[R^e, R^e + S]	0.34144	0.39687	0.36478	0.37550	0.40278	0.40537	0.37694	0.39465
[R^e + S, R^e + 2S]	0.13585	0.07988	0.12866	0.10793	0.08693	0.09041	0.07920	0.05346
[R^e+ 2S, R^e + 3S]	0.02136	0.02073	0.01816	0.01857	0.01029	0.01639	0.01955	0.01625
[R^e+ 3S, R^e + 4S]	0.00131	0.00506	0.00151	0.00201	0.00257	0.00596	0.00602	0.00629
[R^e+ 4S, R^e + 5S]	0.00003	0.00101	0.00000	0.00151	0.00103	0.00248	0.00100	0.00157
[R^e+ 5S, R^e + 6S]	0.00000	0.00101	0.00000	0.00000	0.00154	0.00000	0.00000	0.00105

Note. R^e refers to the sample mean, and S refers to the sample's standard deviation of the corresponding daily market return.

Table 6
Outliers

Market	< -3S		< -4S		< -5S		< -6S	
	Expected no. cases for normal distribution	No. cases in empirical data	Expected no. cases for normal distribution	No. cases in empirical data	Expected no. cases for normal distribution	No. cases in empirical data	Expected no. cases for normal distribution	No. cases in empirical data
				Negative outliers				
ARG	2.6703	19	0.0791	6	0.0198	1	0.0192	0
BRA	2.6757	8	0.0793	2	0.0198	1	0.0193	0
CHI	2.6892	18	0.0797	4	0.0199	3	0.0194	1
COL	2.6244	19	0.0778	8	0.0194	6	0.0189	3
MEX	2.7175	13	0.0805	4	0.0201	1	0.0196	0
PER	2.6932	20	0.0798	8	0.0199	4	0.0194	3
VEN	2.5758	11	0.0763	9	0.0191	4	0.0185	2
				Positive outliers				
ARG	2.6703	15	0.0791	5	0.0198	3	0.0192	1
BRA	2.6757	3	0.0793	0	0.0198	0	0.0193	0
CHI	2.6892	7	0.0797	3	0.0199	0	0.0194	0
COL	2.6244	12	0.0778	7	0.0194	5	0.0189	2
MEX	2.7175	17	0.0805	5	0.0201	0	0.0196	0
PER	2.6932	15	0.0798	3	0.0199	1	0.0194	1
VEN	2.5758	21	0.0763	9	0.0191	6	0.0185	4

tries showed much higher empirical probabilities than the prediction of the normal distribution.

Empirical distributions presented fatter left tails than did the normal distribution. Bearing in mind that similar comments can apply to returns to the right of the sample mean, it can be appreciated that empirical distributions for all countries considered were peaked distributions with fatter tails relative to the Gaussian distribution. Thus, leptokurtic distributions seem more appropriate to describe the data for each country.

Comparing the number of outliers predicted for a normal distribution and the actual number of occurrences in the empirical data of each country allowed for a better appreciation of the situation. Table 6 illustrates the number of extreme returns in the empirical data in comparison to the expectations of the corresponding theoretical normal distribution. Extreme values of occurrence were calculated for both positive and negative returns. The first half of the table indicates the situation for negative extreme values and the second half for positive extreme values.

Except for asymmetry features, the behavior of both tails of the distribution was similar. Discussion will be restricted to the left tail. As evident in Table 6, for returns 3, 4, and 5 standard deviations below the mean, the number of empirical data returns was much higher than the number expected for a normal distribution. For instance, Peru reflected 20 cases of returns 3 standard deviations below the mean, whereas the expectation of the normal distribution was 2.6932 cases, a difference of 643%.

For returns 6 standard deviations below the mean, 3 countries showed no occurrences of returns. Actual occurrences can only be in integers, in contrast to theoretically expected cases. Thus, given the small size of the sample and the low probability of occurrences of returns, for the interval considered, determining whether the expected number of cases of the empirical distribution is lower or higher than the number expected in a normal distribution was not possible. However, the pattern exhibited suggests similar behavior for the interval when compared to the former extreme intervals.

Therefore, investors who make investment decisions based on a normal distribution could be underestimating severely the probability of extreme adverse returns. Were investors' risk aversion more related to the possibility of extreme negative returns than frequent moderate negative returns, the assumption of a normal distribution could lead to bad investment decisions for the return-risk preferences of investors.

Normality over Time

This section involves examining whether longer return periods approach a normal distribution. The study involved considering periods of 5, 20, 60, and 120 block

Table 7

Sample Moments of the Distributions of Returns for Argentina

	K = 1	K = 5	K = 20	K = 60	K = 120
N	1,978	395	98	32	16
M return	0.0006892	0.0034436	0.0141703	0.0440582	0.0881164
SD of returns	0.0215476	0.0495564	0.1133183	0.1970460	0.2811204
Min return	-0.1129074	-0.2138530	-0.3678334	-0.4055984	-0.6752064
Max return	0.1611652	0.2297794	0.5934334	0.5757295	0.3976514
Skewness	0.1839905	-0.0877070	0.4940497	0.1227302	-1.3036006
Standardized skewness	3.3406648	-0.7116352	1.9966781	0.2834332	-2.1287708
Kurtosis	4.9707985	2.6717777	7.9733762	0.9162758	2.3497764
Standardized kurtosis	45.126711	10.8391008	16.1120082	1.0580242	1.9185844

Note. Statistics estimated from stock market returns.

days. Calculation of returns occurred as follows: $RK_t = Ln(I_t) - Ln(I_{t-k})$. In the equation, RK_t is the market return for period t, corresponding to a period of K block days, with K = 1, 5, 20, 60, and 120 block days. $Ln(I_t)$ is the natural logarithm of a corresponding market index for day t, and t = K+1, 2K+1, 3K+1, and so on, with k = K, K+1, K+2, and so forth.

