Emerging Markets Review 17 (2013) 186–208

Contents lists available at ScienceDirect

Emerging Markets Review

journal homepage: www.elsevier.com/locate/emr

Financial liberalization and stock markets efficiency: New evidence from emerging economies

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ARTICLE INFO

Article history:
Received 4 March 2013
Received in revised form 4 July 2013
Accepted 23 September 2013
Available online 29 September 2013

JEL classification:
G01
G14
G15
G18
C21

Keywords:
Financial crises
Informational efficiency
Financial liberalization
Emerging markets
Treatment effects model
GARCH

ABSTRACT

This paper aims to assess the impact of financial liberalization on the degree of informational efficiency in emerging stock markets while considering three types of financial crises, i.e. banking, currency and twin crises. To this end, a treatment effects model with time-varying parameters is estimated for 13 emerging economies from January 1986 to December 2008. Empirical results show that there is a greater efficiency in recent years and that financial liberalization not only improves the degree of efficiency but also reduces the probability of financial crises. They also suggest that improving efficiency depends upon several internal characteristics.

Contents

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http://dx.doi.org/10.1016/j.ememar.2013.09.001

1. Introduction

According to emerging countries regulatory agencies, liberalization leads to a reduction of risk, especially if it is accompanied by an improvement of the financial market performance. Therefore, although it may reduce volatility for most emerging markets over the long term,[1] it is also important to assess the informational efficiency in these markets (Fontaine and Nguyen, 2006). According to Fama (1991), an efficient market is a market where the prices fully reflect all available information. This has strict implications on stock market analysis and portfolio management. Indeed, in the case of an efficient market, the abnormal profits are non-existent. According to Fontaine and Nguyen (2006), in the case where the market is efficient, investors are able to easily determine the risk and the return of their investments because there are no overvalued and/or undervalued assets. In addition, because in an efficient market, the price accurately reflects the perspectives of the listed company, capitals will be allocated efficiently to the most profitable investments, which are beneficial for the market development and probably helps in promoting economic growth.

It should be noted that emerging countries are characterized by a low quality of information disclosure, a weak trading volume and an inadequate accounting regulations. This may lead to a weak dependency of prices over time, and markets are considered as weakly efficient in this case. For these reasons, financial literature focuses on testing the weak form efficiency in emerging markets. Moreover, it is important to check whether future prices movements of financial assets can be predicted from past prices movements. However, so far there is no consensus on the validity of the weak efficiency hypothesis in emerging markets. Indeed, some studies conclude that emerging market returns are not autocorrelated, which supports the weak efficiency hypothesis (Füss, 2005; Kim and Singal, 2000a, 2000b), while others emphasize the invalidity of the weak form efficiency (Dockery and Vergari, 1997; Emerson et al., 1997; Harrison and Paton, 2005; Rockinger and Urga, 2001; Zalewska-Mitura and Hall, 1999).

Since the liberalization of emerging stock markets in the mid-1980s, these markets have become more integrated into the global markets. They try to attract international investors and benefit from their experiences to diversify the portfolio risk, to increase the level of liquidity, to improve informational transparency and consequently the degree of efficiency. However, in spite of this increased integration, previous attempts to test the relationship between the stock markets liberalization and the informational efficiency have remained inconclusive. Indeed, the expected impact of financial liberalization[2] has not always been confirmed by the financial literature. The divergence of the empirical results does not allow reaching a clear cut conclusion regarding the relationship between financial liberalization and informational efficiency in emerging markets.

The divergences in empirical results may be due to the fact that most existing studies have examined the effects of financial liberalization on the informational efficiency by comparing measures of the market efficiency in two sub-periods (pre-liberalization and post-liberalization). We do believe that this way of

[1] This finding is corroborated by several previous studies including Bekaert and Harvey (1997, 2000), Kim and Singal (2000a, 2000b), Kassimatis (2002) and recently Ben Rejeb and Ben Salha (2013), Nguyen (2010) and Jayasuriya (2005).

[2] The expected impact of financial deregulation on efficiency is usually manifested by a gradual improvement in the degree of informational efficiency.

doing is inappropriate and generally leads to spurious results. In addition, a change in the degree of informational efficiency cannot be attributed only to the effects of financial liberalization, since the latter is often accompanied by financial crises, which affects the degree of efficiency. We believe that the econometric methods used in previous studies in order to determine the degree of efficiency are not adapted to emerging markets characteristics. The use of econometric models assuming the stability of parameters through time does not allow capturing the degree of efficiency, given that the latter may vary depending on the structural changes affecting the pre-requisites of efficiency, for example, the liquidity and informational transparency.

We propose, in this paper, an original empirical framework allowing to determine more effectively the impact of financial liberalization on the informational efficiency, and to take into account the mediating effect of financial crises on the relationship between these two concepts. The main purpose of this paper is to test the impact of financial liberalization on the informational efficiency in emerging markets using a more appropriate methodology. In line with Jefferis and Smith (2005), Fountain and Nguyen (2006) and Arouri et al. (2010), we take into consideration the evolutionary characteristics over times of emerging markets. Our main methodological contribution resides in the consideration of the mediating effect of financial crises on the relationship between financial liberalization and informational efficiency using the treatment effects model which is until now, rarely used in this context.

The remainder of the paper is organized as follows. Section 2 provides a review of literature concerning the relationship between financial liberalization and informational efficiency. In particular, financial crises and their influences on the evolution of efficiency in emerging stock markets are focused on. Section 3 presents the methodology adopted to determine the stock return predictability index as well as the empirical model to assess the impact of financial liberalization on the informational efficiency. Section 4 describes the data used. Section 5 summarizes the empirical results. Section 6 discusses the policy implications and concludes.

2. Literature review

Since the 1980s, the financial literature has sought to study the impact of financial liberalization on many aspects of emerging markets finance. The direct impact of financial liberalization on informational efficiency and the impact of liberalization on financial crises have been treated separately. A rigorous analysis of the interaction between financial liberalization, informational efficiency and financial crises is recommended in order to determine the real effect of financial liberalization on the informational efficiency. In this literature review, we present the empirical studies that dealt with these issues.

2.1. Financial liberalization and weak form informational efficiency

Many Studies have been conducted to examine the effects of financial liberalization on the informational efficiency in emerging markets. Most of them tests two types of hypotheses, namely the serial dependence of returns and the random walk, on two sub-periods: before and after financial liberalization. The financial liberalization effect is often assessed by comparing the empirical results over the two sub-periods, which might provide inconclusive or contradictory results.

Among the studies that have rejected the hypothesis of weak efficiency in emerging markets after financial liberalization, we mention the one of Groenewold and Ariff (1998). These authors attempt to test the hypothesis of weak efficiency and explain changes in the degree of efficiency by financial deregulation. Using a sample of developed and emerging markets, they show that emerging markets have not become more efficient after liberalization. Likewise, Kawakatsu and Morey (1999) examine the hypothesis of weak efficiency in stock markets of nine emerging economies before and after liberalization. They try to see whether past returns have a predictive power on future returns by making use of a first order autoregressive model, and they perform a unit root test in the price process to verify the results of the serial correlation test. They provide evidence that liberalization does not contribute to improve the efficiency of stock markets, which imply that many markets are efficient before the effective liberalization. Basu et al. (2000) test the predictability of returns before and after financial liberalization in a sample of emerging countries using the Ljung and Box (1978) autocorrelation test and the Lo and MacKinlay (1989) test. Their results provide little support of more efficiency in open markets. In the same vein, Laopodis (2003, 2004)

investigates whether financial liberalization in emerging economies has impacted the functioning of stock markets indexes. In order to show that the Greek stock market was weakly efficient before liberalization, the author uses data on Athens Stock Exchange and employs structural change tests as well as several tests of efficiency. His findings corroborates those of Maghyereh and Omet (2002) who conclude that financial liberalization has no effect on markets efficiency, such as the Amman Stock Exchange which remains inefficient after liberalization.

As for studies supporting the weak form efficiency hypothesis in emerging markets, we cite the one of Kim and Singal (2000a). The authors use the Lo and MacKinlay (1988) variance ratio to assess whether financial asset prices from fourteen emerging markets follow a random walk after their effective liberalization. Their results are inconsistent with previous studies in seeing that stock prices are less dependent after liberalization. Such finding reflects an improvement in efficiency. Recently, Füss (2005) tests the random walk and the efficiency hypotheses in the presence of an increase in the integration degree of seven Asian countries. He uses some several tests including the Lo and MacKinlay (1988) variance ratio, the multiple variance tests, and the Chow and Denning (1993) ratio. The weak form market efficiency is also checked directly using a non-parametric test. The author reaches the same conclusion as Kim and Singal (2000a, 2000b).

2.2. Weak informational efficiency and financial crises

The study of the direct impact of financial liberalization on the informational efficiency in emerging markets may not effectively reflect the reality of its magnitude because liberalization is not the only factor that influences the informational efficiency. Other factors may influence the efficiency and are themselves influenced by the liberalization process. In spite of the multiplicity of financial crises in emerging economies during the last decades leads financial economists to believe to the existence of an effect between financial crises and the efficiency in emerging stock markets, few studies have nonetheless discussed the impact of financial crises on the informational efficiency in these markets.

Recently, Hoque et al. (2007) examine the weak form of efficiency for the pre-crisis period (1990–1997) and post-crisis period (1998–2004) in eight Asian stock markets using variance tests. Their results show that crisis has no significant effect on the degree of efficiency in six Asian markets (Hong Kong, Indonesia, Malaysia, the Philippines, Singapore and Thailand). The inefficiency persists even after the crisis, while the opposite occurs for Korea. Taiwan is the only market that recorded a higher efficiency from the pre-crisis to the post-crisis period. These findings are corroborated by Faiq et al. (2010) for the Chinese market. The authors test the weak form of efficiency over two sub-periods (before and during the sub-prime crisis) by checking for the presence of unit root in the return series of two stock markets in China. The authors find that the sub-prime crisis has no impact on the informational efficiency in the Chinese stock market. Using new tests of multiple variance ratio, Kim and Abul (2008) also find that the Asian crisis does not coincide with a significant change in the level of market efficiency for both the efficient group (Hong Kong, Japan, Korea and Taiwan) and the inefficient group (Indonesia, Malaysia and the Philippines). Singapore and Thailand represent two exceptional cases that reach efficiency after the crisis. In an exclusive study on the Malaysian stock market, Cheong et al. (2007) split data into four sub-periods, i.e. pre-crisis, crisis, USD pegged period and post-crisis. Using the median of the computed rolling Hurst exponents, the authors come to the conclusion that inefficiency is higher during Asian financial crisis, followed by pre-crisis, post-crisis and USD pegged periods. Lim et al. (2007) examine the effect of the 1997 financial crisis on the efficiency of eight Asian stock markets by running the rolling bicorrelation test for the three sub-periods (pre-crisis, crisis and post-crisis). On a country-by-country basis, their results demonstrate that the crisis adversely affects the efficiency of most Asian stock markets. Hong Kong is the hardest hit, followed by the Philippines, Malaysia, Singapore, Thailand and South Korea. However, most of these markets recover in the post-crisis period in terms of improved market efficiency. Their findings regarding Malaysia are consistent with those reported by Cheong et al. (2007), in which the highest inefficiency occurs during the crisis period, followed by the pre-crisis and post-crisis periods.

