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Do Emerging Equity Markets Respond Symmetrically to US Market Upturns and Downturns? Evidence from Latin America

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Abstract

We investigate the existence of asymmetries in Latin American equity markets to upturns and downturns in the US stock market. We find the magnitude and duration of an upturn in the US market are fully reflected in equity markets of Latin America and that the impact is significantly different from that of a downturn. The results are consistent with the view that international investors react more sharply to downturns than upturns. We conclude that if portfolios are formed based on average co-movements, which assume symmetry, the performance of the investment may be worse than expected in down markets.

Key words: equity markets; Latin America; response asymmetries

JEL classification: G15; O54; F30

1. Introduction

Over the past decade Latin American emerging markets have gone through an eventful financial liberalization process. Capital flows in the region have increased rapidly as investors included emerging market securities in their portfolios to take advantage of potential diversification benefits. To better understand the underlying characteristics of these emerging markets, researchers have investigated the transmission patterns of equity market movements between the US, Mexico, Argentina, and Brazil (Soydemir, 2000; Meric et al., 2001a, b; Ratanapakorn and Sharma, 2002), interconnectedness of Latin American equity markets (Ratner and Leal, 1996; Choudhry, 1997; Meric et al., 1998; Christofi and Pericli, 1999; Pagan and Soydemir, 2000; Chen et al., 2000; Pretorius, 2002; Johnson and Soenen, 2003), macroeconomic variables and Latin American equity markets (Bailey and Chung, 1995; Bilson et al., 2001; Adrangi et al., 2001), impacts of US interest rates on Latin American equity markets (Soydemir, 2002), response patterns of Latin American

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equity markets to cross-county macroeconomic movements (Verma and Ozuna, 2005), time series characteristics of Latin American equity markets (Ortiz and Arjona, 2001), and the issue of contagion (Calvo and Reinhart, 1996; Bazdresch and Werner, 2000).

However, an area of research that has received little attention in the literature is whether Latin American equity markets react differently in terms of speed and magnitude to upturns and downturns in the US stock market. This issue is important because these fragile emerging equity markets could be vulnerable to asymmetric spillovers and contagion effects from the US stock market. As such, understanding the co-movement of these emerging markets with the US market in different market scenarios is important for portfolio management.

This study extends prior research by analyzing whether Latin American equity markets react differently to positive as opposed to negative shocks in the US stock market. Specifically, we investigate the existence of magnitude and pattern asymmetry in the equity markets of Mexico, Brazil, Argentina, and Chile. Answers to this question are important since the status of the US market (up or down) might play an important role in forecasting Latin American equity market movements. These answers also have important implications for policymakers that seek to reduce spillover effects and for investors who aim to improve portfolio performance.

Using generalized impulse responses from a VAR model and monthly data, we find that the magnitude and duration of US market upturns are fully reflected in Latin American equity markets but that this effect is significantly different from that of downturns. Our results show that equity markets in Mexico, Brazil, Argentina, and Chile exhibit asymmetric responses in terms of timing and extent to US stock market shocks. Further, increases in the US stock market disseminate through Latin American equity markets much faster than decreases. These results are consistent with the view that when investing in emerging equity markets in Latin America, investors react to negative stock market movements in the US more sharply than they do to positive movements.

This paper is organized as follows. Section 2 discusses the theoretical background on response asymmetry and stock prices, while Sections 3 and 4 present our data and econometric methodology. Section 5 discusses the empirical results, and this is followed by concluding remarks in Section 6.

2. Theoretical Framework

Conceptually, response asymmetries may arise from different sources. If stock returns are drawn from symmetric distributions, co-movements between markets during upturn and downturn should be similar. However, evidence suggests that the return distributions are not symmetric for the US (Fama, 1965; Richardson and Smith, 1993), for developed markets (Harvey and Zhou, 1993), and for emerging markets (Harvey, 1995).

Asymmetries may arise from differences in return expectations among investors about the potential international impact of changes in foreign stock

markets (Erb et al., 1994; Odier and Solnik, 1993). For example, a small downturn in the US market could trigger a relatively larger downturn in the Latin American markets due to widespread earnings disappointment among investors rather than as a result of the specific magnitude of the US market decline. Therefore it is the dissatisfaction (satisfaction) arising from the decrease (increase) in the price of a stock that matters most to investors rather than the real magnitude of this change.