The tables that follow indicate the results for the possible conformity to a normal distribution for market returns as block days increase, with two tables appearing for each country. The first table for each country provides estimations of sample moments of the distributions for K = 1, 5, 20, 60, and 120. More specifically, the tables illustrate data related to sample size, mean return, standard deviation, minimum and maximum returns, skewness, standardized skewness, kurtosis, and standardized kurtosis. Section 2 included definitions of the last four statistics. The second table for each country shows the results of the normality tests applied to the different time series of returns. More specifically, the tables present the statistics and the *p* values corresponding to the following normality tests: Shapiro-Wilk, Jarque-Bera, Pearson chi-square, Shapiro-Francia, and Kolmogorov-Smirnov.

The first tables for each country allow for the analysis of symmetry and kurtosis for the empirical distributions relative to a normal distribution. Asymptotically, a normal distribution implies that the coefficients of skewness and kurtosis will follow a normal distribution with expected values of zero and variances of $6/N$ and $24/N$ respectively, where N is the sample size. Thus, if the coefficients of standardized skewness and standardized kurtosis are outside of the interval of -1.96 and 1.96, one may question the normality assumption. The second tables for each country illustrate formal tests with respect to the normality assumption. Conclusions were drawn based on a $p < .05$ significance level.

Argentina

With respect to skewness, Table 7 shows departures from a normal distribution for 1, 20, and 120 market days. Similar conclusions cannot be reached for 5 and 60 market days. In addition, the coefficients of standardized skewness exhibited positive and negative signs for different time blocks. Thus, for Argentina, no assertion can be made with respect to a convergence toward a symmetrical empirical distribution as block days increase.

Table 8

Argentina: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
1	0.9416	0.0000	2,035.00	0.0000	227.79	0.0000	0.9402	0.0000	0.0722	0.0000
5	0.9662	0.0000	113.73	0.0000	28.90	0.0675	0.9626	0.0000	0.0661	0.0003
20	0.8712	0.0000	234.27	0.0000	21.39	0.0186	0.8552	0.0000	0.1115	0.0044
60	0.9771	0.7121	0.55	0.7600	4.50	0.4799	0.9684	0.3860	0.1035	0.5168
120	0.8839	0.0447	4.87	0.0876	5.00	0.2873	0.8781	0.0366	0.1354	0.6025

Note. Statistics estimated from stock market returns.

Table 9
Sample Moments of the Distributions of Returns for Brazil

	K = 1	K = 5	K = 20	K = 60	K = 120
N	1,982	396	99	33	16
M return	0.0006652	0.0033454	0.0133815	0.0401444	0.0772821
SD of returns	0.0182195	0.0409020	0.0810222	0.1188910	0.1639827
Min return	-0.0962865	-0.1381972	-0.1867589	-0.2561701	-0.1674060
Max return	0.0733561	0.1348822	0.2229557	0.2625434	0.3369533
Skewness	-0.2542985	-0.1454410	-0.3646627	-0.3306758	-0.0336668
Standardized skewness	-4.6218943	-1.1815680	-1.4812667	-0.7755035	-0.0549776
Kurtosis	0.9436676	0.6154016	0.0655374	0.1215786	-1.5151553
Standardized kurtosis	8.5756148	2.4997733	0.1331071	0.1425636	-1.2371191

Note. Statistics estimated from stock market returns.

In Table 7, a decreasing standardized kurtosis as the block of time increases is noticeable. The possibility of a kurtosis behavior corresponding to a normal distribution could not be rejected for periods longer than 60 market days. Thus, from the information in Table 7, one can conclude that for Argentina, the longer the time block, the less peaked and less fat tailed the market return distribution. No conclusions could be reached with respect to symmetry.

Table 8 shows that, with the exception of the Pearson chi-square test, all the other tests rejected the normality assumption for periods of 20 or fewer market days. For 60 market days, the normality assumption could not be rejected based on any of the tests. For K = 120, the Shapiro-Wilk test and the Shapiro-Francia test indicated rejection of the normality assumption, whereas the Jarque-Bera, the Pearson chi-square, and the Kolmogorov-Smirnov tests did not permit rejection of the normality assumption. In general, the empirical data indicate a nonnormal distribution for the short time horizon and a behavior that could be approaching a normal distribution as the time horizon increases.

Brazil

Table 9 illustrates coefficients of standardized skewness. The coefficients indicated the symmetrical behavior of the distribution for all time blocks but that daily returns could not be rejected. With respect to kurtosis, the hypothesis of normality could not be rejected for time blocks of 20 or more market days. The result suggests the possibility of market return distribution approaching a normal distribution as the period increases.

As evident in Table 10, all the tests rejected the normality assumption for K = 1. For K = 5, the tests of Jarque-Bera and Shapiro-Francia led to rejection of the normality assumption. In contrast, the Shapiro-Wilk, the Pearson chi-square, and the Kolmogorov-Smirnov tests did not permit rejection of the normality assumption. For K = 20, 60, and 120, no tests allowed for the rejection of the normality hypothesis, except for the Pearson chi-square test for 120 block days.

Chile

In accordance with the data in Table 11, symmetrical

Table 10
Brazil: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
1	0.9927	0.0000	94.04	0.0000	55.62	0.0410	0.9921	0.0000	0.0282	0.0009
5	0.9932	0.0705	7.18	0.0276	17.00	0.5899	0.9924	0.0420	0.0412	0.1048
20	0.9812	0.1681	2.13	0.3451	9.60	0.4766	0.9818	0.1645	0.0820	0.0971
60	0.9787	0.7461	0.55	0.7579	5.45	0.4870	0.9787	0.6545	0.0910	0.6965
120	0.9185	0.1594	1.37	0.5031	11.13	0.0252	0.9356	0.2544	0.1734	0.2229

Note. Statistics estimated from stock market returns.

