Stock market liberalization and informational efficiency in emerging markets: new consideration and tests

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I Introduction

It is generally accepted that the majority of emerging markets are less than efficient, due particularly to the poor quality of their information disclosures, thin trading and inadequate accounting regulations. Since the liberalization of stock markets in the mid-1980s, hope then exists for a greater presence of foreign investors, which would imply increased market liquidity and market transparency, ultimately enhancing the efficiency of emerging stock markets. However, previous attempts to test the relationship between stock market liberalization and informational efficiency in emerging markets remained inconclusive.

To date, Groenewold and Ariff (1998) test this relationship in four Asian emerging markets using a standard regression of actual returns on past returns and autocorrelation tests, and show evidence of return predictability as a follow-up to stock market liberalization. By contrast, using Lo and MacKinlay's variance ratio test to assess the weakest efficiency hypothesis, Kim and Singal (2000) demonstrated that market liberalization has made stock prices behave more efficiently in emerging markets. There are also other empirical findings suggesting that stock market liberalization did not bring emerging markets into more efficient markets. For example, when testing the predictability of excess actual returns by past returns in nine emerging markets, Kawakatsu and Morey (1999) documented that most of the sample markets were already weak-form efficient prior to actual liberalization.

In addition to the divergence of empirical results, it is worth noting that most existing studies have examined the effects of market liberalization on the informational efficiency in emerging markets through the comparison of market efficiency measures over the pre- and post-liberalization periods. We think that this methodology is inappropriate for two main reasons. First, dividing the study period into two sub-periods with the official dates of liberalization as breakpoint produces misleading results. For example, if there is evidence pointing to improvements on efficiency measures, it is hardly plausible to attribute this to the effects of market liberalization alone, because the latter is often undertaken together with other economic and financial reforms (e.g., trade liberalization and exchange rate reforms). Moreover, since market liberalization is often announced ahead of official dates set for liberalization, stock prices are likely to react to the announcements. Therefore, the result obtained, based on the official liberalization date, might not be accurate. Second, as emerging countries have liberalized their capital markets only gradually, stock markets may have different stages of development and as a result, different degrees of market efficiency over time. This implies that models with a stable structure of parameters cannot describe the time-varying modifications in terms of emerging market efficiency levels.

This paper will contribute to the related literature on this subject by offering a dynamic model with changing coefficients, in order to characterize the potentially time-varying pattern of weak-form efficiency in emerging stock markets, under the gradual effects of financial liberalization. The focus is on the weakest efficiency hypothesis, because most emerging markets still impose significant obstacles to the proper dissemination of information. It will

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also attempt to quantify the induced impact of market liberalization on ever-changing market efficiency levels by making use of certain market-liberalization proxy variables and the time-varying efficiency measure yielded by the empirical model.

Section 2 presents the empirical model and the estimation procedures. Section 3 describes sample data and its statistical properties. Section 4 reports on our empirical findings regarding the relation between stock market liberalization and emerging market efficiency. Section 5 summarizes and concludes the study.

II Empirical model

An efficient market generally refers to one in which no abnormal profit can be achieved through the use of available information. Depending on the set of available information, efficient market hypothesis tests are commonly divided into three categories: weak-form, semi strong-form and strong-form efficiency[1].

According to Fama's (1970) definitions, weak-form efficiency claims that stock prices fully reflect the information contained in the series of past prices. Semi strong-form efficiency asserts that stock prices reflect all publicly-available information, while strong-form efficiency requires all relevant information that is known to any market operators to be incorporated in stock prices. Although the literature on mature markets is concerned with all three forms of efficiency, recent studies on emerging markets have mainly emphasized weak-form efficiency. A number of factors explain this choice, with the most relevant factors including the poor quality and unreliability of the information, infrequent trading, inappropriate accounting regulations and low liquidity (see, *e.g.*, Kumar and Tsetsekos, 1999; Lesmond, 2005). It is worth noting that the majority of listed companies in emerging markets usually publish their financial reports with some time lags. Moreover, when testing the predictability of stock returns in emerging markets, previous works show evidence of serial dependencies in return structure (see, Claessens et al., 1995; Harvey 1995; Chang, Lima and Tabak, 2004). For the aforementioned reasons, weak-form market efficiency still remains a testable hypothesis in emerging markets. Therefore, in this paper, weak-form efficiency is equally examined. However, rather than assessing weak-form efficiency in a traditional way, we focus on evolving efficiency over time and the overall impact of stock market liberalization on the evolution of market efficiency. The rationale behind this intuitive approach is based on the notion that the rapid maturing of emerging markets after stock market liberalization involving substantial transformations in market structure, increased sophistication of market participants and greater quality and availability of information would induce the level of market efficiency to change over time.

As mentioned earlier, the hypothesis of weak-form market efficiency states that if stock returns are predictable from their past realizations, then the market is said to be not weak-form efficient. Hence, the test of weak-form market efficiency can be carried out as follows:

$$R_t = \beta_{0t} + \beta_{1t} R_{t-1} + \alpha h_t + \varepsilon_t \qquad \varepsilon_t \sim N(0, h_t) \tag{1}$$

$$\beta_{it} = \beta_{it-1} + v_{it} \qquad v_{i,t} \sim N(0, \sigma_i^2)\ ; \quad i = 0, 1 \tag{2}$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} \tag{3}$$

Where R_t denotes stock market returns at the time t. β_{0t} is a constant term measuring the long-term trends in stock markets. β_{1t}, called autocorrelation or predictable coefficient, measures the potential serial dependency of stock market returns. Both are time-varying parameters. Under the null hypothesis of weak-form efficient market, all the values of estimated β_{1t} must be equal to zero or statistically insignificant. h_t is the conditional variance of residuals which follows a GARCH (1,1) process as proposed by Bollerslev (1986). The return generating process (i.e., equation 1) is corrected for the local market risk through the presence of the '*in-mean*' parameter α which will be interpreted as a market-risk premium related to conditional volatility. Finally, the random variables v_{it} and $\mathring{a}_t$ represent the noise processes from state and measurement equations. They are assumed to be independent from one another and to have a normal distribution. The above model is general in the sense that it contains the case of constant parameter model when v_{it} does not vary over time. Using Monte Carlo experiments, Zalewska-Mitura and Hall (1999) emphasize that this model is able to efficiently detect shifts in market efficiency with the exception of the first few observations. Rockinger and Urga (2000) apply this methodology to test for return predictability in some transitional-economy stock markets of Central and Eastern Europe. In comparison with our model, these authors developed a GARCH (1,1) process which allows for asymmetric volatility, but they did not take into account the market risk premium in the mean equation. By employing the same methodology as presented above, Li (2003) finds evidence of time-varying informational efficiency in China's A-Share and B-Share markets, while Jefferis and Smith (2005) show empirical evidence of time-varying efficiency in several African stock markets. However, none of these papers have studied the effect of stock market liberalization on the changing market efficiency.

