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**PRESS FREEDOM AND PREDICTABILITY OF STOCK MARKETS**

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**Abstract**. This study uses the Efficiency Index of Kristoufek and Vosvrda (2013) to investigate the relation between press freedom and the informational efficiency of 41 stock market indices over the period 1999 – 2012. We employ short memory (linear and nonlinear dependencies) and long memory as input variables for the Efficiency Index to control for different types of inefficiencies. Our panel results, supported by robustness tests, show a direct and significant relation between stock markets informational efficiency and press freedom. In addition, as expected, market capitalization and volatility are other two determinants of efficiency, whereas the degree of market openness has influence only on the long-term behavior of returns.

**JEL Classification**: C13, G14, G15

**Keywords**: predictability, press freedom, short memory, long memory, stock market indices.

**1. Introduction**

Media is a western concept almost universally accepted. With few exceptions, the Constitution of most countries guarantees the human right to free speech. Freedom of the press reflects the degree of freedom of journalists and media organizations in each country and the efforts of the authorities to respect and ensure the respect for this freedom. In a free environment any news immediately becomes public through various channels, print or electronic, while in a constrained or unfree environment, characterized by a low degree of disclosure, media becomes a target for those who want to control the news. The freedom of the press has experienced over time a positive evolution especially in democratic countries. However, the report of press freedom issued by Freedom House in 2014 denotes an overall pattern of decline, largely due to the situation in the Middle East and North Africa. Thus, despite the openings created by transnational media, the internet and privatizations of broadcasting, there still are various threats which restrict the ability of journalists to operate and the public access to information. Analyzing the trend of the last five years (2009-2013) we observe a shift towards a middle level (50-60 points according to the ratings established by Freedom House) with constant decreases in the freer regions of Europe and America, stagnation in Asia-Pacific and gains for weaker-scoring regions of sub-Saharan Africa, Eurasia, Middle East and North Africa. This suggests that the decline generally occurs in more democratic countries while improvements are visible in countries with a less permissive regime.

In an economic environment in which the media have a high degree of freedom, agents are unable to hide negative information or disclose it gradually. In contrast, in restrictive environments, the stock markets will register a lower frequency of negative price changes, i.e. a reduction of negative asymmetry of returns, as economic agents tend not to disclose negative information to the market. In the literature there are many studies which sustain that the gradual diffusion of information among investors affects the stock prices, but very few are those that investigate the impact of press freedom on the informational efficiency of stock markets.

The Efficient Market Hypothesis (EMH) has been the cornerstone of finance for more than four decades. Jensen (1978) stated that no other hypothesis in economics had more empirical support. Testing the relation efficiency – press freedom is a challenge mainly due to the abstract nature of the definition of an informational efficient market. According to Fama (1970), a market in which the current stock prices always fully reflect available information is called efficient. In this case, the prices are in equilibrium against all this information relevant to their fundamental value and fluctuations appear only as a response to the arrival of new information on the market. The new information is random by nature and determines a random behavior of stock prices if stock prices incorporate them quickly. In other words, the stock prices are “unforecastable if they fully incorporate the expectations and information of all market participants” (Lo, 1997: xii). In contrast, if stock prices mis-react, linear and nonlinear correlations will emerge in the series of returns making them more predictable.

Focusing on the weak form of in formational efficiency, the Martingale stochastic model[[2]](#footnote-2), a less restrictive version of the random walk, provides an appropriate framework for testing whether stock prices are predictable. The model refers only to the first conditional moment of the probability distribution of price changes and implies linear and nonlinear independent returns and, consequently, the current price as the best predictor of the future price. In this case, there can be no long-term profits exceeding the market profits assuming the same risk. The weak-form version of market efficiency has become the most commonly investigated criterion of the EMH in the empirical literature. However, the evidence is contradicting even for the same market because the vast majority of the empirical work is largely concerned with absolute market efficiency. Campbell et al. (1997), Lo & MacKinlay (1999) and Lo (2008) have repeatedly argued that perfect efficiency is an unattainable benchmark. Grossman & Stiglitz (1980) show that, under the presence of information costs, the investors have no incentive to trade if markets are perfectly efficient because there are not sufficient profit opportunities to compensate their cost of information gathering. Thus, Campbell et al. (1997) introduce a more practical concept - the relative efficiency, which is the efficiency of one market measured against another. As Lim (2008) noted, an empirical measure of relative efficiency will enable the researcher not only to compare the degree of informational efficiency across countries, but also to identify the underlying factors associated with higher efficiency.