2.3. Financial liberalization and financial crises

The recurrence of financial crises during the last two decades including the European Monetary System crisis (1992–1993), the Tequila crisis (1994–1995), the East Asian and Russian crisis (1997–1998), the Turkish crisis (2001), the Sub-prime crisis (2007–2009) and the Greek debt crisis (2011) have focused on

the implication of financial liberalization in triggering these crises (Aka, 2006; Cunado et al., 2006; Giannetti, 2007; Ranciere et al., 2006).

Many empirical studies, including Kaminsky and Reinhart (1999) and Ranciere et al. (2006), show that the majority of historical crises are preceded by a period of financial liberalization. In their pioneering study, Demirguc-Kunt and Detragiache (1998) analyze the empirical linkage between banking crises and financial liberalization among a sample of 53 countries over 1980–1995. They conclude that banking crises occur in liberalized countries rather than non-liberalized ones. They also conclude that the impact of financial liberalization on the fragility of the banking sector is weak when the institutional environment is strong. Menkhoff and Suwanaporn (2007), Currie (2006) and Noy (2004) notice that financial liberalization, followed concomitantly by a strengthening of prudential regulation and a reliable internal and external control, helps to reduce the likelihood of banking crises. After using a multi-variate probit model with a sample of 56 countries over 1977–1997, Mehrez and Kaufmann (2000) indicate that financial crisis is likely to occur within 5 years following financial liberalization. Moreover, they find that the probability of a crisis is higher in countries where corruption is widespread. Mehrez and Kaufmann (2000) provide their own calendar of financial liberalization and construct their liberalization measures on the basis of these dates. Mehrez and Kaufmann (2000) results are corroborated by Kaminsky and Schmukler (2003) who investigate a panel of industrialized and developing countries They agree that financial liberalization has a short-term negative effect, which disappears as soon as financial reforms adjust to the new environment.

Based on both currency and banking crises, Kaminsky and Reinhart (1999) analyze 76 currency crises and 26 banking crises in 20 countries over 1970–1995. They use, as a financial liberalization variable, the growth of domestic credit. Among the most important findings reached is that financial crises are often preceded by financial liberalization. Based on panel data analysis, Caprio and Martinez (2000) provide evidence that the nationalization of banks increases the probability of banking crises. However, Barth et al. (2004) conclude that public ownership is not significantly linked to an increase in the banking fragility, especially if the government controls the regulatory and supervisory environment. Shehzad and De Haan (2009) examine the impact of different dimensions of financial liberalization on the probability of systemic and non-systemic banking crises. In order to show that financial liberalization reduces the risk of systematic crises, Abiad et al. (2008) analyze a large sample of developing and developed countries over 1973–2002 using a multi-variate probit model and information collected from Abiad et al. (2008). They distinguish seven dimensions measuring financial sector liberalization, which they classify through a scale extending from 3 (total liberalization) to 0 (absence of liberalization). Glick and Hutchison (1999) analyze the incidence and the underlying causes of banking, currency and especially twin crises in 90 industrialized and developing countries over 1975–1997. They come to the followings conclusions. Firstly, twin crises are more redundant in emerging markets that have started the process of financial liberalization; secondly, the occurrence of banking crises provides a good leading indicator of currency crises in emerging markets; and thirdly, the opening of emerging markets to international capital flows makes them particularly vulnerable to twin crises. In the same vein, using the propensity score matching methodology on a panel of developing countries, Glick et al. (2006) try to find out whether countries with unregulated capital more vulnerable to currency crises or not. Their study is based on the idea that the opening of the capital account can strengthen institutions and helps pursuing sound economic policies, which in turn decrease the probability of financial crises. Glick et al. (2006) come to the conclusion that countries with liberalized capital accounts are less exposed to currency crises.

3. Empirical methodology

In this section, we present the methodology adopted to determine the degree of return predictability and the one allowing measuring and assessing the impact of financial liberalization on the informational efficiency.

3.1. A state space model for time-varying predictability

In the financial literature, market efficiency has been defined in different ways,[3] but until now, no standard conventional definition has been advanced. Therefore, it is important to clarify how to describe

[3] For a comprehensive review of theoretical and empirical evidence on market efficiency, interested readers are invited to consult Fama (1970, 1998), Dimson and Moussavian (1998) and Lim and Brooks (2010).

and measure the informational efficiency. We adopt in this context the definition provided by Fama (1970), according to which, an efficient market is a market that is efficient in the treatment of information in the sense that prices fully reflect all relevant and available information. According to Fama (1970, 1998), there are three types of efficiency depending on the available information on the market, i.e. weak, semi-strong and strong efficiency. Although the literature on the developed markets address the three forms of efficiency, recent studies on emerging markets emphasize particularly on testing the weak form of efficiency. Fontaine and Nguyen (2006) argue that a number of factors might explain such choice. The most important of them are the poor quality and reliability of the information, the scarcity of trade, the inappropriate accounting regulations and especially the low liquidity. The authors assert that the majority of companies listed in emerging markets publish their financial reports with some delays.

Since the weak form efficiency requires the instantaneous incorporation in financial asset prices of the available information contained in past prices, this therefore results in that the past returns have no predictive power on the future returns. Thus, the weak efficiency hypothesis can be tested using a linear model linking the current return to the past one,[4] which implies that the autoregressive coefficient is either equal to zero or statistically insignificant.

In this paper, the weak efficiency is also discussed. Unlike studies using traditional methods, we rather focus on the evolution of the degree of efficiency through time. The basic idea behind this intuitive approach is based on the notion that the rapid maturation of emerging markets following the liberalization of stock markets involves major changes in the structure of the markets, an increasing sophistication of markets participants and greater availability of the information. These changes likely induce the level of market efficiency to change through time (Arouri and Nguyen, 2010; Arouri et al., 2010; Fontaine and Nguyen, 2006). Such feature (changes over time), if it exists, cannot be taken into account only by a dynamic modeling of returns. For this purpose, we use the time-varying technique proposed by Zalewska-Mitura and Hall (1999) and extended by Fontaine and Nguyen (2003), in which the autocorrelation coefficient of stock returns is allowed to vary depending on market conditions. The weak form efficiency can be therefore tested by running the following time varying and dynamic multi-equations model:

$$R_{i,t} = \beta_{i,t}^{(0)} + \beta_{i,t}^{(1)} R_{i,t-1} + U_{i,t} \tag{1}$$

$$U_{i,t} = h_{i,t} z_{i,t} \tag{2}$$

$$h_{i,t} = \alpha_i^{(0)} + \alpha_i^{(1)} U_{i,t-1}^2 + \alpha_i^{(2)} h_{i,t-1} \tag{3}$$

$$\beta_{i,t}^{(k)} = \beta_{i,t-1}^{(k)} + \eta_{i,t}^{(k)}, \quad k = 0, 1 \tag{4}$$

where R_{it} represents the stock market returns at time t; it is computed as $R_{i,t} = \ln(P_{i,t}/P_{i,t-1})$, $\beta_{i,t}^{(0)}$ and $\beta_{i,t}^{(1)}$ respectively measure, for country i, the long-term trend and the potential serial dependency of stock market returns. They are allowed to change over time according to a first-order random-walk process described in Eq. (4). The basic idea behind using this dynamic modeling framework is that time values of these unobserved factors are function of the underlying market fundamentals that drive stock market price formation (Arouri et al., 2010). h_t represents the conditional variance of model residuals ($U_{i,t}$), which is generated by the standard GARCH (1,1)[5] specification proposed by Bollerslev (1986). $z_{i,t}$ and $\eta_{i,t}^{(k)}$ are random noises following a normal distribution with a mean of zero and respective variances of 1 and $V_i^{(k)}$. To run the Kalman filter, innovations in Eq. (1) are further assumed to be uncorrelated with those in Eq. (4). It is worth noting that to corroborate the weak form efficiency hypothesis, the estimated value of $\beta_{i,t}^{(1)}$ should be either equal to 'zero' or statistically insignificant.

[4] According to Fontaine and Nguyen (2006), posing efficiency as a null hypothesis, the entire information revealed by the periods $t-2, t-3, \ldots, 1$ is assumed to be fully incorporated into the returns observed in $t-1$. Therefore, taking into account a one period lagged return in the equation generating stock returns appears to be sufficient to test the weak efficiency.

[5] Different GARCH models specifications have been tested by making use of the commonly-used information criteria (Akaike information criterion, Schwarz criterion and log-likelihood). However, the GARCH (1,1) turned out to be the preferred specification for all countries' volatility processes. For the sake of concision, the test results are not reported here, but they are available upon request.

The above model belongs to the state-space models family whose main property is the presence of hidden variables. Its estimation requires the application of an optimal algorithm, called the Kalman filter, because the use of usual estimation techniques is impossible. Generally, the Kalman filter recursively delivers the optimal estimator of the system's current states, depending on the available information at that time, within a two-step procedure; firstly, the expectations of the unobserved state vector are calculated based on previously available information; and secondly, the state vector is updated when a new observation becomes available. To obtain estimated values of the set of other unknown parameters ($V^k_{i,t}$,$\alpha^{(0)}$,$\alpha^{(1)}$,$\alpha^{(2)}$), we have to construct a log-likelihood function based on the Kalman gain under the normality assumption (Harvey, 1989). Estimation of the model is then carried out using the quasi-maximum likelihood[6] method introduced by Bollerslev and Wooldridge (1992), which provides asymptotic and robust estimates even though the conditional returns are not normally distributed. It should be noted that this model has been tested by several authors, including among others, Zalewska-Mitura and Hall (1999) who show that in the case of the Kalman filter, the model is quite powerful in the detection of the time variability of various of market efficiency degrees, except for a minimum number of observations at the beginning of the period. The same model is used in many studies evaluating the weak form of informational efficiency in emerging markets (see among others, Arouri et al., 2010; Fontaine and Nguyen, 2006; Jefferis and Smith, 2005).