As far as weak-form market efficiency is concerned, the question of whether the predictability of stock returns (if such exists) can be exploitable or not is also of interest. Intuition suggests that some stock return predictability may be present in the data before transaction costs are introduced, but may not be economically significant after such costs have been taken into account. On the other hand, when emerging markets become more open to foreign investment flows, transaction costs will be lower than before. In this scenario, the dynamics of market efficiency are directly linked to the dynamics of transaction costs. However, grasping the effects of transaction costs on the time-varying measure of return predictability proves quite difficult in the context of emerging markets due to a lack of proper measures of these costs prior to liberalization. Hence, in this paper we have restricted our analysis to studying the way that informational efficiency is implicitly driven by market mechanisms. We are neverthe-

less aware that greater inefficiency in the pre-liberalization period does not automatically imply higher exploitability than in the post-liberalization period, which is characterized by the reduction of transaction costs and other investment barriers.

Given the state space forms of our empirical model, the Kalman Filter technique can be applied to construct the log-likelihood function under normality assumption. After that, the above model can be estimated in the traditional way by maximizing the log-likelihood function (see, Harvey, 1993). The quasi-maximum likelihood estimation (QMLE) is used to ensure the robustness of the results. The optimization strategy is based on the BHHH algorithm (Berndt, Hall, Hall and Hausman, 1974).

To address the question of whether emerging markets become more efficient after stock market liberalization, we perform a powerful regression model. Precisely, the testable model takes the following form:

$$EFFICIENCY_t = CONST + \lambda_1 LIB1 + \lambda_2 LIB2 + \sum_{i=1}^{5} \delta_i PROXY_{i,t} + \sum_{j=1}^{4} \phi_j CONTROLS_{j,t} + \varepsilon_t \quad (4)$$

Where $EFFICIENCY_t$ is the estimated time-varying measure of market efficiency (*i.e.*, β_{lt}). *CONST* is a constant term. *LIB1* is a dummy variable taking the value of one if market is liberalized and zero otherwise. *LIB2* is a dummy variable taking the value of one during the period of host sequential liberalizations and zero otherwise. *LIB2* is set to one from T-12 to T + 12, where T is the official date of liberalization for each market identified by Bekaert and Harvey (2000). $PROXY_{i,t}$ refers to market-liberalization proxy variables, including five variables: *NS*, *ST*, *VT/GDP*, *MCAP/GDP* and *TURNOVER*. *NS* refers to the natural log of the number of stocks listed on the local market. *ST* refers to the natural log of the total number of shares traded during the month *t*. *VT/GDP* refers to the ratio of the total value of shares traded expressed in millions of US dollars to GDP. *MCAP/GDP* refers to the ratio of emerging market capitalization to GDP. *TURNOVER* equals the trading value divided by average market capitalization for the period *t* and *t – 1*. *TR/GDP* refers to the ratio of the sum of total imports and exports to GDP. $CONTROLS_{j,t}$ is the growth rate of four macroeconomic variables including interest rates, real exchange rates, inflation rates and political stability indexes.

In this setting, *LIB1* was designed to capture the immediate effects of market liberalization. Liberalization's gradual effects are controlled by *LIB2* and other proxy variables related to changes in market liquidity (*ST*, *VT/GDP* and *TURNOVER*), market development (*NS* and *MCAP/GDP*) and market integration (*TR/GDP*). In finance literature, some of the above explanatory variables have been used to test the effects of market liberalization on the cost of capital (see, e.g., Henry, 2000; and Bekaert and Harvey, 2000). In addition, Errunza (2001) documents improvements on market indicators such as the number of listed companies, trading value, turnover ratio, and market capitalization to GDP ratio, following market liberalization. Bekaert and Harvey (1995) considered the trade-to-GDP ratio as a proxy of market openings when testing the time-varying market integration in emerging market countries. Hence, we expect that such explanatory variables should capture all of the various development stages of market liberalization policy. The role of control variables is to control for the effect of economic and political perspectives in local markets, which might be essentially guided by other simultaneous reforms such as interest-rate and exchange-rate reforms.

All in all, according to the regression model, stock market liberalization leads to more efficient markets in emerging countries only if the explanatory variables related to liberalization are negatively correlated to the efficiency measure.

III Sample markets and data

This paper investigates whether stock market liberalization led to improved weak-form market efficiency in emerging markets. Our empirical evidence focuses on the stock markets of eight countries: Argentina, Brazil, Chile, Colombia, Malaysia, Mexico, Thailand and Venezuela, using monthly returns for the S&P/IFC Global Equity Market Indices[2]. This data come from the Standard and Poor's Emerging Market Database (EMDB). However, since the available sample periods are not the same for all markets examined in the study, and since in some cases data is available only for recent years, the sample period chosen is necessarily different among sample markets. Specifically, the data for Argentina, Brazil, Chile, Mexico and Thailand covers January 1976 to March 2000 while for Colombia, Malaysia and Venezuela the given data covers the period January 1986 to March 2000. It is important to note that we intentionally end our empirical analysis in 2000 for two reasons. First, by extending the sample period beyond ten years following the event date and whether stock market liberalization is a gradual process or not, we complicate our analysis because other unexpected macroeconomic and political events are likely to bias the effect of stock market liberalization on market efficiency. Second, our study depends on the availability of macroeconomic series for emerging markets when testing for the long-term relationship between stock market liberalization and informational efficiency by regression analysis.

Table 1 reports alternative dates of market liberalization for sample emerging markets. Major differences in these liberalization dates can be summarized as follows: Bekaert and Harvey (2000) examine the chronology of capital control restrictions for each country and then consider the date after which foreign investors can legally hold domestic securities and domestic investors can trade on foreign markets as official equity market liberalization. The purpose of Kim and Singal (2000) is to use the effective liberalization date which corresponds to the most significant market liberalization. Henry (2000) follows a more complex procedure to date equity market liberalization. According to the authors, official policy decree dates are chosen if availa-

ble; otherwise, two alternative criteria are used: the announcement date of the first Country Fund introduction and the specific date indicating a sizeable increase in the investable index as established by the International Finance Corporation.