Asymmetries may occur due to the investment strategies based on incomplete and irrelevant information. Such information set could lead to biased investments leading to irrational buying or selling. In such cases, the effect of capital flows on equity markets could be dissimilar for upturns and downturns. Aitken (1996) suggests that institutional investor sentiments towards emerging markets can help determine equity prices in these markets. Institutional investors lacking local knowledge about each individual country's fundamentals may treat these markets as if they belong to a unique class. However, the importance of local information is increasing due to the segmented nature of emerging markets (Harvey, 1995). Therefore investment strategies based on biased information could lead to asymmetric responses.

Asymmetries may also occur due to the unidentified component of risk which is priced in equity markets. Fama and French (1992) suggest the existence of multidimensional risks associated with any stock. One dimension of risk is the unidentified risk which is nonetheless reflected in stock prices. However, the relationship between the unidentified components of risk with stock returns may not be linear and therefore may lead to dissimilar positive and negative returns to investors. Downs and Ingram (2000) provide evidence in support of this argument and find that up market betas are not equal to down market betas in absolute terms. Similarly, there is evidence in support of a positive (negative) relationship between betas and returns in an up (down) US market (Pettengill et al., 1995) and international equity market (Fletcher, 2000).

The economic rationale for an asymmetric response can also be explained from the behavioral standpoint of investor psychology. Investors, in general, are more concerned about market downturns than upturns, partly due to risk-aversion. This tendency is reflected in market prices, causing greater market responses to downturns in other markets. Evidence on momentum profitability and reversals suggests the effect of investor sentiments on the stock market may be asymmetric (Hong et al., 2000; Hong and Stein, 1999). The asymmetric effect of sentiments on the stock market is attributed to the limits to arbitrage (Brown and Cliff, 2004) and overconfidence (Gervais and Odean, 2001; Daniel et al., 1998).

Price movement asymmetries have been found in Asian markets (Bahng and Shin, 2003), Australian equity markets (Iorio and Faff, 2000), EMS exchange rates (Laopodis, 2001), commodity markets (Karrenbrock, 1991), goods markets (Peltzman, 2004), and real and underground output in New Zealand (Giles, 1999). In the light of these theoretical propositions and empirical findings, we expect asymmetric responses of Latin American equity markets to external positive and negative shocks. Specifically, upturns and downturns in the US market could lead to

asymmetry since US business conditions are the major global factor affecting these markets (Taylor and Sarno, 1997). Although asymmetries could be a result of one or more sources, our objective is to identify the existence of asymmetries rather than quantify the contribution of each source.

3. Econometric Methodology

We undertake two approaches to investigate the existence of asymmetric response of Latin American stock prices to US market movements. Specifically, we test for magnitude and pattern asymmetries.

3.1 Magnitude Asymmetry

Returns in equity market *i* (R_i) are defined to have a magnitude asymmetric impact if an increase in equity market *j* (R_j) affects equity market *i* differently than a decrease of equal magnitude. The statistical model takes the form described in equations (1) to (3). The statistical model captures contemporaneous relationships of equity returns between the markets (see Karoyli and Stulz, 1996):

$$R_{it} = \alpha_0 + \alpha_1 RI_{jt} + \alpha_2 RD_{jt} + \alpha_3 R_{it-k} + \varepsilon_t , \quad (1)$$

$$RI_t = P_t - P_{t-1} \text{ if } P_t - P_{t-1} > 0 \text{ and 0 otherwise,} \quad (2)$$

$$RD_t = P_t - P_{t-1} \text{ if } P_t - P_{t-1} < 0 \text{ and 0 otherwise,} \quad (3)$$

where α_0 is a constant term, ε_t is an error term, and α_1, α_2, α_3 are the parameters to be estimated. Here, P_t and P_{t-1} are expressed in logarithms so that returns are continuously compounded returns (Tsay, 2002), all RI_t are positive or zero, and all RD_t are negative or zero. In equation (1), we test the null hypothesis that the upturns and downturns in equity market *j* have the same effect on changes in equity market *i*. For example, if the Mexican market (R_i) responds symmetrically to US market upturn (RI_j) and downturn (RD_j), then one would expect to find $\alpha_1 = \alpha_2$. We test the hypothesis $H_0 : \alpha_1 = \alpha_2$ using the Wald test (Greene, 2000). The appropriate lag length *k* may be sufficient to characterize model dynamics and capture the return generating process. In order to obtain unbiased and efficient parameter estimates, we also assume that the constant α_0 captures the average influence of factors not explained by changes in the US market.