3.2. The impact of financial liberalization on weak informational efficiency

In order to determine the impact of financial liberalization on informational efficiency, we use the treatment effects methodology developed by Maddala (1983)[7]. This methodology has been used widely in the literature, especially in the areas of economic growth and social economics (Maeda, 2008; Ranciere et al., 2006). Nevertheless, it has not so far been used in finance despite its strong ability to deal with high-frequency data, which generally exhibit an important interdependence degree (endogeneity). Among the main advantages of this methodology is the correction of the endogeneity problem between variables, and evaluating the impact of the intermediate variable (treated variable) to the studied relation.

The empirical strategy this paper adopts differs from previous studies as it accounts for a main feature of emerging markets, namely the fragility of financial systems. Indeed, it is not only a question of assessing a direct effect between financial liberalization and informational efficiency, but also rather to test the existence of an indirect effect arising from the impact of liberalization on financial crises. This empirical strategy consists in adding to the standard regression of efficiency a variable representing financial liberalization and another one standing for financial crises. We treat the financial crises variable (treated variable) as an endogenous variable that depends on several variables including financial liberalization. With reference to this strategy, the impact of financial liberalization on informational efficiency is composed of two effects: a direct effect on the efficiency in the absence of crises, and an indirect one related to a higher propensity of financial crises in cases where the effect of the crises on efficiency is significant. The general model of efficiency is expressed as follows:

$$\hat{\beta}^1_{it} = \alpha C_{it} + \beta LF_{it} + \gamma I^{\text{crises}}_{it} + \varepsilon_{it}. \tag{5}$$

In this model, i and t represent, respectively, country and time period. $\hat{\beta}^1_{it}$ represents the potential serial dependency of stock market returns generated from the state space model. $C_{i,t}$ is a vector of control variables. $LF_{i,t}$ is a variable of financial liberalization. $I^{\text{crisis}}_{i,t}$ is a variable of financial crises taking the value 'one' if country i experiences a financial crisis in period t and 'zero' otherwise. $\varepsilon_{i,t}$ is the error term.

The model treats the variable crisis ($I^{\text{crisis}}_{i,t}$) as an endogenous variable that depends on the realization of a latent variable W^*_{jt} as follows:

$$I^{\text{crisis}}_{i,t} = \begin{cases} 1 & \text{if} \quad W^*_{it} > 0 \\ 0 & \text{otherwise} \end{cases}. \tag{6}$$

[6] The optimization is carried out in GAUSS using the BFGS algorithm (Broyden, Fletcher, Goldfarb and Shanno).

[7] For more details about the treatment effects model, readers can consult Cong and Drukker (2000) and Guo and Fraser (2010).

It is assumed that the latent variable depends linearly on a set of control variables, a financial liberalization variable and an error term.

$$W_{jt}^{*} = aZ_{i,t} + bLF_{i,t} + \eta_{it}. \tag{7}$$

The model of crises (Eq. (6)) can be rewritten as follows:

$$I_{i,t}^{\text{crisis}} = \begin{cases} 1 & \text{with probability: } \Pr(W_{it}^{*} > 0) = \Phi\left(aZ_{i,t} + bLF_{i,t}\right) \\ 0 & \text{with probability: } \Pr\left(W_{it}^{*} \le 0\right) = 1 - \Phi\left(aZ_{i,t} + bLF_{i,t}\right) \end{cases} \tag{8}$$

where Φ is the cumulative distribution function of the normal distribution.

The parameters of the crises model (a, b) can be estimated using a probit model. The general pattern of efficiency (Eq. (5)) can be estimated in a two-step procedure[8] (see Maddala, 1983). In the first step, the following probit model is estimated and the probability of crises is calculated:

$$\Pr\left(I_{i,t}^{\text{crisis}} = 1\right) = \Pr(W_{it}^{*} > 0) = \Phi\left(aZ_{i,t} + bLF_{i,t}\right). \tag{9}$$

In the second step, the general equation (Eq. (5)) parameters α, β and γ are estimated. Finally, the whole impact of financial liberalization on efficiency is considered as the sum of a direct effect $\left(\hat{\beta}\right)$ and an indirect effect, which is calculated by multiplying the adjusted coefficient of crises $(\hat{\gamma})$ and the partial effect of liberalization on financial crises $\left[E\left(\Phi\left(\hat{a}Z_{i,t} + \hat{b}\right) - \Phi(\hat{a}Z_{i,t})\right)\right]$. It is worth noting that the overall effect will be constituted only by the direct effect, if the coefficient $\hat{\gamma}$ is not statistically significant. Indeed, from Eq. (5), we can deduce the expected value of the informational efficiency from the value taken by liberalization (1 or 0):

$$E\left(\hat{\beta}_{it}^{1} | LF_{it} = 1\right) = \hat{\alpha}C_{it} + \hat{\beta} + \hat{\gamma}E\left(I_{it}^{\text{crises}} | LF_{it} = 1\right) \tag{10a}$$

$$E\left(\hat{\beta}_{it}^{1} | LF_{it} = 0\right) = \hat{\alpha}C_{it} + \hat{\gamma}E\left(I_{it}^{\text{crises}} | LF_{it} = 0\right). \tag{10b}$$

Moreover, we have:

$$E\left(I_{i,t}^{\text{crisis}} | LF_{it} = 1\right) = E\left(\Phi\left(\hat{a}Z_{i,t} + \hat{b}\right)\right). \tag{11a}$$

Similarly,

$$E\left(I_{i,t}^{\text{crisis}} | LF_{it} = 0\right) = E\left(\Phi\left(\hat{a}Z_{i,t}\right)\right). \tag{11b}$$

Hence, the effect of financial liberalization is written as follows:

$$E\left(\hat{\beta}_{it}^{1} | LF_{it} = 1\right) - E\left(\hat{\beta}_{it}^{1} | LF_{it} = 0\right) = \hat{\beta} + \hat{\gamma}E\left(\Phi\left(\hat{a}Z_{it} + \hat{b}\right) - \Phi(\hat{a}Z_{it})\right). \tag{12}$$

One can note that in the case of non-significance of the $\hat{\gamma}$ coefficient, the effect of financial liberalization becomes:

$$E\left(\hat{\beta}_{it}^{1} | LF_{it} = 1\right) - E\left(\hat{\beta}_{it}^{1} | LF_{it} = 0\right) = \hat{\beta}. \tag{13}$$

[8] For estimating the treatment effects model, we used the generalized least squares technique. The estimation was performed using Stata, version 11. For more details on the estimation procedures in Stata, readers may consult Cong and Drukker (2000).

Table 1
Basic statistics of stock markets monthly returns.

	Mean	Standard deviation	Skewness	Kurtosis	Jarque–Bera	ADF statistics	Q (6)	Q (12)	ARCH (6)	ARCH (12)
Argentina	0.936	16.526	−0.038	16.081	1968.041^{++}	−18.610^{++}	14.489	19.876	43.117^{++}	50.943^{++}
Brazil	0.616	15.828	−0.675	6.472	159.679^{++}	−16.999^{++}	3.560	11.756	7.604	32.744^{++}
Chile	1.337	7.223	−0.268	4.261	21.596^{++}	−13.005^{++}	16.865^{+}	23.866	8.278	18.58
Colombia	1.328	8.767	0.184	4.683	34.172^{++}	−11.565^{++}	32.788^{++}	38.162^{++}	25.910^{++}	27.252^{++}
India	0.569	8.910	−0.070	3.251	0.958	−14.996^{++}	8.321	10.785	15.294^{+}	19.746
Jordan	0.473	5.960	1.120	10.198	653.703^{++}	−6.468^{++}	19.254^{+}	23.329	32.711^{++}	35.360^{++}
Malaysia	0.262	9.054	−0.254	7.309	216.515^{++}	−9.315^{++}	19.099^{++}	40.857^{++}	51.081^{++}	69.993^{++}
Mexico	1.382	11.706	−2.463	18.641	3092.773^{++}	−11.418^{++}	33.778^{++}	38.458^{++}	62.181^{++}	62.150^{++}
Pakistan	0.386	9.636	−0.217	5.888	98.147^{++}	−15.383^{++}	5.505	10.792	28.240^{++}	35.815^{++}
Philippines	0.893	9.715	0.095	5.458	69.898^{++}	−12.271^{++}	26.144^{++}	36.564^{++}	12.227	21.617^{+}
South Korea	0.649	10.667	0.186	5.818	92.929^{++}	−15.656^{++}	6.055	9.444	53.687^{++}	65.521^{++}
Thailand	0.430	11.176	−0.477	5.104	61.411^{++}	−15.365^{++}	13.636	36.357^{++}	36.052^{++}	43.047^{++}
Venezuela	0.356	13.644	−0.967	7.720	299.269^{++}	−17.669^{++}	4.619	9.193	6.869	8.747

Notes: Columns 1 to 5 are reserved to the mean (%), the standard deviation (%), the skewness, the kurtosis and the Jarque and Bera normality test statistics. Q (6) and Q (12) are statistics of the Ljung–Box autocorrelation test applied on returns with lags between 6 and 12. ARCH (6) and ARCH (12) are the statistics of the conditional heteroskedasticity test proposed by Engle (1982) using the residuals of the AR (1) model. ADF is the statistics of the Augmented Dickey and Fuller (1981) test. The ADF test is conducted without time trend or constant. $^{+}$ and $^{++}$ denote that the null hypothesis of tests (normality, non-stationarity, non-autocorrelation, and homogeneity) are rejected at 5% and 1% level, respectively. The study period is from January 1986 to December 2008.

4. Data sources and description

Throughout this research, we use monthly data of a sample of emerging countries. The choice of countries is based on data availability. The data is classified into two types: market data extracted from the Datastream database and macroeconomic data extracted from the International Financial Statistics (International Monetary Fund, 2011). They are expressed in U.S. dollars, covering the period from January 1986 to December 2008. This section presents the properties of stock returns and macroeconomic variables used in the treatment effects model.

