

An Investigation of the Relationship between Risk and Return: The Case of the Latin American Stock Markets

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Abstract

This paper empirically explores the time-varying risk and return relationship in the Latin American equity markets. Our investigations find some positive linkage between risk and return in Latin America although it does not always perfectly hold. More concretely, first, we find that in the Latin American stock markets, in the daily and quarterly data, positive relationship between risk and return is relatively often observed although it is not always recognized. Second, we find that in Brazilian and Colombian equity markets, positive relations between risk and return are relatively often observed. On the other hand, from our investigations, in the stock markets in Chile, no positive risk-return tradeoff is observed.

Keywords: EGARCH-in-mean model, GARCH-in-mean model, Latin American stock markets, Risk-return tradeoff, Time-varying volatility

1. Introduction

Risk-return tradeoff is the central concern in the world of standard finance. In the markets of some countries in Latin America, the time-series trends are generally upward recently; thus it is natural to consider that the positive risk-return tradeoff is observed in the recent Latin American equity markets. Based on this prediction, it shall be meaningful to analyze recent stock market data of several countries in Latin America even if their sample periods are not necessarily long enough.

There are preceding studies that investigated the risk-return tradeoff in the US. These are researches by French et al. (1987), Ghysels et al. (2005), and Lundblad (2007), which documented the positive linkage between risk and return. On the other hand, Baillie and DeGennaro (1990) and Glosten et al. (1993) insisted that there were negative relations between risk and return. In addition, studies by Campbell (1987), Harvey (1991), and Whitelaw (1994) evidenced the mixed relations between them. Although there are many researches on this matter in the US as reviewed above, however, there seem to be little empirical examination on this issue by utilizing the recent upward Latin American stock market data.

Thus based on these research backgrounds, the objective of this paper is to empirically examine the time-varying linkage between risk and return in some countries' stock markets in Latin America. In our investigations, we use the daily, weekly, monthly, and quarterly data. This is also one of the favorable characteristics of this study. The interesting findings of this study are as follows. First, we find that in the Latin American equity markets, in the daily and quarterly data, positive linkage between risk and return is relatively often observed although it is not always recognized. Second, we reveal that in the equity markets of Brazil and Colombia, positive relations between risk and return are relatively often observed although it does not always hold either. On the other hand, in the stock markets in Chile, no positive risk-return relationship is observed. The rest of the paper is organized as follows. Section 2 documents our several discussions, Section 3 explains our data and methodology, Section 4 displays our empirical results, and Section 5 summarizes the paper with some perspectives.

2. Discussion

This section discusses several important points to consider the risk-return tradeoff of stock returns. (1) First are regarding the trends of markets. In markets of the countries in Latin America, the stock price trends are generally upward recently; thus naturally, there would be higher possibility that the positive risk-return tradeoff is observed in the recent Latin American equity markets. (2) Second is the data time period: it is important to analyze the long-term

data generally, however, from more practical point of view, our concern often lies in the states of recent and future market dynamics. Hence it shall be meaningful to analyze recent market data even if their sample periods are not so long enough. (3) Third is the data frequency: we consider that in existing studies, several data frequencies were not simultaneously analyzed regardless of the importance of the data frequency. For example, in practice, even if the risk-return tradeoff is observed in daily data, it may be neither highly useful nor significant for institutional investors. Thus it is favorable for us to analyze the data of several frequencies simultaneously. (4) Fourth is the model specification. Namely, we consider that analyzing by using several kinds of econometrical models is important for judging the states of the real-world equity markets. In general, the more complicated the models become, the higher the so-called model risk is, thus generally, it may be difficult to judge the real states of the risk-return relationship in equity markets when we use more complicated models. Therefore, we shall analyze stock return data by using several kinds of models.

In order to derive some answers to the above questions, we should perform careful empirical analyses by considering several issues discussed above. Hence from the next section, we describe the data and empirical methodologies used in this paper.