Table 2 provides some market indicators for each market before and after stock market liberalization. In general, we observe that all the market indicators substantially increased in the post-liberalization period, which is consistent with the previous findings of Errunza (2001).

Table 1. **Financial liberalization dates for sample emerging stock markets**

Markets	Bekaert & Harvey (2000)	Kim & Singal (2000)	Henry (2000)
Argentina	November 1989	November 1989	November 1989
Brazil	May 1991	May 1991	March 1988
Chile	January 1992	October 1989	May 1987
Colombia	February 1991	February 1991	December 1991
Malaysia	December 1988	N.A	May 1987
Mexico	May 1989	May 1989	May 1989
Thailand	September 1987	August 1988	January 1988
Venezuela	January 1990	January 1990	January 1990

Table 2. **Market indicators: pre- and post-liberalization periods**

Market	Pre-liberalization period				Post-liberalization period			
	No. of listed stocks	Trading Value	Market Turnover (%)	Market Cap.	No. of listed stocks	Trading Value	Market Turnover (%)	Market Cap.
Argentina	202.60	47.44	1.95	2195.02	176.71	654.84	3.98	15099.74
Brazil	584.56	1634.69	3.26	26882.06	571.56	1659.13	3.38	47901.33
Chile	216.64	46.69	0.84	5618.68	230.02	156.27	0.60	25898.63
Colombia	92.08	5.50	0.59	963.40	80.56	32.31	0.78	3711.74
Malaysia	232.10	305.19	1.25	22341.75	324.32	4083.75	3.66	79782.07
Mexico	183.00	622.02	5.42	12615.25	198.68	3139.55	3.57	90637.30
Thailand	120.02	516.50	6.40	7612.95	266.5	4413.17	9.19	42247.88
Venezuela	59.54	10.76	0.37	936.54	86.75	204.33	2.68	7349.83

Notes: This table reports the monthly average values for some market indicators. The pre-liberalization period is from January 1986 to December 1989 (48 months) and the post-liberalization period from January 1990 to December 1993 (48 months). Trading value and Market capitalization are expressed in millions of US dollars. Turnover ratio (measured in percentages) for the month i is calculated by dividing the total trading value of the month i by average market capitalization for months i and i-1. This information was derived from S&P's Emerging Market Data Base.

Table 3 reports descriptive statistics for monthly return series. The sample means for emerging markets range from 0.48% per month for Malaysia to 1.92% per month for Chile. Brazil appears to be the riskiest market, with a standard deviation of 22.53% per month. The significance of sample skewness and kurtosis coefficients, coupled with the Jarque-Bera normality statistics, demonstrates that the distribution of monthly returns is non-normal. The only exception is Malaysia, where a Jarque-Bera test provides evidence of normally distributed returns. The results of the Ljung-Box Q-Statistics applied to the first six and twelve lags in return levels, and the first twelve lags in squared returns, indicate that serial correlations and nonlinear dependencies exist in all countries, except for Venezuela. We also recognize that the nonlinear dependencies are more significant than the linear ones because the value of the Ljung-Box Q-Statistics for squared returns is generally higher than for the raw returns. Finally, Engel's (1982) test for conditional heteroscedasticity rejects the null hypothesis of no ARCH effects in stock returns for seven markets, and thus justifies our empirical model's specification.

Monthly export and import data used to construct the *TR/GDP* ratio is derived from the International Monetary Fund's International Financial Statistics (IFS) database. GDP data also comes from the IFS and we divide annual GDP by twelve to obtain monthly GDP. The political stability index is provided by the International Country Risk Guide database, while other macroeconomic variables come from the IFS database[3]. All other data was extracted from S&P's EMDB. Summary statistics for the liberalization proxy variables and control variables are reported in Table 4.

Table 3. **Basic statistics of stock market returns**

Properties	Argentina	Brazil	Chile	Colombia	Malaysia	Mexico	Thailand	Venezuela
Mean	1.71	0.83	1.92	1.60	0.48	1.24	0.76	0.69
Std. Dev.	22.53	16.03	10.01	8.61	10.38	13.39	10.17	14.52
Skewness	0.07	– 0.46	0.29	0.67	– 0.23	– 2.08	– 0.52	– 1.07
Kurtosis	5.28	2.99	1.83	2.09	3.37	10.03	3.64	4.75
Q (6)	5.27	2.67	19.09***	36.88***	16.57*	21.89***	19.50***	5.51
Q (12)	10.11	12.65	45.16***	40.85***	33.22***	28.53***	48.00***	11.57
Q^2 (12)	46.74***	44.97***	40.26***	108.63***	92.72***	31.58***	181.58***	5.66
JB	62.42***	10.07***	20.41***	19.19***	2.53	800.56***	18.09***	55.69***
ARCH(6)	30.43***	6.98	7.67	13.05**	23.95***	35.10***	45.74***	1.75
ARCH(12)	38.14***	33.01***	21.47**	22.98**	32.95***	37.15***	54.03***	0.89

Notes: Mean and standard deviations for monthly returns are reported in percentages per month. Q (6), Q (12) and Q^2 (12) are the Ljung-Box tests for serial correlation in levels and squares of returns. JB is the Jarque-Bera (1980) test for normality. ARCH (6) and ARCH (12) are Engle's (1982) tests for conditional heteroscedasticity in returns. Notice that skewness is equal to zero in a normal distribution, while excess kurtosis is three if series are normally distributed. The superscripts *, **, *** indicate that coefficients are significant at the 10%, 5% and 1% levels of significance, respectively.