4.1. Descriptive analysis of stock market data

The market data include the S&P/IFCG Index for thirteen emerging countries (Argentina, Brazil, Chile, Colombia, South Korea, India, Jordan, Pakistan, the Philippines, Malaysia, Mexico, Thailand and Venezuela). Table 1 reports the descriptive statistics of return series associated with emerging economies mentioned above. An inspection of skewness, kurtosis and Jarque–Bera statistics lead to reject at the 1% level the normality hypothesis of the distribution of returns for all countries except India. The study of stationarity using the Dickey–Fuller unit root test clearly shows that the distribution of market returns is stationary at the 1% level, since the calculated ADF values are strictly below the critical threshold.[9] The correlation structure of monthly return series is examined using the Ljung–Box autocorrelation test of lags orders between 6 and 12. The results suggest that stock returns are not autocorrelated in almost half of emerging countries. Finally, from the ARCH effect test in the series of market returns, one may conclude that the heteroscedastisity phenomenon exists in all the emerging markets return series. In sum, all these findings lend support to the GARCH specification proposed previously.

4.2. Variables of empirical model

In order to estimate the efficiency equation (Eq. (5)), we use as a dependent variable, the time-varying predictability of returns generated from the state space model. The set of the explanatory variables includes the financial liberalization variable, the crises adjusted by liberalization variable and some control variables explaining informational efficiency. It is worth noting that financial liberalization is measured by

[9] Critical values for the ADF test at 10%, 5%, and 1% levels are, respectively, −1.616, −1.941 and −2.57.

two types of indicators. The first one is a de jure indicator constructed based on the official dates of financial liberalization determined by Bekaert and Harvey (2000). The second indicator is a de facto indicator based on the following reasoning: a country is considered as liberalized if the ratio of total investments (sum of portfolio investments, banking investments and foreign direct investments) to the Gross Domestic Product (GDP) is greater than or equal to 5%.[10] This choice of the 5% threshold is justified by the fact that the removal of barriers on capital flows and on exchange rate increases the international trade activities, which results in an increase in investment flows. The use of this indicator permits to account for the intensity of financial reforms, whereas the de jure indicator supposes that the situation of financial openness is always stable, which does not reflect the real situation. The second important variable in our empirical model is the one associated with financial crises. Three types of financial crises are considered, namely currency, banking and twin crises. The main problem we have encountered is the lack of data on monthly episodes of financial crises. Thus, we decide to construct two different crises indicators. The first one is the exchange market pressure index, used to detect the episodes of currency crises, which takes into account the evolution of exchange rates as well as interest rate and international reserves. Following Cartapanis et al. (1998), the binary variable of currency crises takes 'one' if the value of the indicator on a given date exceeds the average augmented with two standard deviations of the indicator, and 'zero' otherwise. The second indicator, developed by Kibritçioglu (2003) is the banking sector fragility index (BSFI)[11] which identifies the episodes of banking sector fragility. Similar to currency crises, we construct a binary variable for the banking crises, which takes 'one' if the value taken by the indicator is less than or equal to -0.5, and 'zero' otherwise. Finally, twin crises are considered as the occurrence of both currency and banking crises during the same month. Data used for the calculation of these indicators are sourced from International Financial Statistics database (IFS, CD-ROM, 2011). Table 2 summarizes the monthly episodes of banking and currency crises.[12]

We also use control variables carrying more information about both efficiency and financial liberalization. These variables can be split into three groups. The first group contains the level of market liquidity which is proxied by the TURNOVER ratio and measured by the value of shared equity divided by the stock capitalization of national markets. The second group contains the level of the market development measured by the ratio of market capitalization to the Gross Domestic Product (MCAP/GDP) and NE which stands for the number of stocks listed on local market. The third group contains a variable that reflects the investment quality (performance of securities) proxied by the dividend yield (DY), which is an important indicator to appraise the attractiveness of a market; it is expressed as a percentage of the shared price, and measured by the ratio of the dividend to the stock price. Finally, we consider four control variables frequently used in the financial literature which may affect the stock market efficiency, namely the interest rate (INR), the exchange rate (ER), the inflation rate (IFR) and the ratio of M2 to international reserves (M2R).

5. Empirical results

In this section, the emphasis is put on the presentation and the discussion of the results of the different empirical estimation models namely the state space model of informational efficiency and the treatment effects model that determines the impact of financial liberalization on informational efficiency.

5.1. Evolution of the weak efficiency

The estimation results of the state space model (time-varying coefficient model), previously presented, are shown in Table 3. It stands out from Table 3 that the mean of coefficients β_{it} is generally very close to zero, which means that past returns do not contribute much to anticipate future returns. We conclude the independence between past prices and future prices.

[10] The choice of the 5% threshold is based on the study of Ranciere et al. (2006).

[11] Kibritçioglu (2003) calculated the BSFI for 22 countries with a monthly frequency for a period varying from one country to another given the lack of data. The end date of the period is December 2002. We have updated this index for the period January 2002–December 2008.

[12] To compare the dates of banking and currency crises with previous works, readers may consult Kibritçioglu (2003, pp. 61–62), Laeven and Fabian (2008, pp. 32–56) and Kaminsky (1999).

Table 2
Episodes of banking and currency crises.

Countries	Episodes of low fragility (<3 months)		Episodes of high fragility (≥3 months)	
	Banking crises	Currency crises	Banking crises	Currency crises
Argentina	Oct 88/Aug 89/Jan 92	Jun 82/Dec 83/Jul 84/Nov 84/Feb 85/ Feb 87/Apr 87/Sep 87/Dec 89/Feb 90/ Jan 91/Mar 91/Mar 95/Jul 01/Jan 06	Aug 83 → Mar 85/ Jan 90 → Aug 91 Sep 01 → Feb 02/ Jan 03 → Aug 04	Feb 89 → Apr 89 Nov 01 → May 02
Brazil	Dec 85/May 86/Jan 00/ Feb 00/Feb 06/Mar 06	Sep 82/Oct 82/Jan 83/Feb 83/Oct 83/ Jan 85/Jan 86/Oct 86/Jan 87/Feb 87/ Jun 87/Oct 90/Nov 90/Sep 91/Oct 91/ Mar 95/Oct 97/Sep 98/Jan 99/Apr 00/ Apr 02/Jul 05/Dec 05	Jan 87 → May 88/ Jun 89 → Feb 91 Jun 03 → Mar 04/ May 05 → Nov 05	Jul 02 → Sep 02 Sep 08 → Nov 08
Chile	Apr 90	Feb 83/Mar 83/Nov 84/Jan 85/Mar 85/ Jul 85/Jan 86/Mar 87/Jul 87/Jun 89/Oct 95/Jan 96/Jan 98/Jun 98/Feb 99/Jun 99/ Sep 01/Jun 02/Mar 04/Jan 06/Aug 07/ Nov 07/Apr 08/Jun 08/Oct 08	Jun 83 → Jul 84/ Sep 85 → Jun 88 May 89 → Jul 89/ Jul 90 → Jan 92 Jun 97 → Mar 98/ Aug 99 → Nov 00	Jun 82 → Nov 82 Nov 97 → Jan 98
Colombia	Sep 03/Apr 93/Aug 93/ May 99/Jul 01	Feb 86/May 86/Sep 87/Aug 88/Sep 88/ Mar 89/May 89/Sep 89/Oct 93/Sep 94/ Jun 95/Aug 95/Sep 95/Jan 97/Aug 97/ Sep 97/Apr 98/Aug 98/Sep 98/Jan 01/ May 04/Mar 05/Aug 07	Nov 98 → Nov 01/ Dec 03 → Mar 04	Apr 99 → Sep 99 Jul 02 → Sep 02 Apr 06 → Jun 06 Aug 08 → Oct 08
India	Jan 82/Jun 82/Sep 82/Jun 87/ Jul 88/Jul 90/Jan 95/Feb 95/ Apr 95/May 95/Jan 97/ Mar 97/Jan 98	Feb 82/Jun 82/Jan 83/Dec 83/Jan 86/ May 86/Jun 86/Jan 89/Apr 89/May 89/ Aug 89/Jul 91/Aug 91/Nov 92/Mar 93/ Sep 95/Oct 95/Jan 96/Nov 97/May 98/ May 08/Sep 08/Oct 08	Oct 98 → Mar 00/ Nov 01 → Oct 02	–
Jordan	Jul 03/Aug 03/Apr 04/ Mar 08/Nov 08	Dec 82/Aug 85/Jan 86/May 86/Aug 86/ Jan 87/Apr 87/Jan 88/Apr 88/Jun 88/ Dec 88/Jan 89/Apr 89/Nov 89/Mar 91/ Aug 91/Oct 92/Mar 93/Apr 93/Nov 94/ Apr 95/May 95/Jan 96/Jul 97/Aug 97/ May 98/Jun 06	Jan 89 → May 91/ May 97 → Jul 97 Oct 97 → Feb 98/ Oct 03 → Jan 04 May 08 → Sep 08	–
Malaysia	Dec 99/Feb 00/Apr 02/ Dec 06/Jan 07	Feb 82/Mar 82/May 82/Dec 83/Mar 84/ Oct 84/Jan 85/Feb 85/Mar 86/Apr 86/ Jan 88/Apr 88/Aug 88/Jan 89/Nov 90/ Mar 91/Dec 92/Oct 93/Dec 94/Aug 95/ Jan 96/Dec 97/Jan 98/May 98/Jun 98/ Mar 01	Apr 87 → Feb 88/ Jan 90 → Dec 90 Oct 94 → Aug 95/ Sep 98 → Apr 99 May 00 → Sep 00/ Mar 01 → Feb 02	Jul 97 → Oct 97 Aug 08 → Oct 08
Mexico	May 00/Jul 02/Aug 02/Apr 04/ Jan 05/Oct 08/Nov 08	Jan 82/Feb 82/Apr 82/Jun 82/Dec 82/ Aug 83/Jul 85/Jun 86/Jul 86/Dec 87/ Sep 88/Nov 88/Mar 90/Mar 94/Apr 94/Oct 95/Aug 98/Oct 08	Feb 83 → Jun 84/ Dec 85 → Nov 86 Apr 87 → Oct 88/ Dec 95 → Mar 97 Dec 98 → Feb 00/ Dec 01 → Apr 02	Nov 94 → Mar 95
Pakistan	Jul 88/Aug 88/Nov 94/Dec 94/ Nov 99/Dec 99/Dec 05/Oct 07/ Dec 08	Jun 82/Dec 84/Jan 85/May 85/May 86/ Aug 87/Jun 88/Feb 89/May 89/Nov 89/ Oct 90/Mar 91/Nov 92/Mar 93/May 93/ Jul 93/Sep 93/Oct 95/Sep 96/Oct 96/ Oct 97/Jun 98/Jul 98/May 99/Sep 00/ Jan 01/May 08	Nov 90 → May 91/ Apr 93 → Jan 94 Aug 97 → Dec 97/ May 00 → Jul 00 Sep 01 → Apr 03	Jan 82 → Mar 82 Aug 08 → Oct 08
Philippines	Feb 01/Oct 05/Nov 05	Jan 86/Feb 86/Jan 88/Jul 88/Sep 88/ Apr 89/Jan 90/Feb 90/Apr 90/Sep 90/ Nov 90/Apr 92/May 92/May 93/ Sep 93/Feb 95/Jun 98/Aug 98/Jan 00/ May 00/Jul 00/Oct 00/Apr 01/Oct 08	Jan 86 → Dec 86/ Jun 91 → Feb 92 Aug 98 → Dec 99/ Jun 01 → Jan 04 Sep 05 → Dec 06	Sep 87 → Nov 87 Jul 97 → Jan 98
South Korea	Mar 93/Apr 93/Aug 93/ May 99/Jul 01	Apr 83/Jun 83/May 84/Jan 85/Mar 85/ May 85/Jan 86/Dec 86/Mar 87/Dec 87/ Dec 89/Jan 90/Jan 97/Mar 97/Aug 98/ Mar 01/Nov 02/Mar 03/Dec 08	May 87 → Feb 89/ Nov 93 → Feb 94 Jun 98 → Feb 99/ Feb 04 → Feb 06	May 82 → Jul 82 Oct 97 → Dec 97 Jul 08 → Oct 08