3. Data and Methodology

In this study, we use four kinds of time-series stock return data of the countries in Latin America. The countries include Brazil, Chile, Colombia, and Mexico, and our sample period spans from June 2001 to November 2013. More specifically, the stock returns data are computed from the Morgan Stanley Capital Index (MSCI, dividends included and local currency base), and these data are supplied by the Quick Corp. In addition, our daily data sample period is from 21 June 2001 to 26 November 2013; our weekly data sample period is from the final week of June 2001 to the final week of November 2013; our monthly data sample period is from June 2001 to November 2013; our quarterly data sample period is from the third quarter of 2001 to the fourth quarter of 2013. We exhibit the descriptive statistics for our four kinds of stock returns as to four countries in Latin America in Table 1. In addition, we show the daily dynamics of the MSCI stock index prices of the above four countries in Latin America in Figure 1.

Next, for testing the risk-return tradeoff in the recent Latin American stock markets, we employ four kinds of GARCH-in-mean models. The first model is the following GARCH-in-mean (1,1) model including the conditional variance in its mean equation as follows:

$$\begin{aligned} RET_{i,t} &= \eta_{i,0} + \eta_{i,1}\sigma_{i,t}^2 + \nu_{i,t}, \\ \sigma_{i,t}^2 &= \tau_{i,0} + \tau_{i,1}\sigma_{i,t-1}^2 + \tau_{i,2}\nu_{i,t-1}^2. \end{aligned} \quad (1)$$

In model (1), the variable $RET_{i,t}$ denotes the return of country i at time t and the variable $\sigma_{i,t}$ denotes the return volatility at time t .

Our second model is the following GARCH-in-mean (1,1) model including the conditional standard deviation in its mean equation as follows:

$$\begin{aligned} RET_{i,t} &= \zeta_{i,0} + \zeta_{i,1}\sigma_{i,t} + \omega_{i,t}, \\ \sigma_{i,t}^2 &= \mu_{i,0} + \mu_{i,1}\sigma_{i,t-1}^2 + \mu_{i,2}\omega_{i,t-1}^2. \end{aligned} \quad (2)$$

Again, $RET_{i,t}$ in model (2) denotes the return of country i at time t and $\sigma_{i,t}$ in model (2) denotes the return volatility at time t .

Further, our third model is the following EGARCH-in-mean (1,1) model including the conditional variance in its mean equation as follows:

$$\begin{aligned} RET_{i,t} &= \xi_{i,0} + \xi_{i,1}\sigma_{i,t}^2 + \varepsilon_{i,t}, \\ \ln(\sigma_{i,t}^2) &= \nu_{i,0} + \nu_{i,1}\ln(\sigma_{i,t-1}^2) + \nu_{i,2}(|\varepsilon_{i,t-1}|/\sigma_{i,t-1}) + \nu_{i,3}(\varepsilon_{i,t-1}/\sigma_{i,t-1}). \end{aligned} \quad (3)$$

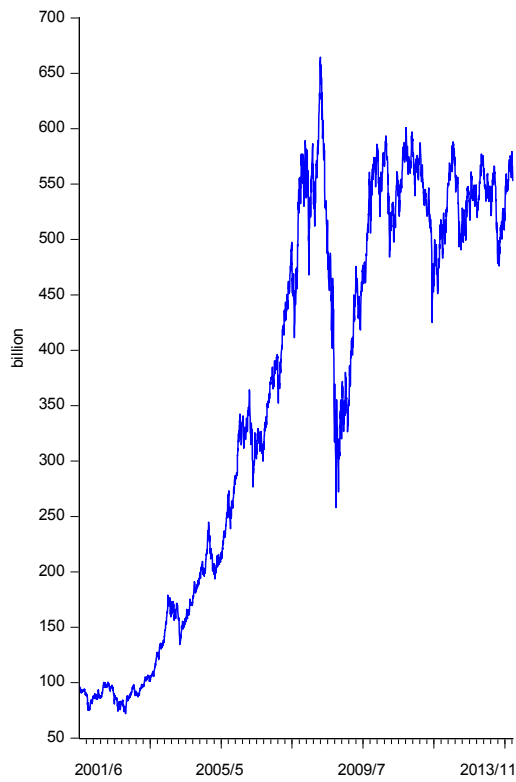
In the above model (3), variable notations are the same as those of the models (1) and (2).