Table 4. **Summary statistics on liberalization proxies and control variables**

Variables	Argentina	Brazil	Chile	Colombia	Malaysia	Mexico	Thailand	Venezuela
NS	169.77 (27.01)	0.56 (0.03)	0.25 (0.03)	0.12 (0.05)	0.43 (0.18)	0.19 (0.01)	0.29 (0.13)	0.08 (0.01)
ST	261.25 (221.67)	668.08 (590.51)	1.86 (1.31)	9.99 (77.80)	3.39 (3.76)	1.78 (1.58)	2.13 (2.84)	0.29 (0.52)
VT/GDP	0.03 (0.03)	0.10 (0.08)	0.07 (0.06)	0.01 (0.01)	0.76 (0.93)	0.09 (0.06)	0.30 (0.27)	0.02 (0.03)
MCAP/ GDP	1.25 (0.87)	2.15 (1.17)	8.52 (4.26)	1.18 (0.77)	18.55 (10.09)	2.79 (1.55)	4.87 (3.15)	1.16 (0.54)
TURN	0.02 (0.02)	0.04 (0.17)	0.01 (0.04)	0.01 (0.00)	0.03 (0.03)	0.04 (0.02)	0.06 (0.03)	0.02 (0.01)
TR/GDP	0.16 (0.03)	0.14 (0.02)	0.50 (0.07)	0.26 (0.03)	1.45 (0.33)	0.42 (0.13)	0.69 (0.14)	0.52 (0.18)
EXC	0.19 (0.69)	0.31 (0.37)	0.01 (0.02)	0.03 (0.02)	0.00 (0.02)	0.04 (0.07)	0.00 (0.03)	0.05 (0.11)
INF	0.08 (0.13)	0.14 (0.15)	0.01 (0.01)	0.02 (0.01)	0.00 (0.00)	0.02 (0.03)	0.00 (0.00)	0.03 (0.02)
INT	0.21 (1.61)	0.09 (0.43)	0.06 (0.39)	– 0.00 (0.05)	0.00 (0.08)	0.00 (0.16)	0.02 (0.25)	0.01 (0.13)
PSI	0.00 (0.02)	0.00 (0.02)	0.00 (0.01)	– 0.00 (0.03)	– 0.00 (0.01)	0.00 (0.02)	0.00 (0.02)	– 0.00 (0.02)

Notes: This table reports the mean and standard deviation (in parentheses) of liberalization proxies and control variables. *NS* is the number of listed stocks in local market. *Shares traded* equalize the total shares traded during the month expressed in billions of shares. *Value trade to GDP* refers to the value of total shares traded in GDP percentages. *Mcap to GDP* is the ratio of the market capitalization divided by GDP. *Turnover ratio* refers to the total value of shares traded during the month *t* divided by the market capitalization. *Trade to GDP* refers to the value of trade sector (imports + exports) divided by GDP. *Interest rate*, *Inflation rate*, *Exchange rate* and *PSI* refer to growth rates of macroeconomic fundamentals. Summary statistics are calculated from January 1986 to March 2000.

IV Result and interpretations

1. The evolution of market efficiency

This section reports and discusses empirical findings from the evolving test of weak-form efficiency. The estimation results of the time-varying coefficient model are presented in Table 5. The point to emphasize is that the mean value of β_{it} coefficients appears to be very close to zero, suggesting a small amount of return predictability. In addition, the coefficients remain relatively stable over time as the estimated values of σ^2_0 and σ^2_1 are generally small. The insignificance of risk premium parameters in all markets indicates the absence of a relation between risk and return in emerging stock markets. It is also demonstrated that the GARCH (1,1) model successfully captures the leptokurtic behavior and nonlinear dependencies of stock market returns for all sample markets, since the conditional volatility process coefficients are highly significant.

Table 5. **Empirical model estimation results**

Markets	β_0 (×10)	β_1 (×10)		σ_0^2 (×10)	σ_0^2 (×10)	$_0$ (×10)	$_1$	$_2$
Argentina	0.07 (0.40)	0.77 (0.07)	0.32 (0.25)	0.00 (0.02)	0.00 (0.13)	0.06*** (0.01)	0.32*** (0.02)	0.67*** (0.00)
Brazil	0.30 (0.08)	0.50 (0.82)	– 1.38 (1.35)	0.00 (0.02)	0.00 (0.11)	0.08*** (0.02)	0.29** (0.09)	0.40*** (0.02)
Chile	0.25 (0.38)	0.51 (1.18)	– 0.23 (2.59)	0.00 (0.04)	0.00 (0.15)	0.02*** (0.01)	0.35** (0.13)	0.42*** (0.01)
Colombia	0.04 (0.08)	4.24 (0.81)	– 4.03 (3.07)	0.00 (0.01)	0.00 (0.43)	0.02*** (0.00)	0.19*** (0.06)	0.50*** (0.00)
Malaysia	0.06 (0.09)	0.58 (1.90)	0.52 (0.73)	0.00 (0.01)	0.00 (0.12)	0.01 (0.01)	0.54*** (0.12)	0.40*** (0.21)
Mexico	– 0.03 (0.11)	2.67 (1.13)	0.57 (0.99)	0.00 (0.02)	0.00 (0.20)	0.05*** (0.01)	0.43*** (0.07)	0.10*** (0.00)
Thailand	0.19 (0.23)	1.37 (0.88)	– 1.29 (0.82)	0.00 (0.02)	0.00 (0.12)	0.01*** (0.00)	0.24*** (0.05)	0.63*** (0.01)
Venezuela	0.87 (0.19)	0.17 (5.94)	– 3.97 (4.73)	0.00 (0.03)	0.03 (0.42)	0.18*** (0.03)	0.13 (0.13)	0.00 (0.00)

Notes: The estimated model is the following:

$$R_t = \beta_{0t} + \beta_{1t} R_{t-1} + \alpha h_t + \varepsilon_t \qquad \varepsilon_t \sim N(0, h_t)$$

$$\beta_{it} = \beta_{it-1} + v_{it} \qquad v_{i,t} \sim N(0, \sigma_i^2) \; ; \; i = 0, 1$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1}$$

The standard deviations are given in parentheses. The superscripts *, **, *** indicate that coefficients are significant at 10%, 5% and 1%, respectively.

To visualize the behavior of estimated β_{it}, we plot their time paths together with their 95% confidence intervals and present results in Figures 1 and 2. Liberalization dates, as identified by Bekaert and Harvey (2000), Kim and Singal (2000), and Henry (2000), are also added to the graph.

We shall now take a closer look at the evolution of informational efficiency for each market under consideration, based on the time paths of the autocorrelation coefficients. Let us recall that for a weak-form efficient emerging market, all β_{1t}'s estimates must be equal to zero or at least statistically insignificant at conventional levels. If market liberalization improves market efficiency, we should see that all markets become efficient after liberalization dates. If a market has already been efficient prior to liberalization, it is reasonable to argue that it appears to be more efficient when the absolute value of β_{1t}'s estimates gradually decreases and moves downwards to zero.

A. Argentina

The graph for this market shows that both β_{0t}'s and β_{1t}'s have evolved over time. With regard to the time paths of the autocorrelation coefficient, we observe a sudden drop which occurred in December 1977. However, this break does not coincide with either liberalization dates or other political changes. Statistical tests indicate that this market was weak-form efficient during the entire estimation period, since the autocorrelation coefficient gradually fell to zero and was not significantly different from zero at 5%.