3.2 Pattern Asymmetry

Returns in equity market *i* (R_i) have a pattern asymmetric impact if the magnitude of the effects from the upturns and downturns in equity market *j* (R_j) changes over time (see Ng, 1998; Iorio and Faff, 2000; Peltzman, 2000; Laopodis, 2001; Pagan and Soydemir, 2001; Bahng and Shin, 2003). We investigate the presence of pattern asymmetry by estimating a 10-variable VAR model (Sims, 1980). Our VAR model captures dynamic feedback effects in a relatively unconstrained

fashion and is therefore a good approximation to the true data generating process. We express the VAR model as

$$Z(t) = C + \sum_{s=1}^{m} A(s)Z(t-m) + \upsilon(t), \tag{4}$$

where $Z(t)$ is a column vector of variables under consideration, C is the deterministic component comprised of constants, $A(s)$ is a matrix of coefficients, m is the lag length, and $\upsilon(t)$ is a vector of random error terms. By construction, $\upsilon(t)$ is uncorrelated with past $Z(t)_s$.

The VAR specification allows policy simulations and the incorporation of Monte Carlo methods to obtain confidence bands around the point estimates (Doan, 1988; Genberg et al., 1987; Hamilton, 1994). The likely response of one variable at times t, t+1, t+2, … to a one-time unitary shock in another variable at time t is captured by impulse response functions. As such, they represent the behavior of the series in response to pure shocks while keeping the effect of other variables constant. Since impulse responses are highly nonlinear functions of the estimated parameters, confidence bands are constructed around the mean response. Responses are considered statistically significant at the 95% confidence level when the upper and lower bands carry the same sign.

It is well known that traditional orthogonalized forecast error variance decomposition results based on the widely used Cholesky factorization of VAR innovations may be sensitive to variable ordering (Pesaran and Shin, 1996; Koop et al., 1996; Pesaran and Shin, 1998). To mitigate such potential problems of misspecifications, we employ the recently developed generalized impulses technique as described by Pesaran and Shin (1998) in which an orthogonal set of innovations does not depend on the VAR ordering. The generalized impulse responses from an innovation to the jth variable are derived by applying a variable-specific Cholesky factor computed with the jth variable at the top of the Cholesky ordering. These generalized impulses capture the effect of unanticipated components and therefore are regarded as appropriate for this study.

4. Data

We obtained monthly data from September 1988 to December 2003 from Datastream® (now Thomson Financial™). In addition to the US market, we chose Mexico, Argentina, Brazil, and Chile since these equity markets have exhibited phenomenal growth in the past two decades. The International Finance Corporation (IFC) ranked Brazil, Mexico, Chile, and Argentina 18th, 25th, 30th, and 31st respectively among top developed and emerging markets in the world (IFC, 1999). In terms of regional ranking based on market capitalization, Brazil, Mexico, Argentina, and Chile are the top four among Latin American equity markets. As measured by the turnover ratio, Brazil (45), Mexico (33), and Chile (10) are the three most liquid stock markets in the region. Eun and Resnick (2004) suggest that

liquidity in these markets have been improving significantly. Further, these markets have been found to be significantly affected by the US stock market and the US economy by varying degrees.

The market variables identified for these countries are the major indexes in their respective stock markets. Specifically, we include the following indexes: DJIA (US), IPC BOLSA (Mexico), BOVESPA (Brazil), General IGPA (Chile), and MERVAL (Argentina). We take first differences of natural logarithms of all indexes to obtain continuously compounded return series (Tsay, 2002).