(continued on next page)

Table 2 (*continued*)

Countries	Episodes of low fragility (<3 months)		Episodes of high fragility (≥3 months)	
	Banking crises	Currency crises	Banking crises	Currency crises
Thailand	May 08/Jul 08	Jun 82/Jul 82/Oct 82/Out 83/Nov 83/ Jul 84/Oct 85/Feb 87/May 97/Jul 97/ Aug 97/May 98/Jun 98/Sep 99/Jan 00/ Jul 00/Oct 00/Mar 01/Sep 02	Mar 86 → Feb 87/ Mar 98 → Oct 02 Feb 03 → Aug 04/ Oct 05 → Dec 06 Oct 06 → Mar 08	Jan 82 → Mar 82 Dec 84 → Feb 85 Oct 97 → Jan 98
Venezuela	Feb 94/Mar 94/Jul 96/Oct 96	Jun 82/Sep 82/Feb 83/Feb 84/Dec 86/ Sep 88/Mar 89/Oct 89/Jul 90/Oct 92/ Dec 95/Apr 96/Jul 98/Dec 00/Aug 01/ Jan 02/Feb 02/May 02/Dec 02/Jan 03/ Feb 04/Out 04/Feb 07/Apr 07	Mar 89 → Oct 90/ Oct 93 → Dec 93 Out 94 → Mar 96/ Nov 98 → Oct 99 Dec 02 → Feb 04	Apr 94 → Jun 94

Notes: Episodes of banking and currency crises are respectively calculated using the exchange market pressure index and the banking sector fragility index. For further details about the construction of these crises indexes, see Kibritçioglu (2003, pp. 61–62) and Cartapanis et al. (1998). The distinction between low and high fragility episodes is based on the persistence of the fragility through the time. If the episode of fragility exceeds or equal to three months, we can consider it as high fragility. Otherwise, the situation is considered as low fragility. The choice of the window of three months is arbitrary. The period is from January 1982 to December 2008, except for the Philippines, for which the period is from January 1986 to December 2008.

When focusing first on the coefficient $\beta_{i,t}^{(0)}$, which represents the constant term in Eq. (1), we promptly notice that the mean values of this coefficient for all countries in the sample are near to zero and fall into the following interval [0.377%; 1.945%]. This suggests a low level of return predictability related to other potentials, such as macroeconomic effects, political events and external shocks (Arouri et al., 2010). Then, regarding the coefficient $\beta_{i,t}^{(1)}$, whose variations indicate the time-varying predictability (autocorrelation) levels in stock returns, their averages are not very different across markets and stand around an average of 11%. This supports the hypothesis of serial independence between past and future returns, except for Chile, Colombia and the Philippines whose recorded coefficients are usually very high, indicating that past returns predict about 17%, 39% and 22% of the current evolution of returns, respectively.

Finally, regarding the global significance of the two coefficients ($\beta_{i,t}^{(0)}$ and $\beta_{i,t}^{(1)}$), we suggest a relative stability over time given the lowest estimated values of the innovations variance issued from the state equations (Eq. (4)). Moreover, it seems that the GARCH (1,1) model is performing quite well in explaining the variations of the emerging stock market returns since it is able to detect the leptokurtic behavior and conditional heteroscedasticity in the returns, except for Venezuela. Indeed, the parameters of the conditional variance equation are positive and statistically significant at the 1% level; they also satisfy the theoretical stability conditions $\alpha_i^{(0)} > 0$, $\alpha_i^{(1)} \geq 0$ et $\alpha_i^{(2)} \geq 0$. However, we do not find strong evidence supporting the persistence of volatility over time since the risk premium measured by sum $(\alpha_i^{(1)} + \alpha_i^{(2)})$ is effectively lower than 0.9 in the majority of stock markets, except for Argentina, Brazil, Chile and Malaysia. The insignificance of risk premium parameters in all markets would indicate the absence of a relationship between risk and return.

To test the weak efficiency hypothesis before and after financial liberalization, it seems important to depict the evolution of the time-varying predictability indices along with 95% confidence intervals while accounting for the presence of the official dates of financial liberalization provided by Bekaert and Harvey (2000). This permits also to test the immediate impact of financial liberalization on the stock return predictability. We draw, simultaneously with the official dates, an area around to capture the impact of other reforms[13] which have been implemented before or after the official dates. Then, we take a year before the official date of liberalization and a year after.

Our analysis for the predictability index is based on the following reasoning: the weak form efficiency hypothesis is verified if its evolution is not significantly different from zero. A positive effect of financial liberalization on the efficiency is explained by the reduction of the predictability of return after financial opening. Even though the market was efficient before liberalization, the positive effect consists in an improvement of efficiency in the period following the official dates of liberalization. Fig. 1 depicts the

[13] Regulatory reforms, the introduction of first country funds and first ADR, and the increase in net U.S. capital flows.

Table 3
Estimation results from the state space model with GARCH effects.

	Conditional mean equation		State equations		Conditional variance equation				Likelihood value
	$\beta_i^{(0)}$ (%)	$\beta_i^{(1)}$ (%)	$V_i^{(0)}$	$V_i^{(1)}$	$\alpha_i^{(0)}$	$\alpha_i^{(1)}$	$\alpha_i^{(2)}$	$\alpha_i^{(1)} + \alpha_i^{(2)}$	
Argentina	1.827	11.112	0.000	0.000	0.003**	0.470**	0.520**	0.990	146.523
	(0.031)	(0.097)	(0.001)	(0.010)	(0.000)	(0.005)	(0.000)		
Brazil	0.377	6.456	0.000	0.000	0.002**	0.444**	0.513**	0.957	238.259
	(0.018)	(0.135)	(0.000)	(0.006)	(0.000)	(0.030)	(0.000)		
Chile	1.359	17.170	0.000	0.026*	0.001**	0.440**	0.500**	0.940	394.945
	(0.014)	(0.156)	(0.000)	(0.012)	(0.000)	(0.048)	(0.000)		
Colombia	0.922	38.891	0.000	0.000	0.002**	0.153**	0.560**	0.713	307.604
	(0.007)	(0.108)	(0.001)	(0.025)	(0.000)	(0.050)	(0.000)		
India	1.259	7.535	0.000	0.007	0.001**	0.176**	0.503**	0.679	455.608
	(0.020)	(0.252)	(0.000)	(0.010)	(0.000)	(0.050)	(0.000)		
Jordan	0.471	7.864	−0.002*	0.000	0.000**	0.337**	0.511**	0.848	570.917
	(0.008)	(0.101)	(0.000)	(0.017)	(0.000)	(0.000)	(0.000)		
Malaysia	0.766	6.964	0.000	0.000	0.001**	0.409**	0.502**	0.911	312.352
	(0.006)	(0.182)	(0.000)	(0.008)	(0.000)	(0.050)	(0.000)		
Mexico	1.945	11.850	0.000	−0.014	0.003**	0.295**	0.508**	0.803	314.624
	(0.010)	(0.151)	(0.001)	(0.011)	(0.000)	(0.067)	(0.000)		
Pakistan	0.451	6.204	0.000	−0.029	0.002**	0.239**	0.504**	0.743	272.293
	(0.003)	(0.183)	(0.001)	(0.027)	(0.000)	(0.072)	(0.000)		
Philippines	1.348	22.290	−0.002	0.004	0.002**	0.203**	0.517**	0.720	275.535
	(0.022)	(0.092)	(0.001)	(0.024)	(0.000)	(0.072)	(0.000)		
South Korea	1.285	6.283	0.000	0.000	0.002**	0.259**	0.500**	0.759	396.113
	(0.015)	(0.160)	(0.000)	(0.006)	(0.000)	(0.050)	(0.000)		
Thailand	0.656	4.269	0.004*	0.000	0.001**	0.329**	0.517**	0.846	412.418
	(0.025)	(0.111)	(0.001)	(0.006)	(0.000)	(0.000)	(0.000)		
Venezuela	0.557	−0.580	0.000	0.028	0.013**	0.164	0.077	0.241	163.164
	(0.013)	(0.438)	(0.001)	(0.025)	(0.004)	(0.110)	(0.240)		

Notes: The standard deviations of estimated parameters are given in parentheses. For the estimated parameters in the conditional mean equation, we report their averages since they are allowed to vary over time. The significance of these coefficients ($\beta_i^{(1)}$ in particular) in each time period is examined by using a standard *t*-test and shown in Fig. 1. * and ** indicate that coefficients are statistically significant at 5% and 1% level, respectively.

evolution of the time-varying predictability indices along with 95% confidence intervals around the official dates of financial liberalization.[14]

In the light of Fig. 1, we can make some general remarks for all studied markets and some specific comments within groups that are identified based on the efficiency degree:

i. As noted by Zalewska-Mitura and Hall (1999), at the beginning of the period, observations arising from the application of the Kalman filter are too volatile.
ii. We distinguish three groups of markets according to their degree of informational efficiency. The first group which includes eight markets (Argentina, Brazil, Korea, India, Jordan, Malaysia, Pakistan and Thailand) evokes efficiency over the entire study period. Indeed, the zero line is located within the estimated confidence interval which leads to accept the null hypothesis of efficiency. A second group contains two markets (Mexico and Venezuela). These markets are characterized by the inefficiency on several sub-periods at the beginning and the middle of the period, but gradually converge towards efficiency at the end, since the associated autocorrelation coefficients decline steadily over time, and they are very close to zero. The last group that is controversy to the previous groups, involves three countries, namely Chile, Colombia and the Philippines. These countries are characterized either by an absolute inefficiency over the entire period as in the case of Colombia or by an efficiency for a short period at the beginning of the investigation period, but exhibit a degree of inefficiency increasingly important over time.