B. Brazil

The evolution of estimated β_{1t} shows some major fluctuations before the first stock market liberalization as indicated by Henry's (2000) date. We recognize, furthermore, that this coefficient stabilized and showed sign of convergence towards zero after the official liberalization date in May 1991. Since all the β_{1t}'s estimates are not significant at the 5% level, the hypothesis of weak-form efficiency cannot be rejected for this market. However, it is useful to note that the estimated β_{0t} starts to be significantly different from zero at the 5% level from December 1984 until the end of the estimation period. This suggests that additional factors, rather than past returns alone, might be relevant in predicting the actual time-varying returns.

C. Chile

For this market, we first observe that the autocorrelation coefficient was negative from January 1977 to August 1980. After this period, it became positive and tended to increase progressively until the end of the estimation period. Second, according to the results of the efficiency test, the Chilean stock market was found to be unpredictable (or weak-form efficient) over the period from January 1977 to January 1991. Then, from February 1991 onwards, the hypothesis of weak-form efficiency can be eliminated because the autocorrelation coefficient is significantly different from zero. Finally, the time path of autocorrelation coefficient demonstrates that the Chilean stock market has no tendency to converge towards weak-form efficiency.

D. Colombia

In this country's case one easily witnesses a upward break in the autocorrelation coefficient's time path following Henry's (2000) liberalization date, which is marked by a 46% jump in the IFC's investable index. We also note that at the same time, foreign investors were legally allowed to purchase up to 100% of companies listed on the local market. This increased predictability seems deny the positive effects of market liberalization on weak-form efficiency. Except for the periods from January 1986 to May 1986, from July 1986 to November 1986, and from January 1988 to March 1988, the stock market in Colombia is found to be weak-form inefficient until the end of the study period, since the estimates of β_{1t} are significantly

Figure 1. **Time paths of estimated β_{0t}**

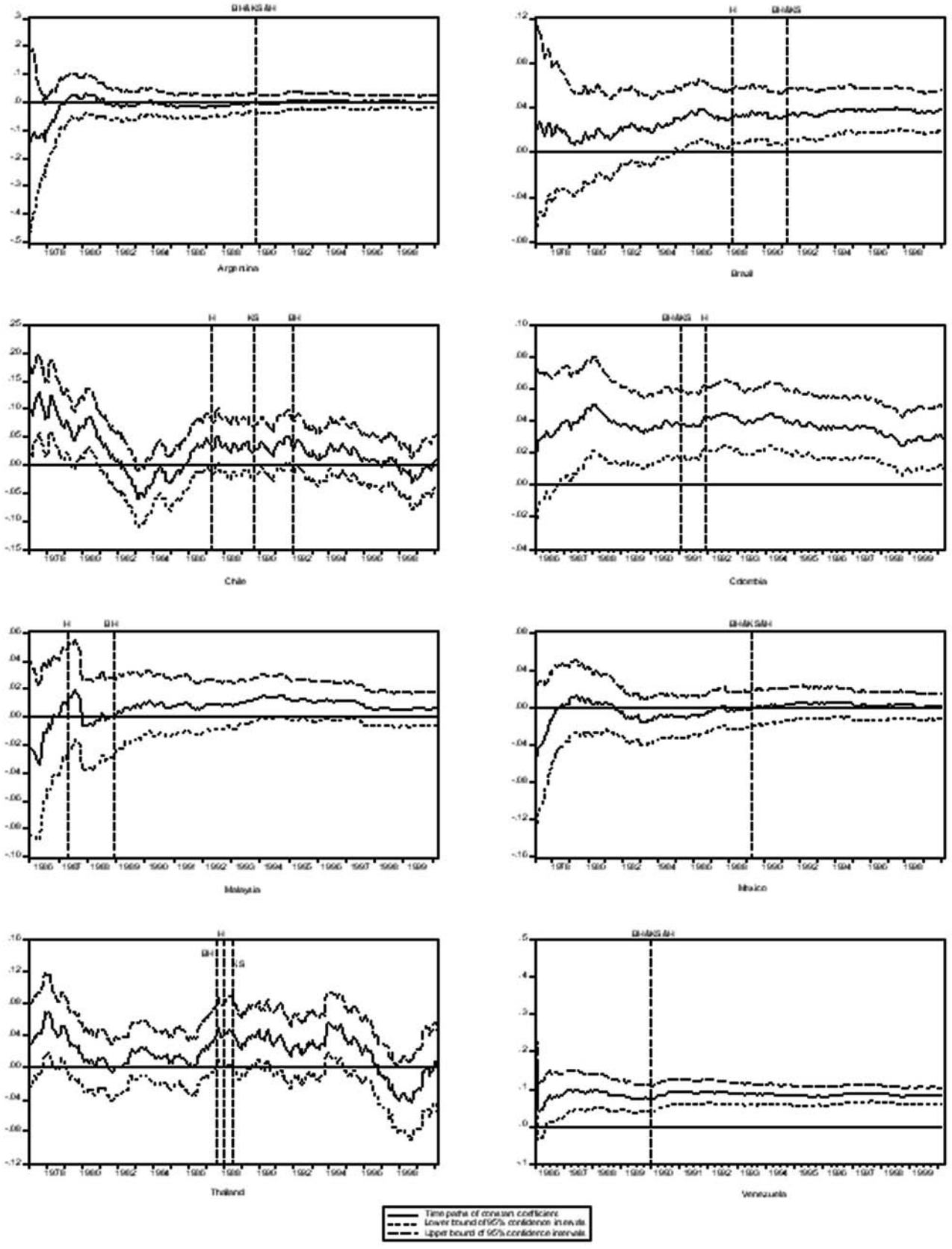
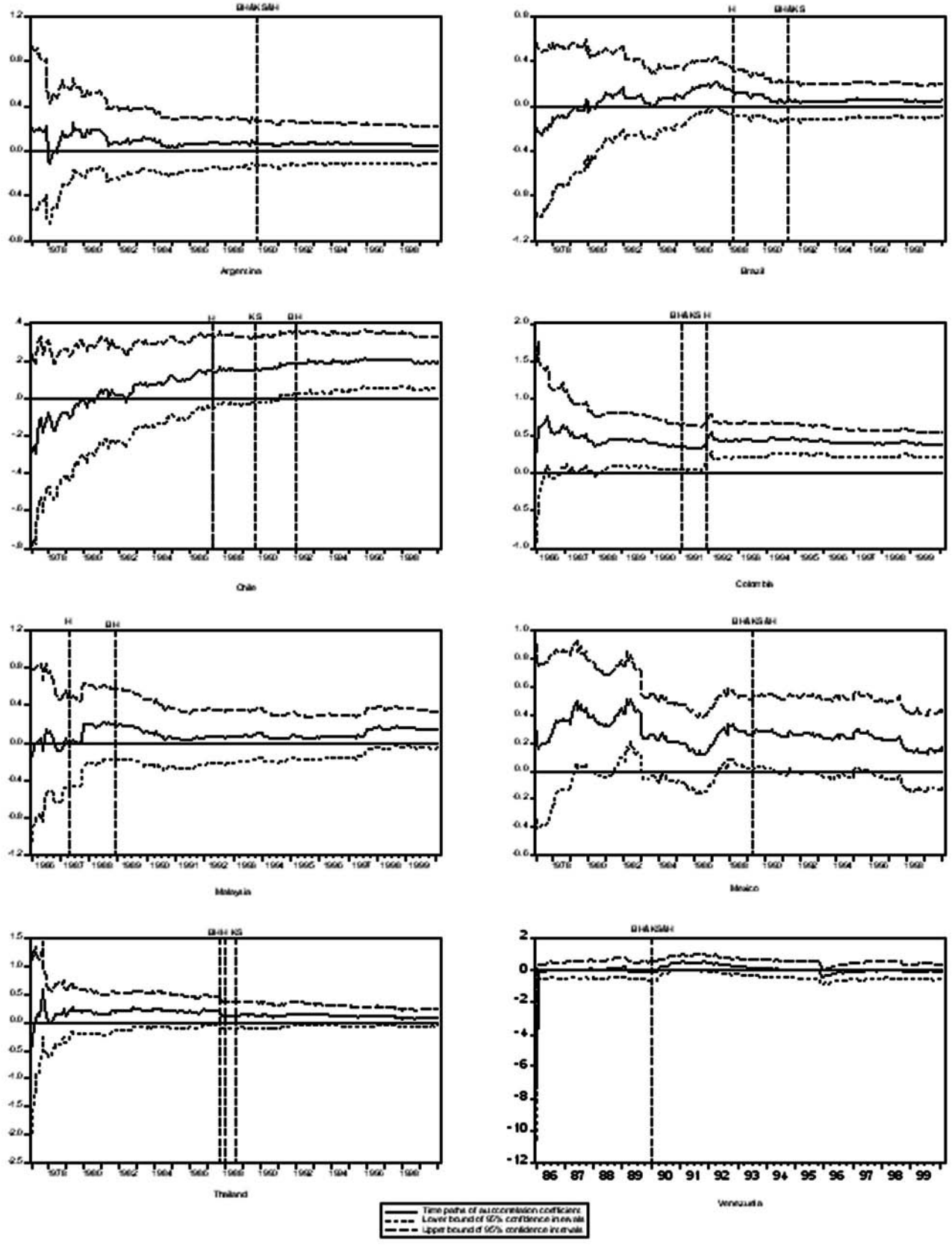