Table 1 reports descriptive statistics for the continuously compounded monthly returns. Brazil, Mexico, and Argentina's stock markets have high standard deviations, suggesting the highly volatile nature of these markets. In comparison, Chile exhibits low volatility similar to the US market. The Brazilian stock market has the highest mean and the highest standard deviation, suggesting that investors are compensated for bearing higher risk. In all cases, mean values are substantially different from the median values, indicating asymmetric distributions.

Table 1. Descriptive Statistics: Continuously Compounded Monthly Returns

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
DJ_RST	0.0082	0.0151	0.1044	−0.1320	0.0452	−0.5583	3.2818
M_RST	0.0115	0.0198	0.1631	−0.3218	0.0864	−0.7128	3.9659
B_RST	0.0419	0.0397	0.6074	−0.4834	0.1508	0.4265	5.2872
A_RST	0.0040	0.0174	0.4304	−0.5006	0.1226	−0.1546	5.9444
C_RST	0.0065	0.0035	0.1539	−0.1987	0.0530	−0.0822	4.8866

Notes: DJ_RST, M_RST, B_RST, A_RST, and C_RST represent the US, Mexican, Brazilian, Argentinean, and Chilean stock market returns, respectively.

Table 2. Unit Root Test Results

		ADF test	KPSS test
DJ_RST		−6.345	0.119
M_RST		−7.285	0.122
B_RST		−4.869	0.106
A_RST		−6.999	0.091
C_RST		−6.701	0.164
Test critical values:	1% level	−3.469	0.739
	5% level	−2.878	0.463
	10% level	−2.575	0.347

Notes: DJ_RST, M_RST, B_RST, A_RST, and C_RST represent the US, Mexican, Brazilian, Argentinean, and Chilean stock market returns, respectively.

Before proceeding to the main results, we first check the time series properties of our variables using unit root tests. Table 2 reports the results of unit root tests using the augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981) and

the KPSS (Kwiatkowski et al., 1992) test. Based on the consistent and asymptotically efficient *AIC* and *SIC* criteria (Diebold, 2003) and considering the loss in degrees of freedom, the appropriate number of lags is determined to be 2. In the case of the ADF test, the null hypothesis of nonstationarity is rejected. In the KPSS test, the null hypothesis is that each series in stationary. We fail to reject the null hypothesis in this case. The inclusion of drift or trend terms in the ADF and KPSS test equations does not change these results (Dolado et al., 1990).

5. Estimation Results

Table 3 reports the regression results using equations (1) to (3) for Mexico, Brazil, Argentina, and Chile. In the case of Mexico, the size of the coefficient for DJ_RST_D is 0.269, which is greater than the coefficient for DJ_RST_I (0.168). Also, the F-statistic is 2.859 (p-value 0.09), thus rejecting the null hypothesis $H_0 : \alpha_1 = \alpha_2$. This suggests that a decrease in the US market has a much greater impact than an increase on Mexico's equity market. We come to a similar conclusion regarding the influence of the US upturn and downturn for Brazil, Argentina, and Chile. The magnitudes of the regression coefficients for a US downturn are greater than those for a US upturn. In the case of Brazil and Argentina, the Wald test rejects the null hypothesis of equal coefficients. The Chilean equity market seems to have the least magnitude asymmetry. Overall, we find evidence of magnitude asymmetry in Latin American equity markets in response to the US market. These results are consistent with the view that investors penalize downturns in such markets more heavily than they reward equivalent upturns.

Table 3. Estimation Results for Magnitude Asymmetry

$$R_{it} = \alpha_0 + \alpha_1 RI_{jt} + \alpha_2 RD_{jt} + \alpha_3 R_{it-k} + \varepsilon_t$$

Dependent Variable	Independent Variables			Dependent Variable lagged		Wald Test	
	Constant	DJ_RST_I	DJ_RST_D	Once	Twice	F-statistics	P-value
M_RST	0.026	−0.168	0.269	0.064	0.015	2.859	0.09
	(0.011)	(0.299)	(0.295)	(0.075)	(0.076)		
B_RST	0.128	−0.416	1.878	0.051	0.340	3.099	0.08
	(0.030)	(0.755)	(0.771)	(0.079)	(0.072)		
A_RST	0.030	−0.654	0.766	0.067	0.117	2.758	0.09
	(0.020)	(0.486)	(0.504)	(0.092)	(0.093)		
C_RST	0.017	0.120	0.193	0.272	0.030	0.893	0.34
	(0.007)	(0.192)	(0.196)	(0.073)	(0.076)		

Notes: DJ_RST, M_RST, B_RST, A_RST, and C_RST represent the US, Mexican, Brazilian, Argentinean, and Chilean stock market returns, respectively. Standard errors are in parentheses.