[14] We use the following abbreviations in the presentation of Fig. 1: 'BH' for the official date of financial liberalization provided by Bekaert and Harvey (2000). '−1 Y' and '+1 Y' are for, respectively, one year before financial liberalization and one year after.

iii. The degree of efficiency varies from one market to another, which leads to believe that the specific characteristics of each market, including the liquidity and the development level, may explain the difference in the level of efficiency between markets. This has been also highlighted by Arouri et al. (2010) and Fontaine and Nguyen (2006). Again, according to these authors, the lack of liquidity slows down the incorporation of available information in the stock price, and therefore hinders the convergence process to efficiency.

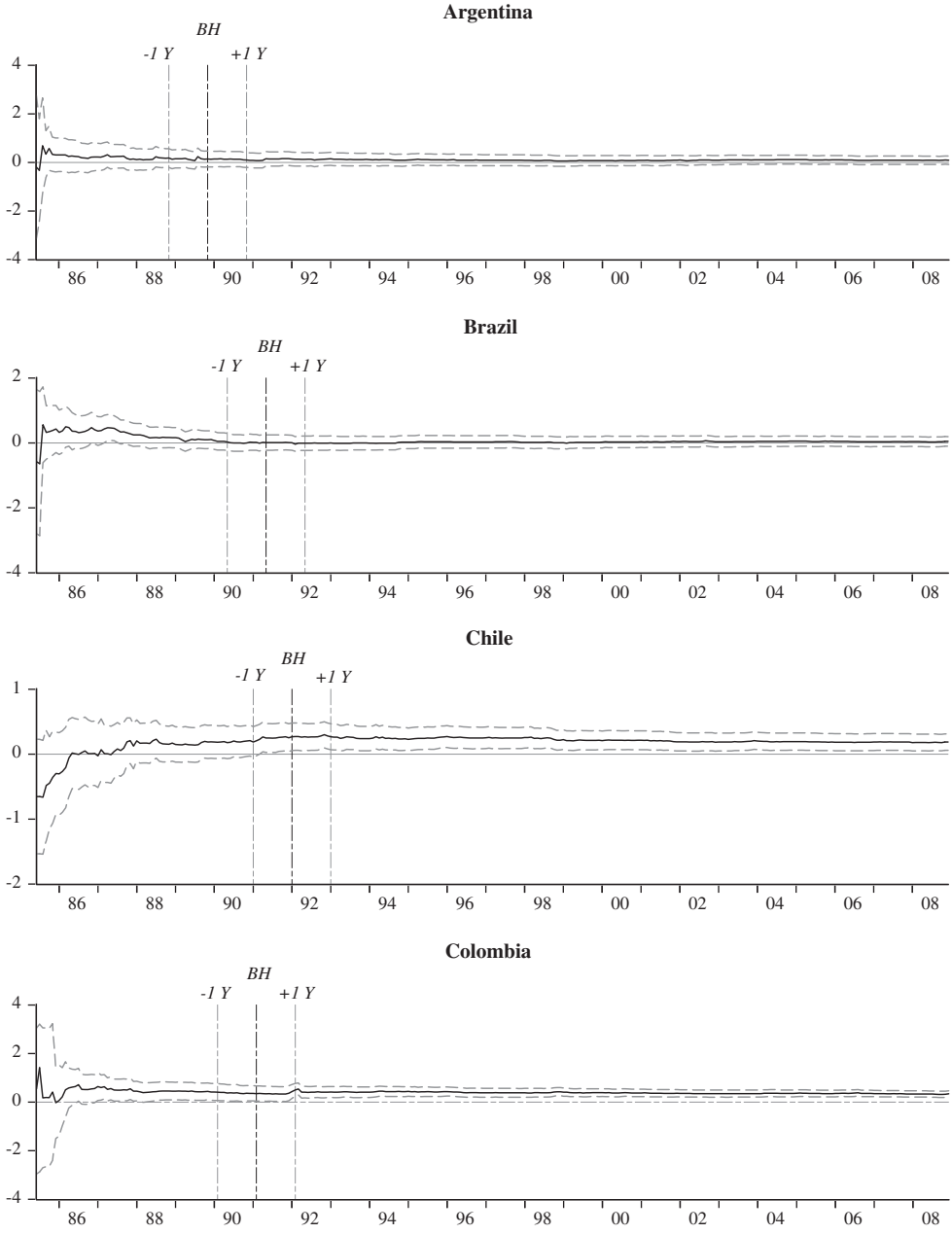

Fig. 1. Evolving efficiency in emerging stock markets, time-varying predictability index with 95% confidence intervals.

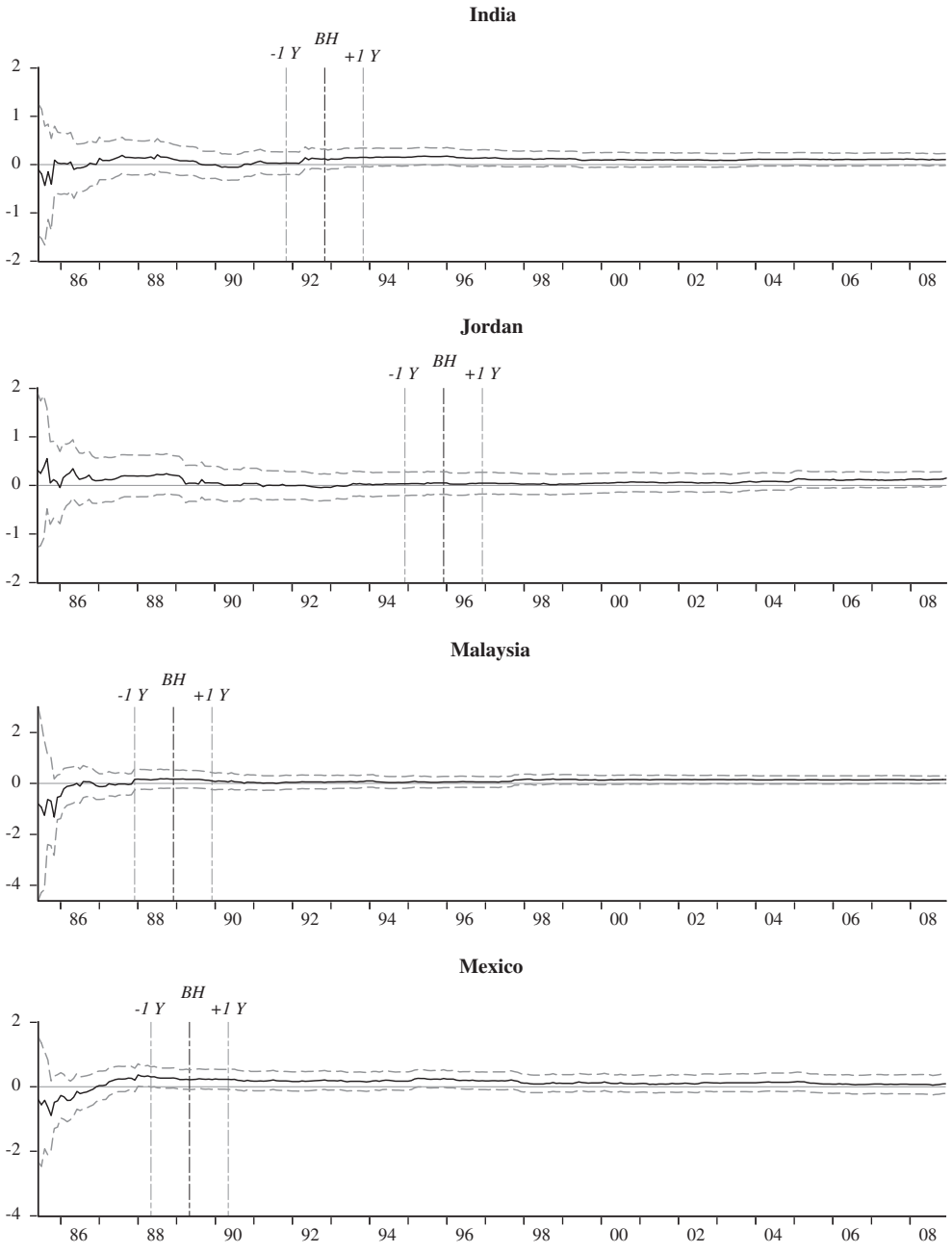

Fig. 1 (*continued*).

iv. It is worth noting that several changes in the trend of the time-varying predictability are take place either at the time of financial liberalization represented by the official dates of Bekaert and Harvey (2000), as in the case of Argentina, Jordan and especially Thailand, or in the periods around financial liberalization like Chile, Colombia, Malaysia, Pakistan, the Philippines and Venezuela. At this stage,