Finally, our fourth model is the following EGARCH-in-mean (1,1) model including the conditional standard deviation in its mean equation as follows:

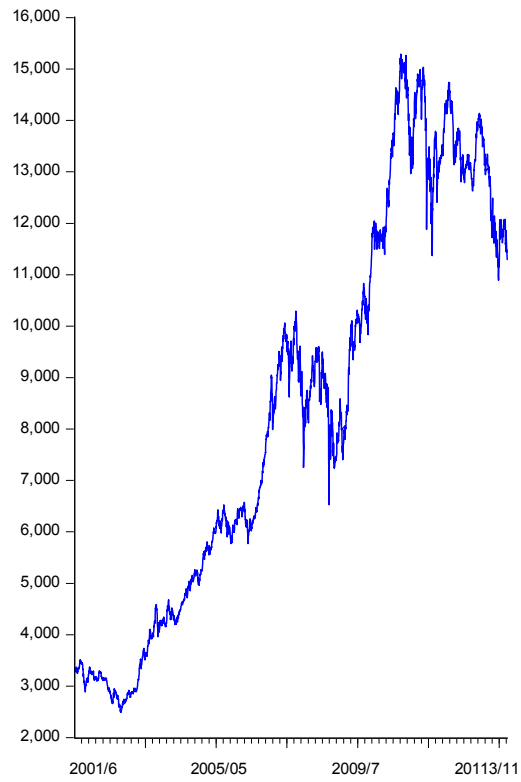
$$\begin{aligned} RET_{i,t} &= \iota_{i,0} + \iota_{i,1}\sigma_{i,t} + \kappa_{i,t}, \\ \ln(\sigma_{i,t}^2) &= \varphi_{i,0} + \varphi_{i,1}\ln(\sigma_{i,t-1}^2) + \varphi_{i,2}(|\kappa_{i,t-1}|/\sigma_{i,t-1}) + \varphi_{i,3}(\kappa_{i,t-1}/\sigma_{i,t-1}). \end{aligned} \quad (4)$$

In the above model (4), variable notations are the same as those of the models (1) and (2).