Table 11
Sample Moments of the Distributions of Returns for Chile

	K = 1	K = 5	K = 20	K = 60	K = 120
N	1,992	398	99	33	16
M return	0.0005030	0.0025178	0.0103292	0.0309875	0.0634268
SD of returns	0.0061202	0.0173836	0.0386314	0.0598168	0.0970733
Min return	-0.0385347	-0.0599934	-0.1358573	-0.0727310	-0.0648024
Max return	0.0277847	0.0646196	0.0903600	0.1587032	0.2436628
Skewness	-0.3966877	-0.3445022	-0.4742471	0.2925534	0.3678472
Standardized skewness	-7.2279945	-2.8058080	-1.9264008	0.6860985	0.6006919
Kurtosis	3.2252526	1.5865871	1.1014442	-0.5780826	-0.8622138
Standardized kurtosis	29.3834490	6.4610013	2.2370437	-0.6778620	-0.7039946

Note. Statistics estimated from stock market returns.

Table 12
Chile: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
1	0.9697	0.0000	909.70	0.0000	86.37	0.0000	0.9687	0.0000	0.0388	0.0000
5	0.9774	0.0000	47.74	0.0000	31.06	0.0398	0.9760	0.0000	0.0481	0.0276
20	0.9802	0.1421	7.61	0.0222	4.87	0.8998	0.9774	0.0790	0.0555	0.6370
60	0.9751	0.6308	1.05	0.5925	3.27	0.7739	0.9820	0.7599	0.0925	0.6728
120	0.9381	0.3261	0.92	0.6314	6.75	0.1497	0.9530	0.4587	0.1388	0.5625

Note. Statistics estimated from stock market returns.

Table 13
Sample Moments of the Distributions of Returns for Colombia

	K = 1	K = 5	K = 20	K = 60	K = 120
N	1,944	388	97	32	16
M return	0.0011567	0.0057948	0.0231791	0.0723743	0.1447487
SD of returns	0.0138876	0.0364820	0.0846745	0.1320623	0.1896683
Min return	-0.1105192	-0.2988605	-0.2936002	-0.2322182	-0.2704352
Max return	0.1468797	0.1365904	0.2392459	0.3332463	0.5680246
Skewness	-0.0514870	-1.6011630	-0.4344733	0.1401023	-0.0185203
Standardized skewness	-0.9267667	-12.875846	-1.7469211	0.3235524	-0.0302436
Kurtosis	14.8308000	13.869213	1.4635376	-0.0269279	1.4105894
Standardized kurtosis	133.4772024	55.765047	2.9422808	-0.0310937	1.1517414

Note. Statistics estimated from stock market returns.

Table 14
Colombia: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
1	0.8701	0.0000	17,719.27	0.0000	340.15	0.0000	0.8673	0.0000	0.0964	0.0000
5	0.8862	0.0000	3,188.08	0.0000	49.28	0.0002	0.8791	0.0000	0.0868	0.0000
20	0.9813	0.1814	10.09	0.0065	11.69	0.3063	0.9760	0.0681	0.0619	0.4790
60	0.9702	0.5061	0.1509	0.9273	7.00	0.2206	0.9704	0.4344	0.1112	0.4002
120	0.9699	0.8367	0.29	0.8669	3.25	0.5169	0.9510	0.4286	0.1172	0.8055

Note. Statistics estimated from stock market returns.

behavior could not be rejected for time blocks of 20 or more market days. Levels of kurtosis of zero could not be rejected for time blocks greater than 60 market days. The results indicate the possibility of market return behavior approaching a normal distribution as the length of time increases.

Table 12 shows that the normality assumption was rejected for K = 1 and K = 5 for all tests performed. For K = 20, only the Jarque-Bera test permitted rejection of the normality assumption; all the other tests did not reject the normality assumption. For K = 60 and K = 120, no test performed allowed for the rejection of the normality assumption.

Colombia

For periods of 60 market days and longer, Table 13 illustrates levels of coefficients of skewness and kurtosis that could not lead to rejecting the hypothesis of a normal distribution. A possibility exists that as the length of time increases, the distribution of market returns approaches a normal distribution.

As evident in Table 14, all the tests permitted rejection of the normality assumption for K = 1 and K = 5. For K = 20, only the Jarque-Bera test allowed for rejection of the normality assumption; none of the other tests rejected the normality assumption. For K = 60 and K = 120, no test led to rejection of the normality assumption.

Mexico

As apparent in Table 15, for periods of 120 market days, the coefficient of skewness could not lead to a rejection of the normality hypothesis. With respect to kurtosis, for K = 60 and K = 120, a normal distribution cannot be excluded.

Table 15
Sample Moments of the Distributions of Returns for Mexico

	K = 1	K = 5	K = 20	K = 60	K = 120
N	2,013	402	100	33	16
M return	0.0007061	0.0035746	0.0147557	0.0426807	0.0850310
SD of returns	0.0139744	0.0344861	0.0675184	0.1056983	0.1570158
Min return	-0.0826735	-0.1563092	-0.1870277	-0.2364434	-0.1897873
Max return	0.0701992	0.1591427	0.1282246	0.1630990	0.2899391
Skewness	-0.1165220	-0.5229036	-1.2101192	-0.9981216	-0.5494813
Standardized skewness	-2.1342943	-4.2801502	-4.9402909	-2.3408026	-0.8972993
Kurtosis	2.8063844	2.8989659	1.1759190	0.3141320	-1.0994583
Standardized kurtosis	25.7017933	11.8645294	2.40033462	0.3683524	-0.8977040

Note. Statistics estimated from stock market returns.

Table 16
Mexico: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
1	0.9680	0.0000	660.40	0.0000	146.44	0.0000	0.9671	0.0000	0.0522	0.0000
5	0.9583	0.0000	154.06	0.0000	48.27	0.0004	0.9546	0.0000	0.0752	0.0000
20	0.8934	0.0000	28.35	0.0000	38.58	0.0000	0.8945	0.0000	0.1473	0.0000
60	0.8921	0.0033	5.00	0.0822	15.27	0.0182	0.8973	0.0062	0.1606	0.0303
120	0.9034	0.0912	1.52	0.4676	5.00	0.2873	0.9195	0.1450	0.2006	0.0846

Note. Statistics estimated from stock market returns.