Having rejected impact symmetry in all estimations, the next step is to investigate pattern asymmetry, i.e., to examine whether the magnitude of the

asymmetry is time invariant. First, we construct the variables related to upturn and downturn in all the markets based on equations (2) and (3). Second, we estimate a 10-variable VAR model (upturn and downturn series for each of the five markets) with two lags, in accordance with equation (4). Sims (1980) and Enders (2003) indicate that the VAR coefficient estimates are not very useful and that the tool we should employ to interpret the VAR results are the impulse response functions obtained from the VAR model. Thus, we analyze the generalized impulse response functions generated from the VAR model (available upon request).

Figures 1a and 1b plot the impulse responses of Mexico's equity market to one-time upturn and downturn (one standard deviation shocks) in the US stock market. The solid line represents the mean response and the dashed lines are confidence bands around the mean response. A total of 500 draws were used in the Monte Carlo simulations to obtain the standard errors. The response of the Mexican market to the US upturn is shorter and less pronounced (Figure 1a) as compared to that of the downturn (Figure 1b). In the case of US upturn the response is 0.01 as compared with 0.025 in the case of US downturn. Also, in the former case, the responses are statistically significant only during the third month, while in the latter case the responses are significant from the second to the fourth month. The results suggest the presence of pattern asymmetry and provide further evidence against magnitude symmetry in Mexico's equity market.

Figures 2a and 2b plot the impulse responses of Brazil's equity market to one-time standard deviation shocks in the US stock market. Similar to the results for Mexico, the response of Brazil's upturn to the US upturn is short-lived and not very pronounced (Figure 2a). However, the response of Brazil's downturn to the US downturn is much more pronounced and lasts from the second to the fourth month (Figure 2a). The results from this analysis provide evidence in favor of pattern and magnitude asymmetry in the case of Brazil's equity market.

Figures 3a and 3b plot the generalized impulse responses of Argentina's equity market to one-time standard deviation upturn and downturn in the US stock market. Once again the response of the upturn to the US upturn is close to 0.01 (Figure 3a) versus approximately 0.025 (Figure 3b) in the case of US downturn. Further, in the former case, the response is statistically significant for a small time period during the third month, while in the latter case, the responses are statistically significant from the second to the fourth month. The responses to upturns become insignificant much faster than downturn responses, suggesting pattern asymmetry in the case of Argentina's equity market.

Figures 4a and 4b plot the impulse responses of Chile's equity market to one-time upturn and downturn in the US stock market. As before, the response to the downturn is of much greater magnitude and becomes insignificant slower than the response to the upturn. However, the response of Chile's equity market is less pronounced than that of Mexico, Brazil, or Argentina. This is consistent with previous findings that Chile is less affected by the US market.

Figure 1. Response of Mexico to US Upturn and Downturn

Figure 1a
Response of increase in Mexico to increase in the U.S.