Figure 2. **Time paths of estimated β_{It}**



different from zero at 5%. This market's specific characteristics, including low liquidity, may be central to providing any potential explanations.

E. Malaysia

Except for some sizeable rallying around the first stock market liberalization which came with the introduction of a Country Fund in February 1987, the estimates for the autocorrelation coefficient appear relatively stable and exhibit a slight ascent at the end of the estimation period. There is only slight evidence of the constant coefficient's significance during two months, September and October of 1994. All β_{1t}'s estimates are statistically insignificant at the 5% level, indicating that it is impossible to eliminate the possibility of weak-form market efficiency, both prior to and following liberalization dates.

F. Mexico

The pattern followed by the Mexican stock market is the most complicated of this sample. Effectively, whereas the constant coefficient is insignificant over the entire period, the predictable coefficient shows evidence of significance during several short sub-periods before, during and after market openings. These sub-periods include: April 1979 through December 1979, July 1981 through December 1982, June 1987 through August 1990, and January 1995 to June 1995. There is also evidence of return predictability in August, September and November of 1995. After those sub-periods, the weak-form efficiency premise cannot be excluded until the end of the estimation period.

G. Thailand

Although the constant coefficient value is quite small, it may be important to note that this coefficient fluctuates with no tendency towards zero. On the contrary, the autocorrelation coefficient is very stable and tends towards zero. We found a slight decline in predictability in November 1987, which might be associated with the announcement of the first Country Fund introduction in January 1988. Given the statistical insignificance of the autocorrelation coefficient, we then conclude that stock prices in this market behave in accordance with weak-form efficiency.

H. Venezuela

In this case there is a sudden change in the time path of the autocorrelation coefficient in December 1995, but it does not coincide with market liberalization dates. The predictability of stock market returns from past returns is statistically significant at the 5% level in January 1986, November 1991 and during the period comprised between November 1990 and March 1991. Apart from these periods, the predictability hypothesis can be excluded, thus pointing to weak-form efficiency for this market. Moreover, as in most markets, the constant coefficient is highly significant throughout the estimation period.

In sum, we found that Mexico's and Venezuela's stock markets exhibited some short periods of inefficiency before becoming efficient at the end of the estimation period. In contrast, after being efficient at the beginning of the estimation period, the Chilean and Colombian stock markets show no tendency of converging towards weak-form efficiency. For the other markets, the hypothesis of weak-form efficiency cannot be excluded for the entire period. These results corroborate with the findings of Kawakatsu and Morey (1999) which contend that some emerging markets were already weak efficient before the actual liberalizations. Furthermore, we must note that there are no significant changes in return predictability around the liberalization dates.

2. The effects of market liberalization on informational efficiency

It is generally accepted that the liberalization process is typically a progressive one. This implies that the impact of liberalization on emerging markets should be gradual. To verify this assertion, we first test the null hypothesis that financial liberalization has an immediate effect on emerging market efficiency. A reduced form of the equation (4) in which only *CONST*, and *LIB1* are retained as explanatory variables is then estimated. Note that the construction of *LIB1* is based on Bekaert and Harvey's (2000) liberalization dates. The regression analysis is examined over the period covering January 1986 to March 2000 given the availability of macroeconomic data. The empirical results are shown in Table 6.