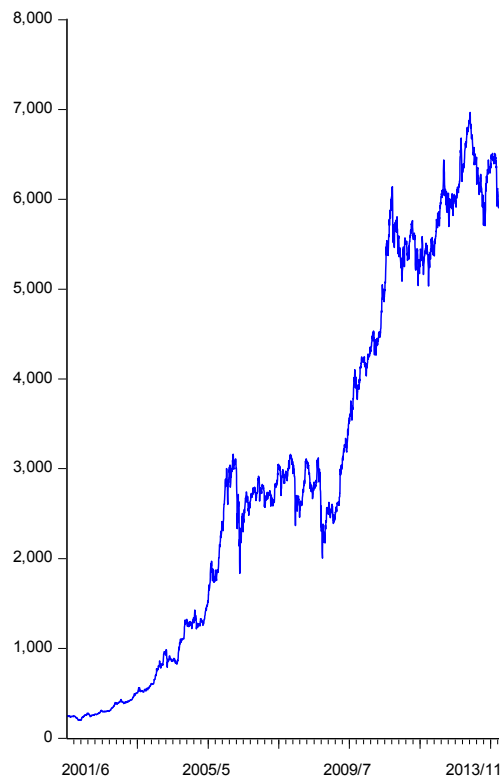
Panel A. Brazil



Panel B. Chile



Panel C. Colombia



Panel D. Mexico

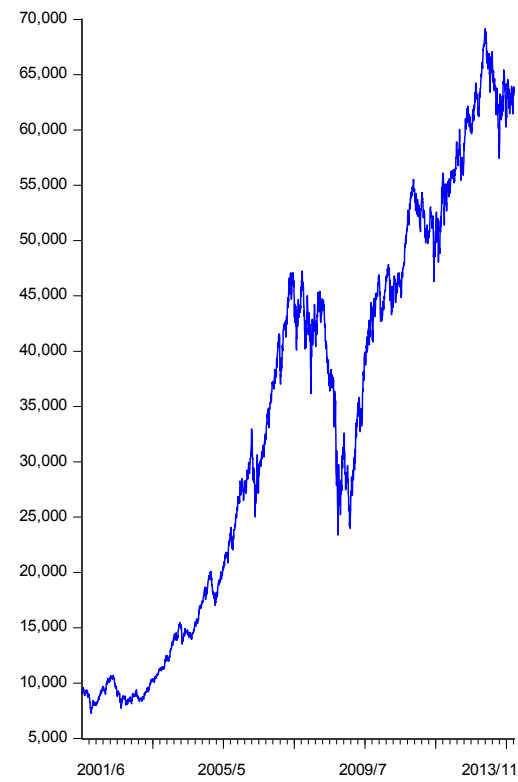


Figure 1. The daily dynamics of the MSCI stock index prices of the countries in Latin America: The time-series trends from 21 June 2001 to 26 November 2013

Table 1. Descriptive statistics for the stock returns of the countries in Latin America: Evidence from June 2001 to November 2013

Panel A. Daily returns				
	Brazil	Chile	Colombia	Mexico
Mean	0.0724	0.0463	0.1151	0.0736
Max	16.3949	18.7958	18.8480	11.3653
Min	-13.1232	-7.0997	-11.3015	-7.4200
Standrd Deviation	1.7537	1.1197	1.4005	1.3867
Skewness	0.2603	1.1953	0.3943	0.2192
Kurtosis	10.8531	32.6479	20.2625	8.6803
Obs.	3055	3055	3055	3055
Panel B. Weekly returns				
	Brazil	Chile	Colombia	Mexico
Mean	0.3372	0.2214	0.5396	0.3455
Max	18.4024	18.1306	12.1579	18.8131
Min	-19.2305	-20.4679	-19.3804	-17.5622
Standrd Deviation	3.6525	2.5750	3.0967	3.0357
Skewness	-0.2399	-0.5475	-0.4854	-0.1939
Kurtosis	6.6901	13.0796	8.3355	8.1775
Obs.	649	649	649	649
Panel C. Monthly returns				
	Brazil	Chile	Colombia	Mexico
Mean	1.4070	0.9339	2.3757	1.4312
Max	19.4946	15.7686	20.5411	12.8498
Min	-25.0804	-12.7334	-21.3756	-20.0244
Standrd Deviation	6.6259	4.6731	6.6914	5.1729
Skewness	-0.2711	0.1273	-0.0575	-0.6681
Kurtosis	4.1986	3.5196	4.0088	4.3240
Obs.	149	149	149	149
Panel D. Quarterly returns				
	Brazil	Chile	Colombia	Mexico
Mean	4.4391	2.8939	7.3585	4.4248
Max	36.3285	22.9408	42.1552	26.6023
Min	-24.6472	-17.5928	-22.7243	-16.7831
Standrd Deviation	13.3640	9.2662	13.2684	10.3876
Skewness	-0.0582	0.0737	0.3565	-0.0190
Kurtosis	2.8444	2.5832	3.0281	2.2966
Obs.	50	50	50	50

Notes: This table displays the descriptive statistics for the stock return data in the countries in Latin America. The countries include Brazil, Chile, Colombia, and Mexico. The sample period under our analyses spans from June 2001 to November 2013. In the table, Obs. means the number of the daily, weekly, monthly, and quarterly return data, in order.