Table 17
Sample Moments of the Distributions of Returns for Peru

	K = 1	K = 5	K = 20	K = 60	K = 120
N	1,995	399	99	33	16
M return	0.0011310	0.0056548	0.0234562	0.0703685	0.1454678
SD of returns	0.0113402	0.0329057	0.0767978	0.1371113	0.2173732
Min return	-0.0789286	-0.1573820	-0.1660220	-0.1546970	-0.2226098
Max return	0.0820498	0.1322477	0.3086597	0.3181100	0.5470086
Skewness	-0.3293849	-0.3875031	0.7385187	0.0911673	-0.2074088
Standardized skewness	-6.0061970	-3.1599921	2.9998772	0.2138062	-0.3386972
Kurtosis	6.3798855	4.5076570	2.0287995	-1.0028769	0.0023149
Standardized kurtosis	58.167274	18.3794150	4.1205113	-1.1759774	0.0018901

Note. Statistics estimated from stock market returns.

Table 18
Peru: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*	Statistic	*p*
1	0.9283	0.0000	3,395.04	0.0000	270.71	0.0000	0.9266	0.0000	0.0803	0.0000
5	0.9283	0.0000	337.11	0.0000	66.53	0.0000	0.9246	0.0000	0.0962	0.0000
20	0.9588	0.0035	23.12	0.0000	11.96	0.2878	0.9536	0.0023	0.0741	0.1998
60	0.9653	0.3631	1.51	0.4698	3.27	0.7739	0.9779	0.6282	0.0799	0.8561
120	0.9303	0.2460	0.18	0.9158	5.88	0.2087	0.9333	0.2343	0.1825	0.1650

Note. Statistics estimated from stock market returns.

Table 19
Sample Moments of the Distributions of Returns for Venezuela

	K = 1	K = 5	K = 20	K = 60	K = 120
N	1,908	381	95	31	15
M return	0.0010196	0.0050846	0.0200937	0.0623839	0.1360172
SD of returns	0.0160774	0.0409763	0.0844795	0.1580321	0.2722082
Min return	-0.2065804	-0.2638650	-0.2158451	-0.2427682	-0.4376394
Max return	0.1316321	0.2183877	0.3892106	0.4529515	0.6567241
Skewness	-0.5607602	0.3010843	0.8703767	0.3536995	0.0675908
Standardized skewness	-9.9997870	2.3992474	3.4633264	0.8039696	0.1068704
Kurtosis	24.3055300	7.7321864	3.4951914	0.3932781	0.7954750
Standardized kurtosis	216.7148400	30.8076930	6.9538793	0.4469665	0.6288782

Note. Statistics estimated from stock market returns.

Table 20
Venezuela: Normality Tests

	Shapiro-Wilk		Jarque-Bera		Pearson chi-square		Shapiro-Francia		Kolmogorov-Smirnov	
K	Statistic	*P*	Statistic	*p*	Statistic	*p*	Statistic	*P*	Statistic	*p*
1	0.8249	0.0000	46,807.75	0.0000	447.08	0.0000	0.8215	0.0000	0.1077	0.0000
5	0.9035	0.0000	926.37	0.0000	61.94	0.0000	0.8965	0.0000	0.1016	0.0000
20	0.9458	0.0006	53.46	0.0000	21.73	0.0166	0.9359	0.0003	0.1014	0.0174
60	0.9785	0.7710	0.61	0.7365	3.32	0.6504	0.9768	0.6273	0.1242	0.2577
120	0.9628	0.7409	0.03	0.9855	3.80	0.2839	0.9520	0.4734	0.1179	0.8316

Note. Statistics estimated from stock market returns.

Table 16 shows that the normality assumption was rejected under all the tests performed for K = 1, K = 5, and K = 20. For K = 60, except for the test of Jarque-Bera, all tests permitted rejection of the normality assumption. For K = 120, no test allowed for the rejection of the normality assumption.

Peru

Table 17 illustrates that for periods of 60 and 120 market days, coefficients of skewness and kurtosis could not lead to the rejection of the possibility of a normal distribution.

As evident in Table 18, all tests permitted rejection of the assumption of normality for K = 1 and K = 5. For K = 20, the tests of Shapiro-Wilk, Jarque-Bera, and Shapiro-Francia allowed for the rejection of the normality assumption, whereas the other tests did not. For K = 60 and K = 120, no test led to the rejection of the normality assumption.

Venezuela

For periods of 60 and 120 market days, Table 19 illustrates coefficients of skewness and kurtosis that did not support rejection of the possibility of a normal distribution.

Table 20 indicates that for K = 1, K = 5, and K = 20, all tests permitted rejection of the normality assumption. For K = 60 and K = 120, none of the tests allowed for rejection of the normality assumption.

Summary

In general, for shorter periods, the empirical distributions of all the countries departed from a normal distribution and reflected asymmetric and leptokurtic behavior, a left-tailed distribution peaking around the mean value with fat tails. For intermediate values of K for the countries considered, some tests permitted rejection of the normality assumption, and others did not. For lengthier blocks of time, none of the tests supported rejection of the assumption of normality for any country; neither the hypothesis of symmetry nor null kurtosis was rejected. Thus, for the countries considered, returns distributions are nonnormal over short periods and approach a normal distribution when measured over longer periods.

Conclusions

For the Latin American stock markets of Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela for the period 2000 to 2007, the daily market returns showed important departures from a normal distribution. The empirical data indicated that leptokurtic probability distributions are a better explanation of the behavior of daily market returns for the stock markets over the period under study. Specifically, the best description of the empirical distributions of daily market returns for all the markets would be peaked distributions around the mean with fat tails, which, except for Argentina, reflected an asymmetry that leaned toward the left.

The data for all the markets in the study led to a rejection of the null hypothesis of normal daily market returns for all the tests performed (Shapiro-Wilk, Jarque-Bera, Pearson chi-square, Shapiro-Francia, and Kolmogorov-Smirnov) at the $p < .05$ significance level. Furthermore, with the exception of Brazil, the assumption of normality was rejected at the $p < .01$ significance level.