Table 6. **Instantaneous effect of stock market liberalization**

Independent variables	Argentina	Brazil	Chile	Colombia	Malaysia	Mexico	Thailand	Venezuela
CONST.	0.06*** (0.00)	0.07*** (0.01)	0.13*** (0.01)	0.43*** (0.01)	0.09*** (0.01)	0.23*** (0.01)	0.12*** (0.01)	0.07** (0.03)
LIB1 (×10)	– 0.01 (0.02)	0.02 (0.12)	– 0.04 (0.10)	0.43 (0.11)	0.06 (0.16)	0.10 (0.12)	0.02 (0.07)	– 5.06 (4.77)

Notes:

Dependent variable: stock market efficiency index (β_{1t})

Independent variables: *Lib1*

Lib1 takes the value of one when emerging market is officially liberalized, and zero otherwise. The official dates of stock market liberalization are derived from Bekaert and Harvey's (2000) study. Standard deviations of estimated coefficients are provided in parentheses. The superscripts *, **, *** indicate that coefficients are significant at 10%, 5% and 1%, respectively.

In Table 6 we observe that none of the coefficients associated with *LIB1* is significant at conventional confidence levels. In all evidence, our results reject the null hypothesis of market liberalization's instantaneous effects on market efficiency. These findings reinforce the empirical evidence provided by the aforementioned evolving efficiency test.

Excluding the hypothesis of immediate effect of market liberalization on weak-form efficiency does not explicitly imply the existence of its gradual effects. Empirical proof is then necessary to reach a clear-cut conclusion. To this end, we estimate a reduced form of the equation (4) where its right-hand-side includes a constant, *LIB2*, *NS*, *ST*, *VT/GDP*, *MCAP/GDP*, *TURNOVER* and *TR/GDP*. The empirical results are reported in Table 7. As can be observed, the coefficient of *LIB2* is highly significant in five markets, indicating the gradual correction of return behavior with respect to stock market liberalization. More importantly, *LIB2* contributes to reducing the predictability of past returns on actual returns in three of these markets (Brazil, Colombia and Thailand). *LIB2* does not create any significant effects on predictable coefficients in Argentina, Mexico and Venezuela. In this case, it is possible that our period of host liberalizations does not yet cover these markets' effective openings. In Brazil, for example, the first ADR is introduced only in August 1991, well long after the official liberalization date. We recognize, in addition, that although proxy variables of liberalization have significant effects on the time-varying efficiency measure in most markets, the direction of effect is quite different depending on the markets. For example, the *TR/GDP* triggers an increase of return predictability in Argentina, whereas it helps to eliminate market inefficiencies in Mexico and Thailand. In all markets, we noted that the increase of the number of listed companies generates an intensification of return predictability.

In testing the effects of market liberalization on informational efficiency, one fundamental concern is that we are not sure whether or not the changes in return behavior are related only to stock market liberalization. Some authors have shown that other simultaneous economic reforms might also be responsible for a part of these changes (see Henry, 2000). In particular, if a market is opened during a period of good macroeconomic conditions (without uncertainties), it is possible that results presented in Table 7 contain an upward evaluation of liberalization effects. To avoid this problem, we now take into account four control variables and re-estimate the above regression model. The results are reported in Table 8.

Table 7. **Gradual effects of stock market liberalization: unadjusted results**

Independent variables	Argentina	Brazil	Chile	Colombia	Malaysia	Mexico	Thailand	Venezuela
CONST.	– 0.31*** (0.06)	– 1.57* (0.88)	– 0.22 (0.22)	0.13 (0.29)	– 0.53*** (0.06)	– 2.20*** (0.53)	0.21** (0.08)	– 0.37 (0.54)
LIB2	– 0.00 (0.00)	– 0.03* (0.02)	0.02*** (0.01)	– 0.09*** (0.02)	0.14*** (0.02)	0.02 (0.02)	– 0.02* (0.01)	0.05 (0.06)
NS (×10)	0.69*** (0.11)	2.79** (1.32)	0.61 (0.39)	0.75 (0.56)	0.83*** (0.21)	4.64*** (1.04)	0.05 (0.18)	0.93 (1.17)
ST (×10)	0.00 (0.00)	– 0.01* (0.01)	– 0.04 (0.04)	0.19*** (0.06)	0.23 (0.14)	0.09 (0.10)	– 0.14*** (0.05)	– 0.77*** (0.18)
VT/GDP	– 0.10 (0.07)	– 0.15 (0.15)	– 0.01 (0.13)	– 3.74 (2.36)	0.04*** (0.01)	0.13 (0.16)	– 0.04** (0.02)	– 3.31* (1.71)
MCAP/GDP (×10)	0.05 (0.03)	0.10 (0.12)	0.06*** (0.02)	– 0.78** (0.34)	– 0.04*** (0.00)	– 0.08 (0.07)	0.02** (0.01)	3.63*** (0.51)
TURN	0.17 (0.12)	0.15 (0.39)	0.10 (1.38)	5.85 (3.97)	– 1.15** (0.53)	0.40 (0.43)	0.65*** (0.14)	7.94** (3.44)
TR/GDP	0.07*** (0.02)	– 0.00 (0.21)	– 0.03 (0.03)	– 0.27 (0.22)	0.02 (0.02)	– 0.21*** (0.05)	– 0.08*** (0.03)	– 0.20 (0.19)
Adjusted R^2	0.413	0.474	0.840	0.399	0.710	0.567	0.761	0.665

Notes**:**

Dependent variable: Dependent variable: stock market efficiency index (β_{1t})

Independent variables: *Lib2*, *NS*, *ST*, *VT/GDP*, *MCAP/GDP*, *TURN*, *TR/GDP*

Lib2 is a dummy variable which takes the value of one during the period of host sequential liberalization and zero otherwise. *Lib2* is set to one from T-12 to T +12 that gives a 25-month event window, where T is the official date of liberalization identified by Bekaert and Harvey (2000). *NS* is the number of listed stocks in local market. *ST* equalizes the total shares traded during the month expressed in millions of shares. *VT/GDP* refers to the value of total shares traded in percentage of GDP. *MCAP/GDP* is the ratio of the market capitalization divided by GDP. *TURN* refers to the total value of shares traded during the month *t* divided by the market capitalization. *TR/GDP* refers to the value of trade sector (imports + exports) divided by GDP. The regressions are performed from January 1986 to March 2000. Heteroscedasticity-consistent standard deviations are provided in parentheses. The superscripts *, **, *** indicate that coefficients are significant at 10%, 5% and 1%, respectively.