Table 2. The relations between the time-varying risk and return: Evidence from the daily data of four countries in Latin America for the period from June 2001 to November 2013

Panel A. Results of the GARCH-in-mean (1,1) model with conditional variance: Evidence for the period from 21 June 2001 to 26 November 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	0.0176	0.7332	0.0366	0.1033
Chile	0.0468	0.1106	0.0414	0.2351
Colombia	0.0618***	0.0100	0.0522***	0.0011
Mexico	0.0557	0.1004	0.0360	0.1319
Positive (negative) significance	1 (0)		1 (0)	
Panel B. Results of the GARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from 21 June 2001 to 26 November 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	-0.1629	0.2017	0.1833**	0.0419
Chile	0.0067	0.9172	0.0851	0.2635
Colombia	-0.0734	0.2223	0.1903***	0.0010
Mexico	-0.0179	0.8126	0.1104	0.1147
Positive (negative) significance	0 (0)		2 (0)	
Panel C. Results of the EGARCH-in-mean (1,1) model with conditional variance: Evidence for the period from 21 June 2001 to 26 November 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	-0.0572	0.2903	0.0516**	0.0255
Chile	0.0435	0.2067	0.0210	0.6065
Colombia	0.0552*	0.0675	0.0538**	0.0153
Mexico	0.0270	0.4377	0.0318	0.1929
Positive (negative) significance	1 (0)		2 (0)	
Panel D. Results of the EGARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from 21 June 2001 to 26 November 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	-0.2069*	0.0838	0.1808**	0.0316
Chile	0.1000	0.1121	-0.0467	0.5222
Colombia	-0.0207	0.7682	0.1376**	0.0390
Mexico	0.0238	0.7315	0.0395	0.5406
Positive (negative) significance	0 (1)		2 (0)	

Notes: This table exhibits the estimation results of several GARCH-in-mean models as to the daily stock return data in the countries in Latin America. The countries include Brazil, Chile, Colombia, and Mexico. The sample period under our analyses spans from June 2001 to November 2013. For the statistical judgments, * means the statistical significance of the coefficients at the 10% level, ** means the statistical significance of the coefficients at the 5% level, and *** means the statistical significance of the coefficients at the 1% level, respectively. Furthermore, 'Positive (negative) significance' in the table indicates the number of the coefficients that are statistically significantly positive (negative).

Table 3. The relations between the time-varying risk and return: Evidence from the weekly data of four countries in Latin America for the period from June 2001 to November 2013

Panel A. Results of the GARCH-in-mean (1,1) model with conditional variance: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	-0.0629	0.8345	0.0425	0.1203
Chile	0.0920	0.5671	0.0343	0.2496
Colombia	0.1253	0.5944	0.0397	0.1555
Mexico	0.1768	0.4039	0.0374	0.2024
Positive (negative) significance	0 (0)		0 (0)	
Panel B. Results of the GARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	-0.9228	0.1910	0.4112*	0.0633
Chile	-0.0258	0.5157	0.2389	0.1915
Colombia	-0.5011	0.2873	0.3392**	0.0460
Mexico	-0.2001	0.6948	0.2488	0.2157
Positive (negative) significance	0 (0)		2 (0)	
Panel C. Results of the EGARCH-in-mean (1,1) model with conditional variance: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	-0.2093	0.5223	0.0461	0.1318
Chile	0.1163	0.4776	0.0214	0.5191
Colombia	0.1654	0.4453	0.0383	0.1655
Mexico	0.1973	0.3412	0.0192	0.5291
Positive (negative) significance	0 (0)		0 (0)	
Panel D. Results of the EGARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	-0.9257	0.1903	0.3780*	0.0911
Chile	0.0664	0.8524	0.0714	0.6733
Colombia	-0.2398	0.5537	0.2576*	0.0881
Mexico	0.1697	0.6905	0.0609	0.7244
Positive (negative) significance	0 (0)		2 (0)	

Notes: This table exhibits the estimation results of several GARCH-in-mean models as to the weekly stock return data in the countries in Latin America. The countries include Brazil, Chile, Colombia, and Mexico. The sample period under our analyses spans from June 2001 to November 2013. For the statistical judgments, * means the statistical significance of the coefficients at the 10% level, ** means the statistical significance of the coefficients at the 5% level, and *** means the statistical significance of the coefficients at the 1% level, respectively. Furthermore, 'Positive (negative) significance' in the table indicates the number of the coefficients that are statistically significantly positive (negative).