The findings indicate that the assumption of normal daily market returns could lead to significant underestimations of the probability of extreme returns occurring. If investors' risk aversion were focused particularly on extreme negative returns, decisions based on the assumption of a normal distribution of returns would not produce suitable investment returns for the investors' risk preferences. Moreover, fat-tail distributions could imply serious limitations for using the standard deviation of the distribution to predict the risk associated with returns. From the point of view of asset valuation, the assumption of normality for market returns could produce misestimates of the risk-return relationship and affect the composition of efficient portfolios.

When considering longer periods for the market returns, the empirical distributions reflected a behavior closer to a normal distribution. Thus, the longer the block of days measured for market returns, the closer the empirical distributions of the countries under study approximated a symmetrical and mesokurtic distribution. In general, the conclusion applies to all the markets in the study, although the results present some peculiarities depending on the country considered and the particular test. Results showed differences related to the length of the time for which the assumption of normal distribution could not be rejected. At the $p < .05$ significance level for all the tests performed, except the Pearson chi-square test, the normality hypothesis could not be rejected from 20 market days for Brazil; 60 for Chile, Colombia, Peru, and Venezuela; and 120 for Mexico.

Argentina is a special case. The tests supported rejecting the normality hypothesis for 1, 5, and 20 market days, but for 60 market days, no test indicated rejection of the hypothesis. For the 120 market day block, the Shapiro-Wilk test and the Shapiro-Francia test permitted rejection of the Gaussian hypothesis, but the other tests could not support rejection of the assumption of normality. Whether the different behavior of Argentina is due to the financial crisis experienced by the country between 2001 and 2002 remains an open question beyond the scope of this article.

Further research is required at both the theoretical and empirical levels. At the theoretical level, the reasons behind the nonnormal behavior of market returns distributions for short periods, despite the central limit theorem, require exploration and explanation. At the empirical level, testing theoretical distributions against empirical data, especially in the case of emerging capital markets, is important.

References

Aggarwal, R., Inclan, C., & Leal, R. (2001). Volatility in emerging stock markets [Electronic version]. *Journal of Financial and Quantitative Analysis, 34*, 33-55.

Ané, T., & Labidi, Ch. (2001). Revisiting the finite mixture of Gaussian distributions with application to futures markets [Electronic version]. *The Journal of Futures Markets, 21*, 347-376.

Ané, T., & Labidi, Ch. (2004). Return interval, dependence structure, and multivariate normality [Electronic version]. *Journal of Economics and Finance, 28*, 285-299.

Aparicio, F., & Estrada, J. (2001). Empirical distributions of stock returns: European securities markets, 1990-95 [Electronic version]. *The European Journal of Finance, 7*, 1-21.

Arbeláez, H., Urrutia, J., & Abbas, N. (2001). Short-term and long-term linkages among the Colombian capital market indexes [Electronic version]. *International Review of Financial Analysis, 10*, 237-273.

Balaban, E., Ouenniche, J., & Politou, D. (2005). A note on return distribution of UK stock indices [Electronic version]. *Applied Economics Letters, 12*, 573-576.

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities [Electronic version]. *Journal of Political Economy, 81,* 637-659.

Blenman, L., Chatterjee, A., & Ayadi, O. (2005). Volatility persistence, market anomalies and risk in Latin American equity markets [Electronic version]. *The International Journal of Finance, 17*, 3413-3445.

Broadie, M., & Detemple, J. (2004). Option pricing: Valuation models and applications [Electronic version]. *Management Science, 50*, 1145-1177.

Chen, J., Gupta, A., & Troskie, C. (2003). The distribution of stock returns when the market is up [Electronic version]. *Communications in Statistics Theory and Methods, 32*, 1541-1558.

Fama, E. (1965). The behavior of stock market price [Electronic version]. *Journal of Business, 38*, 34-105.

Harris, R., & Kucukozmen, C. (2001). The empirical distribution of stock returns: Evidence from an emerging European market [Electronic version]. *Applied Economics Letters, 8*, 367-371.

Malevergne, Y., Pisarenko, V., & Sornette, D. (2005). Empirical distributions of stock returns: Between the stretched exponential and the power law? [Electronic version] *Quantitative Finance, 5*, 379-401.

Mandelbrot, B. (1963). The variation of certain speculative prices [Electronic version]. *Journal of Business, 36*, 394-419.

Markowitz, H. (1976). *Portfolio selection: Efficient diversification of investments* (4th ed.). Clinton, MA: The Colonial Press.

Ortiz, E., & Arjona, E. (2001). Heterokedastic behavior of the Latin American emerging stock markets [Electronic version]. *International Review of Financial Analysis, 10*, 287-305.

Tolikas, K., & Brown, R. (2006). The distribution of the extreme daily share returns in the Athens stock exchange [Electronic version]. *The European Journal of Finance, 12*, 1-22.

Wilkens, S. (2005). Option pricing based on mixtures of distributions: Evidence from the Eurex index and interest rate futures options market [Electronic version]. *Derivatives Use, Trading & Regulation, 11*, 213-231.

Footnote

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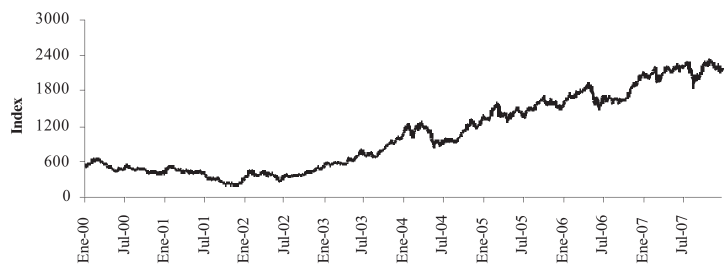
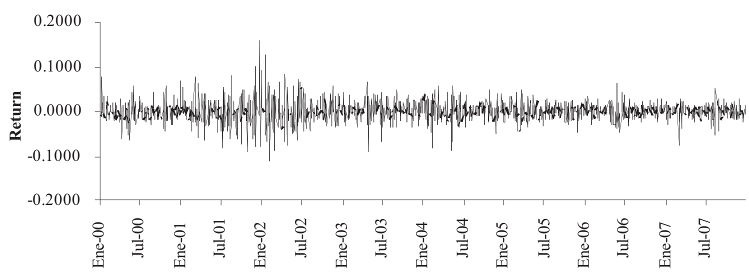
Appendix A: Market Behavior

Figure A1. Indice del Mercado de Valores de Argentina (IMERVAL).