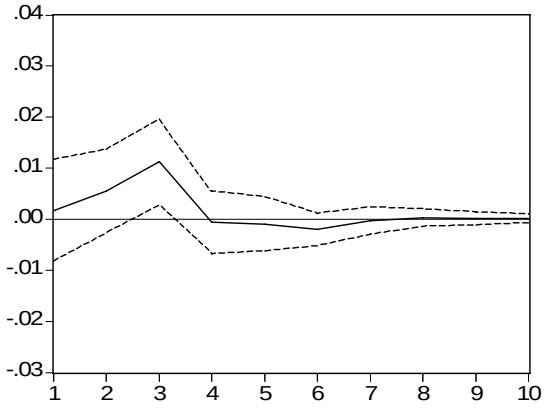
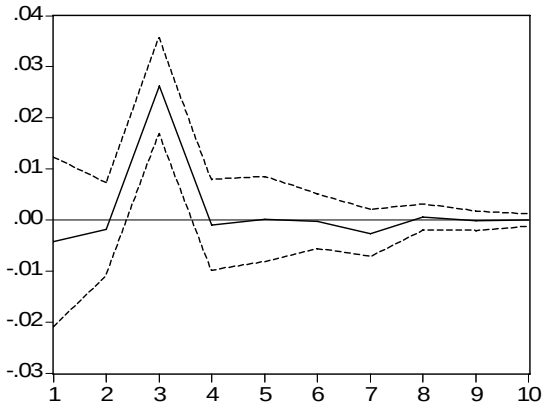


Figure 1b
Response of decrease in Mexico to decrease in the U.S.



Notes: Percentage returns are on the vertical and horizon is on the horizontal axis. Dashed lines represent upper and lower 95% confidence bands.

Figure 2. Response of Brazil to US Upturn and Downturn

Figure 2 a
Response of increase in Brazil to increase in the U.S.

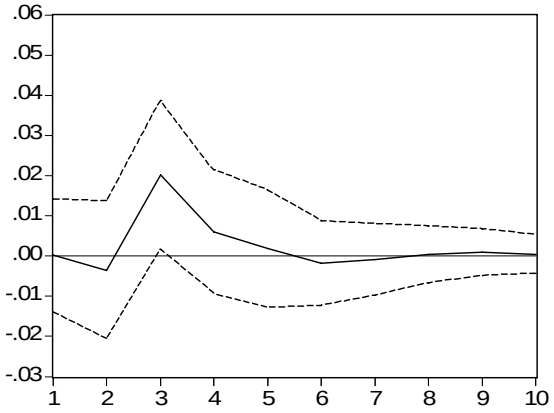
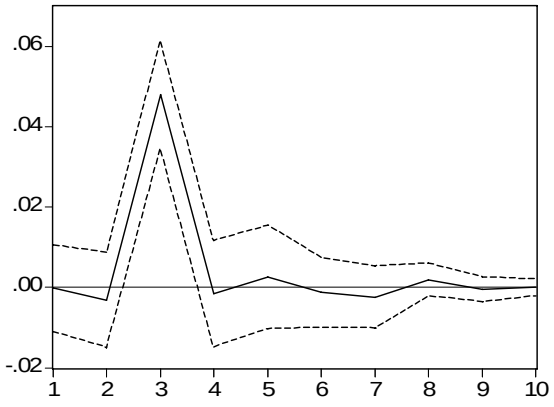
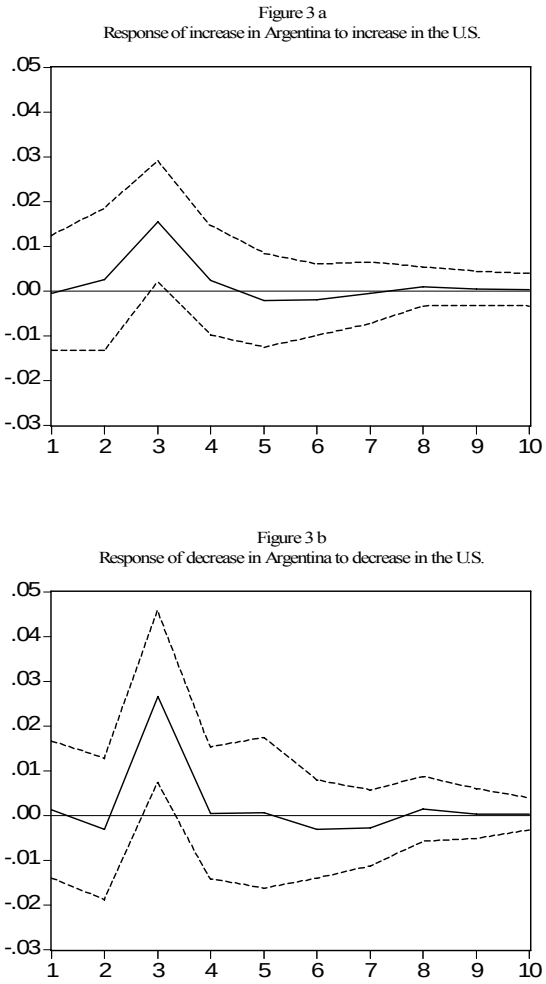


Figure 2 b
Response of decrease in Brazil to decrease in the U.S.