Table 8. **Gradual effect of liberalization: adjusted results**

Independent variables	Argentina	Brazil	Chile	Colombia	Malaysia	Mexico	Thailand	Venezuela
CONST	– 0.31*** (0.06)	– 1.94** (0.89)	– 0.21 (0.22)	0.24 (0.24)	– 0.56*** (0.06)	– 2.39*** (0.45)	0.22*** (0.08)	– 0.43 (0.54)
LIB2	– 0.00 (0.00)	– 0.05** (0.02)	0.02** (0.01)	-0.08*** (0.02)	0.14*** (0.02)	0.04** (0.02)	– 0.02* (0.01)	0.05 (0.06)
NS (×10)	0.70*** (0.12)	3.40** (1.37)	0.59 (0.40)	0.63 (0.49)	0.89*** (0.22)	4.91*** (0.90)	0.03 (0.70)	1.12 (1.20)
ST (×10)	0.00 (0.00)	– 0.08 (0.05)	– 0.04 (0.04)	0.18*** (0.06)	0.24 (0.15)	0.11 (0.09)	– 0.14*** (0.05)	– 0.76*** (0.17)
VT/GDP	– 0.09 (0.06)	– 0.14 (0.15)	– 0.00 (0.14)	– 4.14 (2.57)	0.04*** (0.01)	0.13 (0.13)	– 0.04** (0.18)	– 3.51** (1.57)
MCAP/GDP (×10)	0.05 (0.03)	0.04 (0.13)	0.06*** (0.02)	– 0.70** (0.33)	– 0.05*** (0.00)	– 0.00 (0.06)	0.02** (0.01)	3.51*** (0.50)
TURN	0.16 (0.12)	– 0.04 (0.39)	0.03 (1.53)	6.35 (4.31)	– 1.20** (0.51)	0.06 (0.36)	0.63*** (0.15)	8.57*** (3.01)
TR/GDP	0.07*** (0.02)	– 0.04 (0.20)	– 0.031 (0.04)	– 0.43* (0.22)	0.01 (0.01)	– 0.19*** (0.04)	– 0.08*** (0.03)	– 0.17 (0.19)
EXC	0.01* (0.00)	– 0.02 (0.02)	0.03 (0.07)	0.08 (0.17)	– 0.11 (0.08)	– 0.04 (0.04)	0.06* (0.03)	0.19*** (0.04)
INF	– 0.01 (0.01)	– 0.04 (0.05)	– 0.01 (0.21)	– 0.99 (1.03)	1.47*** (0.47)	0.99*** (0.16)	– 0.22 (0.21)	– 1.31** (0.61)
INT	– 0.00*** (0.00)	0.01 (0.01)	0.00 (0.00)	0.09 (0.07)	0.07 (0.05)	– 0.02 (0.02	0.00 (0.00)	0.11 (0.07)
PSI	0.02 (0.02)	0.17 (0.13)	0.02 (0.11)	0.08 (0.08)	0.14 (0.29)	0.06 (0.17)	0.15** (0.07)	– 0.08 (0.39)
Adjusted R^2	0.476	0.529	0.835	0.402	0.716	0.647	0.763	0.680

Notes**:**

Dependent variable: stock market efficiency index (β_{1t})

Independent variables: *Lib2*, *NS*, *ST*, *VT/GDP*, *MCAP/GDP*, *TURN*, *TR/GDP*, *INT*, *INF*, *EXC*, *PSI*

INF, *EXC* and *PSI* refer to the growth rates of macroeconomic fundamentals. The regressions are performed from January 1986 to March 2000. See also Table 7's notes for the definition of other variables. Heteroscedasticity-consistent standard deviations are provided in parentheses. The superscripts *, **, *** indicate that coefficients are significant at 10%, 5% and 1%, respectively.

We find that for the most part, the new results are similar to those reported in Table 7. The key differences to be noted stem from the significant impact of *LIB2* in Mexico and of *TR/GDP* in Colombia, and from the insignificant impact of *ST* in Brazil. Moreover, the results also indicate that the changing efficiency is mostly influenced by changes in inflation and exchange rates. Finally, as the adjusted R^2 in Table 8 has only improved slightly compared to that in Table 7, it is possible to conclude that our set of proxy variables on liberalization are important drivers of predictability in emerging market returns.

Taken altogether, the findings from our regression analysis provide evidence of a long-term relationship between liberalization and weak-form efficiency. However, the predictability of stock returns can increase in some markets while decreasing in others. This country-specific pattern of empirical results does not allow us to make a common prediction regarding the effect of stock market liberalization on emerging market efficiency.

V Concluding remarks

In this paper, we provide further empirical evidence on the valuation effect of stock market liberalization and on informational efficiency in emerging markets. Using a dynamic model which allows for measuring the time-varying return predictability, we found that stock markets in Mexico and Venezuela were engaged in a gradual course of convergence towards the weakest efficiency after some short periods of inefficiency at the beginning of the estimation period. By contrast, stock markets in Chile and Colombia began with several short periods of efficiency, but they have become inefficient towards the end of the estimation period. For the remaining markets, it is demonstrated that they were already efficient even before actual liberalization, consistent with the findings of Kawakatsu and Morey (1999). We also attempted to relate the dynamic of weakest efficiency to market liberalization by performing a powerful regression analysis. Overall, whereas we found significant linkages between market liberalization and efficiency, we cannot come to a clear conclusion about the sign of effect because empirical results tend to be country-specific. These results do not change when control variables are taken into account.

The model used in this study can be improved in order to directly control for the impact of world information on local market efficiency. Since all of our markets have been liberalized during the sample period, the world market risk may play an important role in the formulation of expected returns in emerging countries. It follows that the world market covariance risk should be included in the model to test market efficiency. Furthermore, given that the dynamics of our informational efficiency measure can be directly

linked to those of both transaction cost and investment restriction in the context of emerging stock markets, it would be beneficial to explicitly incorporate the effects of these factors within our empirical models in a future study. Such avenues for further research are currently being pursued by the authors.

1. For a fully comprehensive review of the theory and empirical evidence on market efficiency, interested readers are invited to refer to the frequently cited works of Fama (1991,1998), and Dimson and Mussavian (1998).
2. Monthly returns expressed in US dollars are used and were computed as $\ln P_t^i - \ln P_{t-1}$, where P_t^i is the S&P/IFC Global Equity Market Index Price at time *t* for market *i*. This allows us to analyze the returns on a common basis and moreover to avoid the effects of inflation in Latin American emerging markets. Note also that weekly and daily data are not of interest in this study because they may lead to spurious results given the so-called problem of non-synchronous and thin trading in emerging markets. Additionally, we may loose some information about liberalization's effects since they are only available from 1988 and 1990, respectively, while most of our markets were liberalized in the middle and late 1980s.
3. The political stability index provides a means of assessing an individual country's political stability perspective. It is constructed by assigning risk points to a pre-set group of factors. The minimum score is zero, indicating the highest risk, while the maximum score is 100, indicating the lowest risk.

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