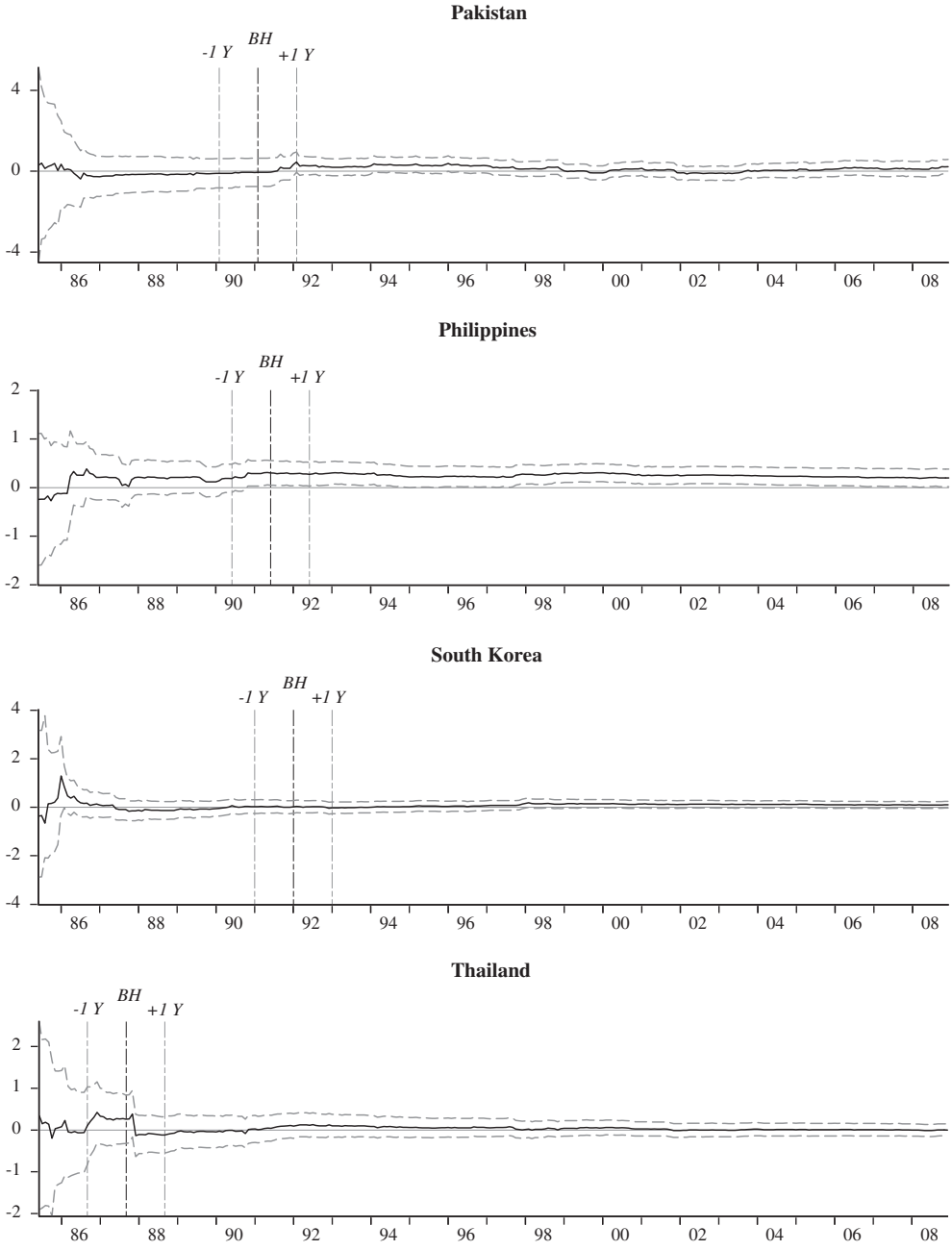

Fig. 1 (*continued*).

we believe that financial liberalization has an impact on the predictability of returns, but it is still hard to detect the direction of this impact from a graphical analysis. In addition, we hardly notice the immediate effect of liberalization on the return predictability, whereas financial liberalization is

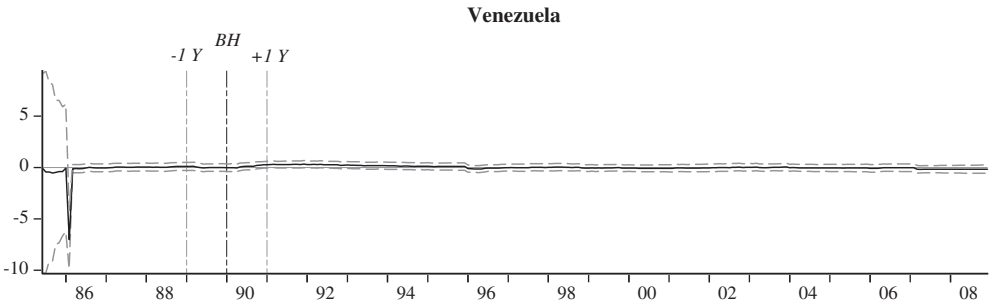

Fig. 1 (*continued*).

actually gradual, which requires a more rigorous empirical analysis of the interaction between liberalization and efficiency.

In sum, we can deduce that overall the weak efficiency hypothesis is verified in the emerging economies, but it varies from one market to another depending on the specific characteristics of each market. As for the impact of financial liberalization on the level of efficiency, we cannot decide on the existence of a clear effect; therefore, it will be better to develop a further empirical analysis, which will be the subject of the next section.

5.2. The impact of financial liberalization on weak efficiency: the mediating role of financial crises

This section is devoted to identifying the effect of financial liberalization on the informational efficiency while accounting for the potential effects induced by financial crises on the latter. More specifically, we seek to check whether an indirect effect of liberalization on the informational efficiency through financial crises exists or not. To do so, we proceed in two steps as shown by Maddala (1983). Firstly, we estimate a probit model in order to determine the impact of liberalization on the probability of financial crises. Secondly, we use a treatment effects model incorporating the results from the probit model in a general equation of efficiency to decompose the impact of liberalization on efficiency into a direct and an indirect impact. In fact, our purpose is to determine the expected effects of financial liberalization on the efficiency in normal times and in times of financial crises. This mainly depends on the existence of the linkage between informational efficiency and financial crises.

We start by determining the impact of financial liberalization on financial crises. This impact is measured by estimating the probit model represented by Eq. (7) on two occasions, with the two types of liberalization indicator mentioned above (de jure and de facto). From results of Panel A in Tables 4 and 5, one may clearly identify the existence of an empirical significant and negative relationship between financial liberalization and crises. This linkage is always present regardless of the nature of the crisis and liberalization indicator used. Indeed, liberalization tends to reduce the probability of banking, currency and twin crises. This justifies the intuition behind the existence of an indirect effect between liberalization and efficiency through financial crises. However, this effect is only verified in the presence of a significant linkage between financial crises and efficiency.

The financial literature shows that the leading causes of financial crises are the macroeconomic environment in emerging countries (Currie, 2006; Glick and Hutchison, 2006). For this reason, we introduce some control variables in the probit model, such as the liquidity ratio and the degree of market development. From the different findings, we note that the control variables used exhibit significant impacts on crises but their signs vary from one specification to other. Indeed, we remark that the exchange rate and the inflation rate have negative effects on currency crises and twin crises. The M2 to international reserves ratio increases the likelihood of crises, while other variables, such as the liquidity ratio and the market capitalization reveal a low incidence on crises. These results corroborate those of by Kaminsky and Reinhart (1999) and Kaminsky et al. (1998).

Table 4
Estimation results throughout de jure liberalization variable.

	Model 1 (Banking crisis)	Model 2 (Currency crisis)	Model 3 (Twin crisis)
Panel A: Crisis probit equation			
Dependent variable: Crisis variable			
Liberalization index (FL)	−0.35618	−0.39391	−0.45096
	(−5.39)***	(−4.14)***	(−3.63)***
Inflation rate (IFR)	0.51644	−3.82176	−2.78179
	(1.42)	(−3.74)***	(−2.01)**
Exchange rate (ER)	1.28035	−29.19104	−6.49145
	(2.47)**	(−19.51)***	(−8.15)***
M2/Reserve (M2R)	−0.00233	0.01759	0.00565
	(−0.97)	(5.67)***	(2.45)**
Market capitalization/GDP (MCAP/GDP)	−0.03131	−0.00074	−0.02086
	(−4.11)***	(−0.08)	(−1.33)
Turnover	0.19202	−0.90678	−3.18677
	(0.40)	(−1.10)	(−1.87)*
Constant	−0.28807	−1.36720	−1.58503
	(−3.03)***	(−12.63)***	(−11.87)***
Rho	0.06010	0.04191	0.05999
Sigma	0.25289	0.20915	0.25264
Log-likelihood	−1902.984	−749.823	−353.202
Number of observations	3575	3575	3575
Financial liberalization, crisis and efficiency			
Estimation technique: treatment effects model, two-step estimation			
Frequency: monthly			
Period of estimation: January 1986–December 2008			
Panel B: Efficiency equation			
Dependent variable: Time-varying predictability index			
Liberalization index (FL)	−0.07879	−0.07904	−0.07905
	(−10.55)***	(−10.58)***	(−10.59)***
Crisis variable (I^{crises})	−0.09067	−0.00032	−0.00705
	(−1.39)	(−0.02)	(−0.13)
Inflation rate (IFR)	−0.00979	−0.05714	−0.05653
	(−0.18)	(−1.32)	(−1.31)
Interest rate (INR)	0.00218	0.00401	0.00397
	(0.32)	(0.60)	(0.59)
Exchange rate (ER)	0.06056	0.03603	0.03381
	(1.14)	(0.62)	(0.61)
Market capitalization/GDP	−0.00412	−0.00415	−0.00415
(MCAP/GDP)	(−5.58)***	(−5.62)***	(−5.62)***
Turnover	−0.16728	−0.16579	−0.16573
	(−3.38)***	(−3.34)***	(−3.34)***
Dividend yield (DY)	−0.00830	−0.00845	−0.00845
	(−6.52)***	(−6.64)***	(−6.66)***
Number of stocks listed on the local market (NE)	−0.00019	−0.00019	−0.00019
	(−2.52)**	(−2.56)**	(−2.56)**
Constant	0.28338	0.28491	0.28493
	(33.67)***	(34.13)***	(34.13)***
Number of observations	3562	3562	3562
Number of countries	13	13	13

Notes: z-statistic (in parentheses). *, ** and *** indicate that coefficients are significant at 10%, 5% and 1% level, respectively.

We note that as the probit model is non-linear, the partial effect of a change in one variable on the crises probability depends on the value of the other variables. For our purpose, we are interested in the average partial effect of financial liberalization on the crises probability: $\left[E\left(\Phi\left(\hat{a}Z_{it}+\hat{b}\right)-\Phi(\hat{a}Z_{it})\right)\right]$. This measure indicates that financial liberalization presented by de jure indicator is on average associated

Table 5
Estimation results throughout de facto liberalization variable.