Table 4. The relations between the time-varying risk and return: Evidence from the monthly data of four countries in Latin America for the period from June 2001 to November 2013

Panel A. Results of the GARCH-in-mean (1,1) model with conditional variance: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	3.1219***	0.0000	-0.0265*	0.0986
Chile	7.0701	0.1121	-0.2949	0.1816
Colombia	110.3547	0.9044	-2.4901	0.9073
Mexico	0.6835	0.3598	0.0323	0.2995
Positive (negative) significance	1 (0)		0 (1)	
Panel B. Results of the GARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	-1.8182	0.5766	0.4934	0.3388
Chile	13.8805	0.2052	-2.8392	0.2393
Colombia	10.9085	0.3849	-1.3058	0.4959
Mexico	-0.2846	0.8446	0.3708	0.2380
Positive (negative) significance	0 (0)		0 (0)	
Panel C. Results of the EGARCH-in-mean (1,1) model with conditional variance: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	1.4926	0.1853	-0.0041	0.8812
Chile	4.3025*	0.0682	-0.1595	0.1785
Colombia	100.0148	0.7763	-2.2203	0.7887
Mexico	0.6510	0.3534	0.0341	0.3034
Positive (negative) significance	1 (0)		0 (0)	
Panel D. Results of the EGARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from June 2001 to November 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	4.0391	0.1238	-0.4048	0.3452
Chile	7.6216	0.1203	-1.4601	0.1845
Colombia	150.9953	0.8167	-22.4372	0.8219
Mexico	-0.3388	0.8071	0.3830	0.2288
Positive (negative) significance	0 (0)		0 (0)	

Notes: This table exhibits the estimation results of several GARCH-in-mean models as to the monthly stock return data in the countries in Latin America. The countries include Brazil, Chile, Colombia, and Mexico. The sample period under our analyses spans from June 2001 to November 2013. For the statistical judgments, * means the statistical significance of the coefficients at the 10% level, ** means the statistical significance of the coefficients at the 5% level, and *** means the statistical significance of the coefficients at the 1% level, respectively. Furthermore, 'Positive (negative) significance' in the table indicates the number of the coefficients that are statistically significantly positive (negative).

Table 5. The relations between the time-varying risk and return: Evidence from the quarterly data of four countries in Latin America for the period from June 2001 to November 2013

Panel A. Results of the GARCH-in-mean (1,1) model with conditional variance: Evidence for the period from the third quarter of 2001 to the fourth quarter of 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	1.4195***	0.0000	0.0200***	0.0000
Chile	8.4250***	0.0000	-0.0545***	0.0002
Colombia	-34.2590*	0.0658	0.3013***	0.0018
Mexico	-0.0656	0.9732	0.0398**	0.0224
Positive (negative) significance	2 (1)		3 (1)	
Panel B. Results of the GARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from the third quarter of 2001 to the fourth quarter of 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	13.7765***	0.0000	-0.7073***	0.0000
Chile	8.3902***	0.0004	-0.7402***	0.0095
Colombia	-80.1422**	0.0322	7.4223***	0.0066
Mexico	-31.8021***	0.0000	2.5667***	0.0000
Positive (negative) significance	2 (2)		2 (2)	
Panel C. Results of the EGARCH-in-mean (1,1) model with conditional variance: Evidence for the period from the third quarter of 2001 to the fourth quarter of 2013				
	Constant	<i>p</i> -value	σ^2	<i>p</i> -value
Brazil	2.0793***	0.0000	0.0262***	0.0035
Chile	5.6824***	0.0000	-0.0392*	0.0982
Colombia	5.3633**	0.0195	0.0121	0.5177
Mexico	-59.7892	0.1678	0.7048*	0.0502
Positive (negative) significance	3 (0)		2 (1)	
Panel D. Results of the EGARCH-in-mean (1,1) model with conditional standard deviation: Evidence for the period from the third quarter of 2001 to the fourth quarter of 2013				
	Constant	<i>p</i> -value	σ	<i>p</i> -value
Brazil	0.7356	0.3438	0.5125***	0.0003
Chile	7.7977***	0.0003	-0.6418**	0.0420
Colombia	-2.3480	0.6374	0.8469*	0.0907
Mexico	-110.1384	0.1663	11.9927	0.1005
Positive (negative) significance	1 (0)		2 (1)	