Notes: Percentage returns are on the vertical and horizon is on the horizontal axis. Dashed lines represent upper and lower 95% confidence bands.

Figure 3. Response of Argentina to US Upturn and Downturn



Notes: Percentage returns are on the vertical and horizon is on the horizontal axis. Dashed lines represent upper and lower 95% confidence bands.

Figure 4. Response of Chile to US Upturn and Downturn

Figure 4 a
Response of increase in Chile to increase in the U.S.

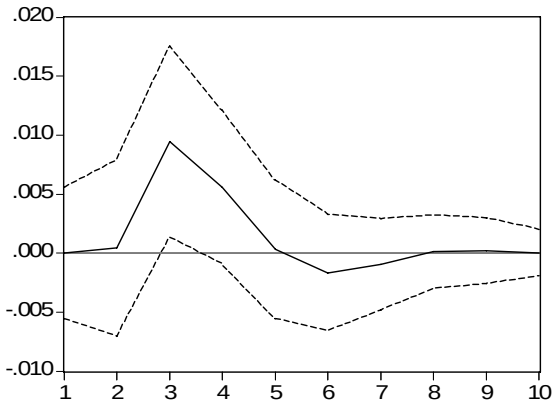
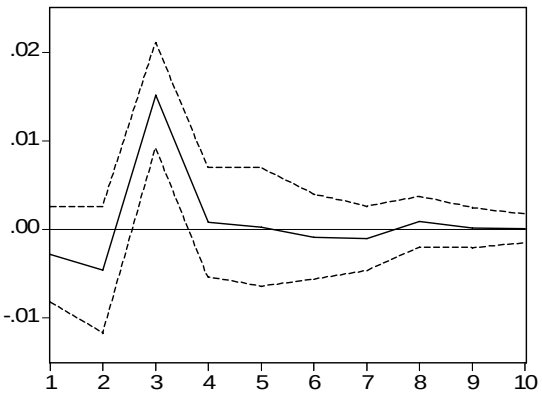


Figure 4 b
Response of decrease in Chile to decrease in the U.S.



Notes: Percentage returns are on the vertical and horizon is on the horizontal axis. Dashed lines represent upper and lower 95% confidence bands.

In summary, the results of the VAR model show that both the timing and the extent of responses of equity markets in Mexico, Brazil, Argentina, and Chile are not symmetric to US stock market shocks.

6. Conclusion

In this paper, we investigate the existence of asymmetries in Latin American equity markets to upturns and downturns in the US stock market. An equity market

displays an asymmetric response when returns exhibit different responses to market upturns than downturns in terms of both speed and magnitude. The economic rationale for asymmetric responses can be described from the behavioral standpoint of investor psychology. Investors, in general, are more concerned about market downturns than upturns, partly due to their risk-aversion. Thus, this tendency towards risk-aversion is reflected in market prices, causing sharper market responses to downturns in other markets.

The empirical results suggest the existence of magnitude and pattern asymmetries in the equity markets of Mexico, Brazil, Argentina, and Chile. We find that the magnitudes and the durations of Latin American equity market responses to US market upturns are markedly different from those to downturns. Specifically, the results shows that both the timing and the extent of responses of equity markets of Mexico, Brazil, Argentina, and Chile is not symmetric when there is a shock to the US stock market. Further, increases in the US stock market disseminates through Latin American equity markets much faster than decreases. These results are consistent with the view that when investing in emerging equity markets in Latin America, investors react to negative stock market movements in the US more sharply than to positive movements.

These results have important practical implications for investors and policymakers. If the portfolios are formed based on average co-movements, which assumes symmetry, the performance of the investment may be worse than expected in down markets because the correlations increase. A direct implication of the evidence found in this study is that international asset pricing models should carefully consider the role of the co-movements in different market scenarios.

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