	Model 1 (Banking crisis)	Model 2 (Currency crisis)	Model 3 (Twin crisis)
Panel A: Crisis probit equation			
Dependent variable: Crisis variable			
Liberalization index (FL)	−0.54433	−0.27803	−0.55280
	(−9.05)***	(−3.03)***	(−3.46)***
Inflation rate (IFR)	0.71633	−3.09733	−2.22813
	(2.01)**	(−3.17)***	(−1.70)*
Exchange rate (ER)	1.26477	−28.47587	−6.14028
	(2.41)**	(−19.32)***	(−7.78)***
M2/Reserve (M2R)	0.00051	0.02073	0.00804
	(0.23)	(6.92)***	(3.51)***
Market capitalization/GDP	−0.03470	−0.00863	−0.03230
(MCAP/GDP)	(−4.77)***	(−0.90)	(−1.95)*
Turnover	−1.13113	−1.43113	−4.03746
	(−0.27)	(−1.71)*	(−2.32)**
Constant	−0.41341	−1.54708	−1.73317
	(−4.00)***	(−15.76)***	(−12.60)***
Rho	0.09251	0.04575	0.08289
Sigma	0.31928	0.21897	0.30063
Log-likelihood	−1874.544	−753.592	−352.396
Number of observations	3575	3575	3575
Financial liberalization, crisis and efficiency			
Estimation technique: treatment effects model, two-step estimation			
Frequency: monthly			
Period of estimation: January 1986–December 2008			
Panel B: Efficiency equation			
Dependent variable: Time-varying predictability index			
Liberalization index (FL)	−0.01039	−0.01038	−0.01040
	(−1.76)*	(−1.75)*	(−1.76)*
Crisis variable (I^{crises})	−0.09509	0.00092	−0.00298
	(−1.45)	(0.06)	(−0.05)
Inflation rate (IFR)	0.07449	0.01707	0.01786
	(1.39)	(0.39)	(0.41)
Interest rate (INR)	0.00329	0.00434	0.00438
	(0.48)	(0.64)	(0.64)
Exchange rate (ER)	0.04663	0.01408	0.01109
	(0.85)	(0.24)	(0.20)
Market capitalization/GDP	−0.00615	−0.00618	−0.00618
(MCAP/GDP)	(−8.45)***	(−8.50)***	(−8.50)***
Turnover	−0.25578	−0.25460	−0.25472
	(−5.16)***	(−5.13)***	(−5.14)***
Dividend yield (DY)	−0.00653	−0.00667	−0.00667
	(−5.09)***	(−5.21)***	(−5.21)***
Number of stocks listed on the local market (NE)	−0.00043	−0.00043	−0.00043
	(−5.79)***	(−5.85)***	(−5.87)***
Constant	0.24680	0.24843	0.24844
	(31.68)***	(32.10)***	(32.10)***
Number of observations	3562	3562	3562
Number of countries	13	13	13

Notes: z-statistic (in parentheses). *, ** and *** indicate that coefficients are significant at 10%, 5% and 1% level, respectively.

with less likely financial crises: banking crises (−13.12%), currency crises (−12.76%) and twin crises (−15.19%). As far as the de facto indicator is concerned, we note that this measure diminishes the probability of crises respectively for the three types of crises: (−19.12%), (−9.06%) and (−17.30%).

So far, we have empirically measured the impact of financial liberalization on the likelihood of financial crises. The question that arises now is: what is the effect of this advantage (the reduction of the probability

of financial crises) on the informational efficiency in emerging economies? To answer this question, we estimate the standard efficiency model represented by Eq. (5). The main advantage of this model is to check, on the one hand, the existence or not of a linkage between informational efficiency and financial crisis variable adjusted by the effect of financial liberalization; on the other hand, it determines the direct impact of liberalization on efficiency. The overall impact is the sum of two effects, the direct and the indirect. It should be noted that if there is no linkage between efficiency and financial crises, the indirect effect is equal to zero. In this case, liberalization directly affects the informational efficiency.

The estimation results of the general model of efficiency, using respectively the two indicators of liberalization are depicted in Panel B of Tables 4 and 5. Results suggest the existence of a substantial and a significant relationship between the stock market deregulation and the stock return predictability, given that the coefficient associated with the liberalization variable representing the direct effect of financial liberalization on the efficiency is negative $\left(\hat{\beta} < 0\right)$. Indeed, the financial liberalization (FL) tends to increase the efficiency of the emerging markets in the sample. It is worth noting that in general, informational efficiency reacts nearly of 8% to the announcement of the liberalization represented by the de jure indicator and nearly of 1% for the de facto indicator, with respective significance threshold of 1% and 10%. This significant difference in the magnitude of the effect, from 8% to 1%, is attributed solely to the intensity of financial liberalization. This could be explained by the fact that the low level of efficiency in the emerging markets before the financial opening does not allow instantaneous incorporation of information related to the decision of liberalization of financial asset prices. By observing the adjusted financial crisis variable estimated from the probit model and represented by three indices, we can see that it has no impact on the predictability index given the non-significance of the estimated coefficients ($\hat{\gamma}$). Our results are corroborated by several previous empirical works that confirm the absence of a link between informational efficiency and crises (see for instance, Kim and Abul, 2008). By now, we may conclude that there is an absence of an indirect effect of financial liberalization on the informational efficiency. This is due to the absence of a significant relationship between efficiency and financial crises. Consequently, financial liberalization contributes only directly to decrease efficiency.

With regard to the control variables, the results are also interesting because they show that all the information variables have significant impacts on return predictability. It should be noted also that the significance of these variables is independent vis-a-vis the liberalization indicator used. As we can see, the variables MCAP/GDP and NE as indicators of stock market development, contribute to significantly weaken the return predictability. In fact, this impact is quite explained by the fact that a reinforcement of the development level of the market implies a higher maturation and therefore greater incorporation of instantaneous information related to the decision of liberalization of financial asset prices. With regards to the variable related to liquidity proxied by the ratio of TURNOVER, results show that it tends to significantly reduce the degree of return predictability. This finding is consistent with those of previous studies according to which financial liquidity is an important pre-condition for the verification of the informational efficiency because it might accelerate the process of inclusion of new information in the financial asset prices (Fontaine and Nguyen, 2003, 2006). As for the variable (DY), results indicate that it contributes to the improvement of the informational efficiency, which confirms that good quality investors which generally seek to invest in high pay equity participate to improve the efficiency. Finally, a close inspection of the coefficients associated with the macroeconomic variables (ER, INR and IFR) show that they have no impacts on return predictability. This finding demonstrates the relevance of other information variables (MCAP/GDP, NE, TURNOVER, and DY) in explaining the evolution of the degree of efficiency.

6. Concluding remarks

The informational efficiency is a very important concept reflecting the effectiveness of the market policy investment. In recent years, the financial literature has focused on determining the degree of informational efficiency in emerging countries, which are considered as good sites for investment, especially after the opening of their markets.

This paper contributes to the literature on weak financial efficiency testing. It tests the hypothesis of weak efficiency on a sample of 13 emerging countries and determines the impact of financial liberalization on the

degree of efficiency while accounting for the essential characteristic of emerging markets, namely the fragility of their financial systems over the past decades as well as the multiplicity of financial crises in these markets. The attention is primarily focused on modeling the weak efficiency, taking into account the evolutionary characteristics of emerging markets. Indeed, we consider the argument that the weak efficiency of these markets evolves over time. The attention is then paid to determining the impact of financial liberalization on the informational efficiency. For this purpose, we adopt a novel methodology that allows testing a three-dimensional relationship between liberalization, on the one hand, and financial crises and the informational efficiency, on the other hand. The adoption of a treatment effects model enabled us to first determine the direct impact of liberalization on efficiency, and then to test for the existence of an indirect effect on the latter originating from the attenuation of the probability of financial crises following financial openness.

The results this paper puts forward show, firstly, that emerging markets are characterized by a greater efficiency in recent years. This is a good indicator for regulators of these countries, since a greater efficiency naturally leads to an increase in the investment. Secondly, the results reveal that financial liberalization helps to improve the degree of efficiency and to reduce the likelihood of financial crises. However, as shown previously, informational efficiency is independent vis-a-vis the proliferation of crises, which indicates the absence of the indirect effect. Finally, we conclude that the improvement of the efficiency depends upon several internal characteristics, including the level of development, the degree of liquidity and the quality of investment that are themselves function of the evolution of financial liberalization process. Thus, financial liberalization is therefore recommended to emerging countries, otherwise, these countries cannot quickly reach the informational efficiency, and consequently, a considerable loss in investments will be recorded.

It should be noted however that in order to push the convergence to the efficiency or to reach a high level of efficiency, regulators of emerging countries should consider the initial conditions of the domestic market before the setting up of a financial liberalization process; they also should keep monitoring these conditions after liberalization. According to Nguyen (2008) and Fontaine and Nguyen (2006), market conditions include, among others, the quality and reliability of information flows, the financial market infrastructure and the sophistication of investors. A good control of this factor helps to significantly reduce the asymmetries that can benefit the informed agents and which involve the manipulation and the loss of investors' confidence. To enhance the sophistication of investors, training on the characteristics of financial instruments and on the relationship between risk and return, as well as portfolio management are needed. This will reduce the benefits of insiders and professional investors. In addition, the implementation of regulations in favor of ownership and the protection of minor investors are also desirable to establish the trust of market participants and prevent the losses due to fraud and manipulation.

Besides, we have shown that financial liberalization provides a significant advantage to emerging countries which consists in a reduction of the probability of financial crises. This advantage can generally improve economic growth in emerging markets by positively affecting many aspects of these markets. We subsequently verified the absence of a linkage between efficiency and financial crises involving that emerging countries have not benefited from the advantage of reducing the probability of financial crises following financial openness. The effect of liberalization on efficiency remains limited to the direct effect. In the light of these results, it is crucial to not ignore in any circumstances the effects of financial crises on the financial and economic aspects in emerging markets during the analysis of the impact of financial liberalization, since the liberalization process allows to reducing crises.

Finally, it can be argued that emerging countries have benefited from financial openness in terms of informational efficiency, and therefore they have become good investment sites for both national and international investors. Nonetheless, this judgment will be more accurate if accompanied by a study of the impact of financial liberalization on the volatility since according to financial theory, investment decisions depend on both the expected return and the risk associated with the various assets constituting the portfolio (Nguyen, 2010; Ruckberg, 1995).

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