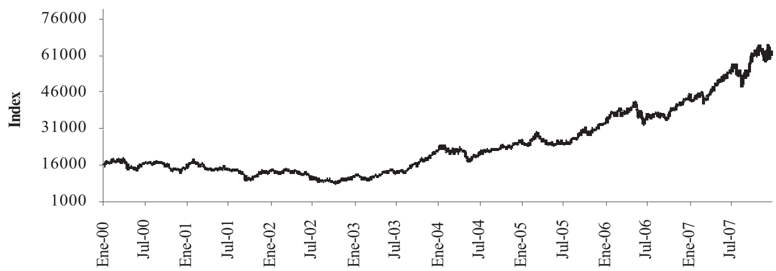
Note. See description of sources in Section 2.

Figure A2. Market return (IMERVAL).



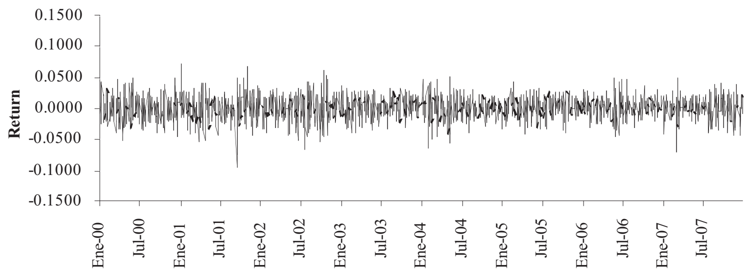
Note. See description of sources in Section 2.

Figure A3. Indice de la Bolsa de Valores de Sao Paulo (IBOVESPA).



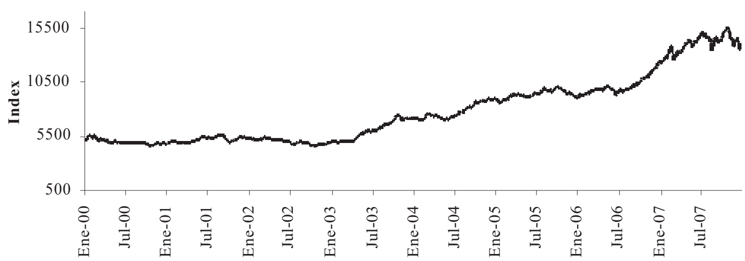
Note. See description of sources in Section 2.

Figure A4. Market return (IBOVESPA).



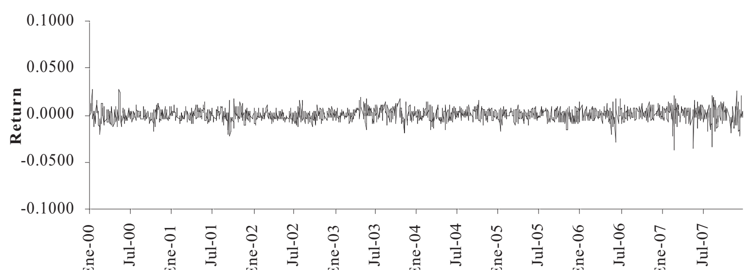
Note. See description of sources in Section 2.

Figure A5. Indice General de Precios de Acciones (IGPA).



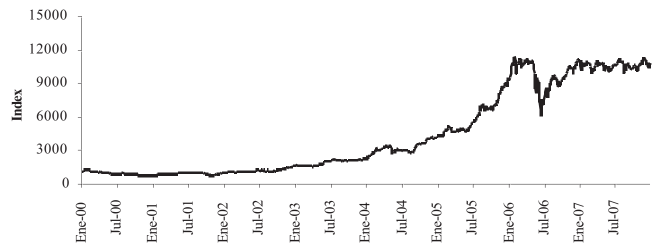
Note. See description of sources in Section 2.

Figure A6. Market return (IGPA).



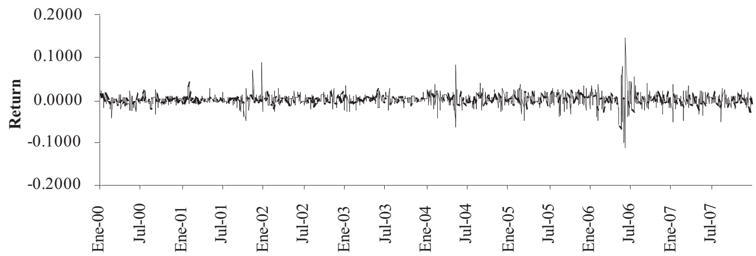
Note. See description of sources in Section 2.

Figure A7. Indice General de la Bolsa Colombiana (IGBC).



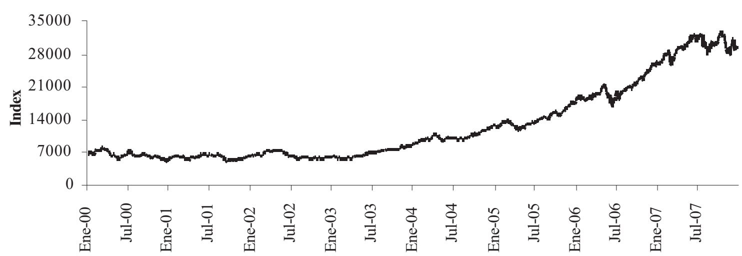
Note. See description of sources in Section 2.

Figure A8. Market return (IGBC).