Notes: This table exhibits the estimation results of several GARCH-in-mean models as to the quarterly stock return data in the countries in Latin America. The countries include Brazil, Chile, Colombia, and Mexico. The sample period under our analyses spans from June 2001 to November 2013. For the statistical judgments, * means the statistical significance of the coefficients at the 10% level, ** means the statistical significance of the coefficients at the 5% level, and *** means the statistical significance of the coefficients at the 1% level, respectively. Furthermore, 'Positive (negative) significance' in the table indicates the number of the coefficients that are statistically significantly positive (negative).

4. Empirical Results

This section documents our empirical results. First, we exhibit the estimation results of our models (1) to (4) from Tables 2 to 5. More concretely, Tables 2 to 5 show the estimation results from our daily data, weekly data, monthly data, and quarterly data, respectively.

Describing the results in short, as to the overall results, the numbers of the statistically significant positive GARCH

and EGARCH-in-mean parameters are 7 for daily data, 4 for weekly data, 0 for monthly data, and 9 for quarterly data, as seen in Tables 2 to 5, respectively. Further, the numbers of the statistically significant negative GARCH and EGARCH-in-mean parameters are 0 for daily data, 0 for weekly data, 1 for monthly data, and 5 for quarterly data, respectively, also as shown in Tables 2 to 5. Describing the evidence from another angle, according to Tables 2 to 5, we understand that the numbers of the statistically significant positive GARCH and EGARCH-in-mean parameters are 8 for Brazil, 0 for Chile, 9 for Colombia, and 3 for Mexico, respectively. Moreover, as recognized from Tables 2 to 5, the numbers of the statistically significant negative GARCH and EGARCH-in-mean parameters are 2 for Brazil, 4 for Chile, 0 for Colombia, and 0 for Mexico, respectively. We here emphasize that it is interesting that in the Latin American equity markets, where upward stock market trends are recently recorded, strictly robust evidence of the positive risk-return relationship cannot always be found. Further, it is also interesting that in Chile, no positive risk-return relationship is observed as above.

Furthermore, inspecting the values of returns in Table 1, mean returns in Chile always take the smallest values in all data frequencies. In addition, mean return volatilities in Chile also always take the smallest values for all data frequencies. On the other hand, in Table 1, mean returns in Colombia always take the highest values for all data frequencies. In addition, mean return volatilities in Colombia take relatively high values for all data frequencies. These tendencies may lead our evidence that, in the equity market in Chile, no risk-return tradeoff is observed while the market in Colombia, risk-return tradeoff is more frequently observed.

5. Conclusions and Several Perspectives

This paper examined the risk and return relationship in the Latin American equity markets. We found that the linkage between risk and return were relatively positive although it was not always. The implications and perspectives from our studies are as follows. First, (1) as to the data frequency, from the practical point of view, quarterly or yearly data would be more important for using the states of the risk-return relations of equity markets for the real-world analyses. Our results by using quarterly data indicated relatively strong positive risk-return relations, thus, further tests by using the quarterly or yearly data of longer periods would be also useful. Second, (2) for the empirical tests, the results seem to depend on the models employed, thus empirical tests by using several models and by altering or adjusting their model specifications shall be more effective; this kind of analyses would always entail the so-called model risk. Nevertheless, it is interesting that strictly robust evidence of the positive risk-return relationship could not necessarily be found in the recent upward Latin American equity markets. Hence it is important for us to watch the real-data and stock market trends in all over the world continuously. Further research by using longer data of several kinds of data frequencies for international equity markets shall be also one of our future tasks.

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