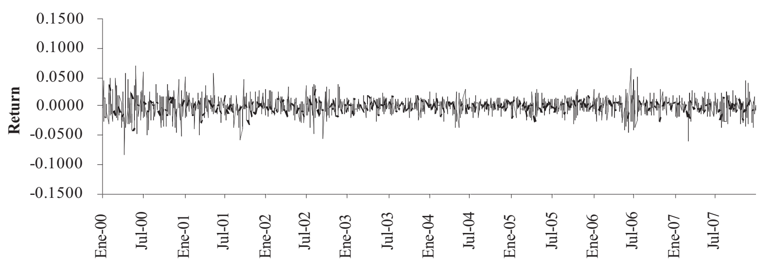
Note. See description of sources in Section 2.

Figure A9. Indice de Precios y Cotizaciones (IPC).



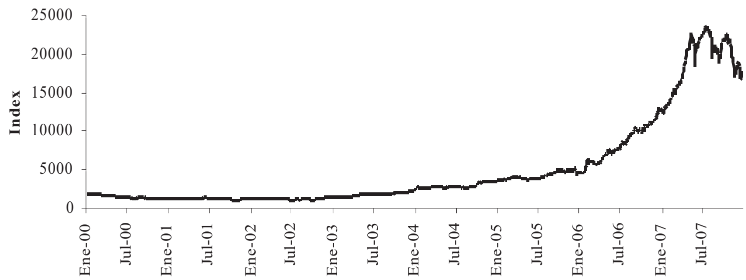
Note. See description of sources in Section 2.

Figure A10. Market return (IPC).



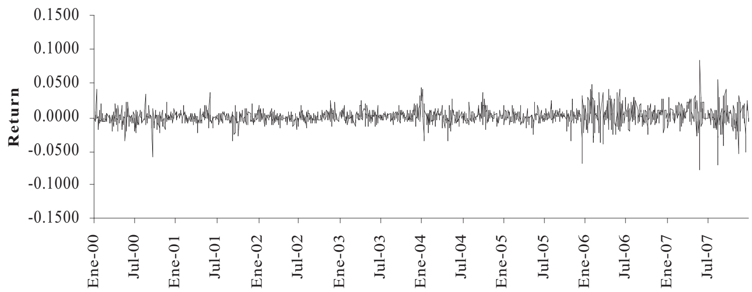
Note. See description of sources in Section 2.

Figure A11. Indice General de la Bolsa de Valores de Lima (IGBVL).



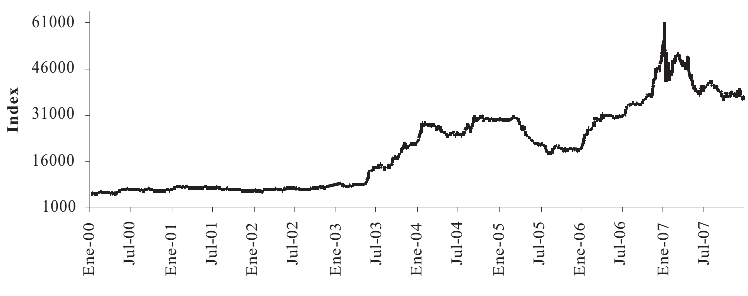
Note. See description of sources in Section 2.

Figure A12. Market return (IGBVL).



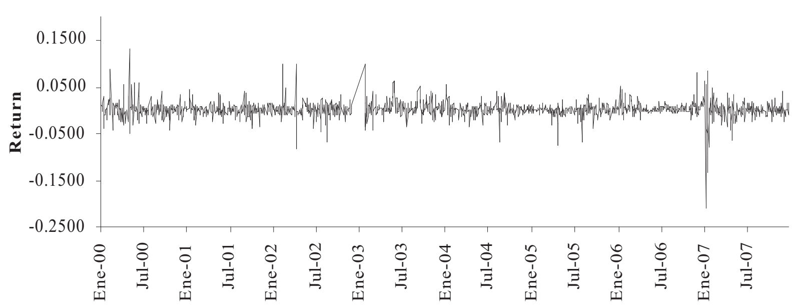
Note. See description of sources in Section 2.

Figure A13. Indice Bursatil de Caracas (IBC).



Note. See description of sources in Section 2.

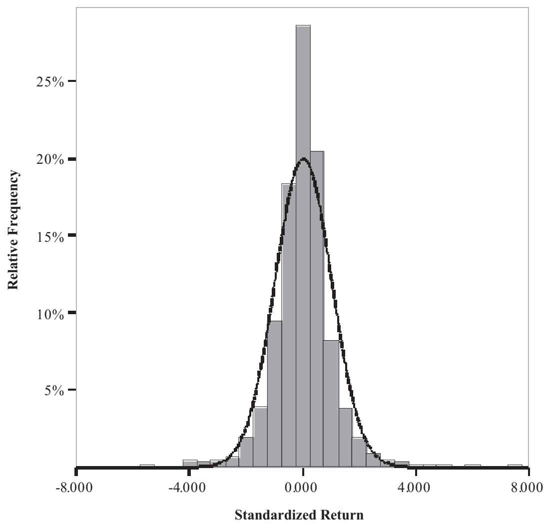
Figure A14. Market return (IBC).



Note. See description of sources in Section 2.

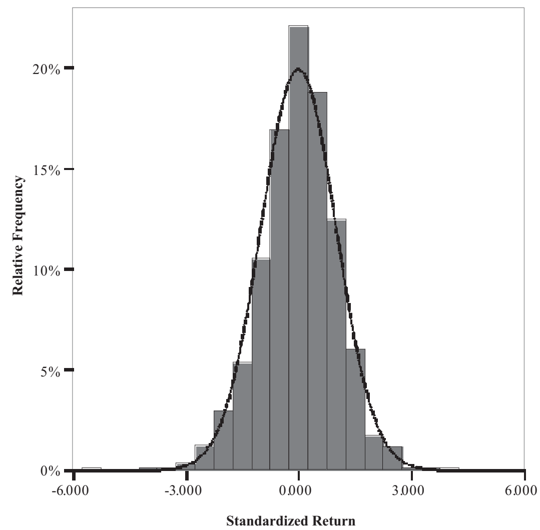
Appendix B: Histograms

Figure B1. Relative frequency and adjusted normal distribution of standardized daily market return for Argentina: 2000-2007.



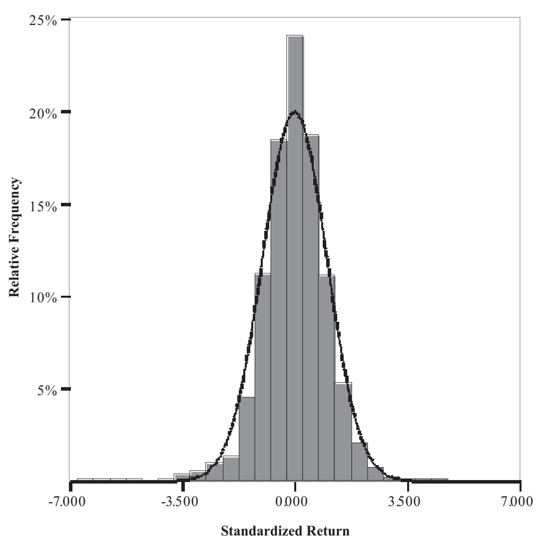
Note. See description of sources in Section 2.

Figure B2. Relative frequency and adjusted normal distribution of standardized daily market return for Brazil: 2000-2007.



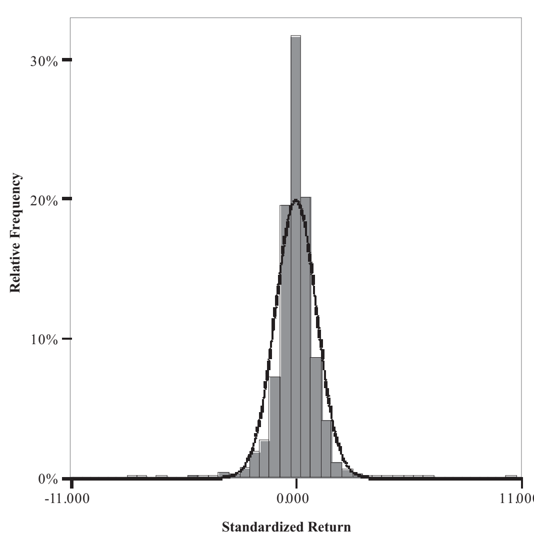
Note. See description of sources in Section 2.

Figure B3. Relative frequency and adjusted normal distribution of standardized daily market return for Chile: 2000-2007.



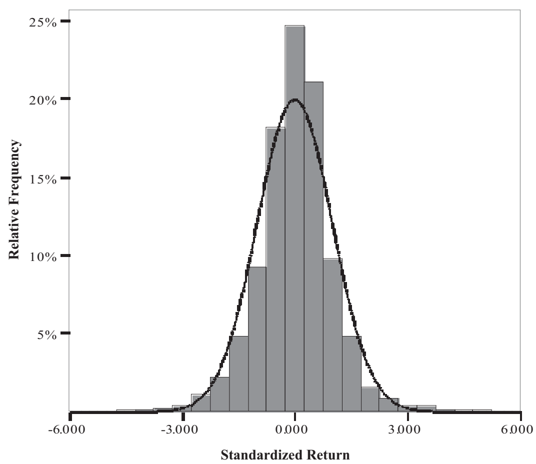
Note. See description of sources in Section 2.

Figure B4. Relative frequency and adjusted normal distribution of standardized daily market return for Colombia: 2000-2007.



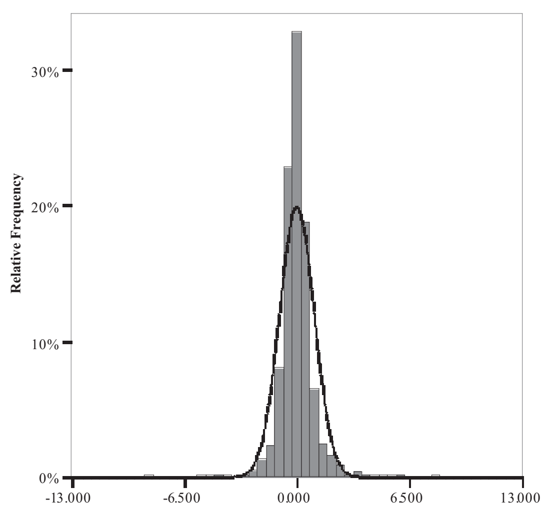
Note. See description of sources in Section 2.

Figure B5. Relative frequency and adjusted normal distribution of standardized daily market return for Mexico: 2000-2007.



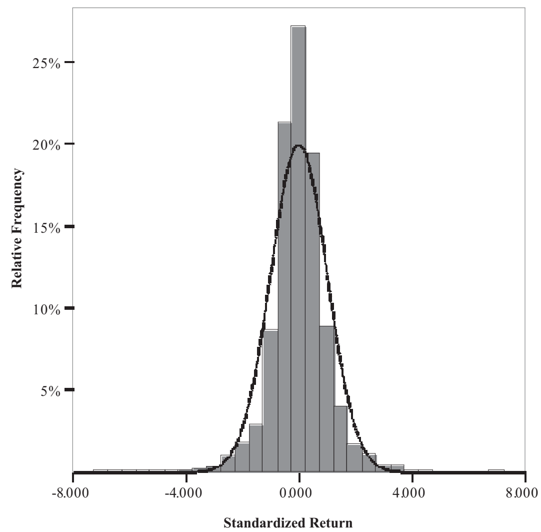
Note. See description of sources in Section 2.

Figure B6. Relative frequency and adjusted normal distribution of standardized daily market return for Peru: 2000-2007.



Note. See description of sources in Section 2.

Figure B7. Relative frequency and adjusted normal distribution of standardized daily market return for Venezuela: 2000-2007.



Note. See description of sources in Section 2.