Many empirical results highlight the underreaction of prices to events such as dividend announcements (Michaely, 1995), earnings (Bernard & Thomas, 1990), splits (Ikenberry & Ramnath, 2002), and changes recommended by analysts (Womack, 1996) or tender offers (Ikenberry et al., 1995). Robinson & Levy (1996) argue that newspapers constitute the majority of media coverage and have a significant impact on investors. Bhattacharya et al. (2000) state that unrestricted insider trading determines prices to incorporate information before they become public. Brunetti & Weder (2003) show that a free press is actually an external mechanism to control corruption and fraud able to produce more externally generated transparency compared to a press affected by government intervention. Chen (2005) shows that the degree of press freedom can be a proxy for the level of asymmetry of information in an economy. Gong & Gul (2011) investigate the media coverage of China's stock market and find that financial assets with high coverage in the media tend to have a positive impact on the stock turnover. Griffin, Hirschey, & Kelly (2008) find on a sample of 33 stock markets that a freer and stronger press is associated with a more rapid information dissemination and incorporation into prices.

In a more recent study, Kim et al. (2014) investigate the impact of press freedom as a measure of externally-generated transparency on the ability of stock prices to incorporate firm-specific information. The authors distinguish between self-generated transparency produced by financial reporting and externally- generated transparency through press reporting, and show that the two do not completely overlap in affecting the informational efficiency because the firms are likely to cover up fraud, corruption or other dubious activities generating a transparency "gap" that can be filled only by external monitoring mechanisms. In other words, external monitoring mechanisms may enhance both the information effect and the investor protection effect of transparency. If a free press can act as such an external mechanism to create transparency for businesses, the ability of price to incorporate firm-specific information will increase. On a sample of 45,220 firms from 50 countries the authors find for the period 2004 – 2009 a significant relation between more press freedom and lower stock price synchronicity and a significant relation between more press freedom and the ability of stock prices to predict future earnings. In addition, the results indicate an exacerbation of the adverse effect of the lack of press freedom on efficiency in countries where the press is state-owned to a greater extent. A contradictory result is obtained by Peress (2014) who finds that the absolute values of stock returns are not diminished on strike days even though turnover is reducing, suggesting that the media are not essential for the informational efficiency of stock markets, even if it plays an important role in spreading information among investors. The rate of incorporation of news into prices reflects the forces of arbitrage: the information is incorporated into stock prices even though many investors do not trade those stocks, due to the investors who remain informed despite discontinuation of information flow and are active in the market. The press matters to investors but is not essential for the informational efficiency of stock markets.

The objective of this paper is to empirically investigate the relation between weak-form efficiency and press freedom using 41 equity indices from 1999 to 2012. This paper contributes to the literature in several ways. First, this study uses the Efficiency Index of Kristoufek & Vosvrda (2013) which takes into consideration the predictability of returns to control for various types of correlations (short memory – linear and nonlinear dependencies – and long memory).The linear dependencies are detected by the Automatic Variance Ratio (AVR) test of Kim (2009), the Generalized Spectral (GS) test of Escanciano & Velasco (2006) is employed for the nonlinear dependencies, while the long memory is investigated through the Generalized Hurst Exponent (GHE) test proposed by Barabasi & Vicsek (1991). Second, we consider the time-varying nature of efficiency by applying the short-memory tests in the rolling window approach. Third, the relation between efficiency and press freedom is investigated using different panel regressions in which we include a set of control variables that captures the characteristics of the investigated markets. Fourth, the robustness checks confirm the relation found between the weak-form efficiency and press freedom.

**2. Methodology**

***The tests used***

The unpredictability of asset returns on the basis of past price changes implies the absence of linear and nonlinear correlations in the series of returns. Therefore, we employ three tests in this study in order to detect the existence of short term – linear and nonlinear – and long term correlations.

First, we test the short term linear correlations in the series of returns using the Automatic Variance Ratio (AVR) test of Kim (2009). The test has the null hypothesis of Martingale Difference Sequence (MDS), i.e:

|  |  |
| --- | --- |
|  | (1) |

where is the autocorrelation coefficient of the return of lag and is the holding period. The central idea of the variance ratio test[[3]](#footnote-3) is based on the observation that when returns are uncorrelated over time, the variance of the -period return is equal to the variance of one-period return times . When implementing the VR tests, the choice of is important and usually is done rather arbitrarily. Thus, Choi (1999) proposes a fully data-dependent procedure based on Andrews (1991) to optimally choose and shows that under the assumption that the returns are i.i.d.

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| --- | --- |
|  | (2) |

where is the Automatic Variance Ratio of the -period return, is the variance ratio of the -period return, is the holding period and is the observation period.

Because the properties of this test in small samples under conditional heteroskedasticity were unknown, Kim (2009) improves this shortcoming by proposing the AVR test in which the critical values are determined through the wild bootstrap of Mammen, thus being robust under conditional heteroskedasticity.

Second, we employ the Generalized Spectral (GS) test of Escanciano & Velasco (2006) to investigate the short term nonlinear correlations in the series of returns. The authors suggest that in order to test the null of MDS the generalized spectral distribution function should be used. They rely on the fact that the normalized spectral density function of the stock returns which follow a MDS is equal to one at all frequencies. Unlike the previous test, the GS test is capable of capturing both linear and nonlinear dependencies. The *p*-value of the test is estimated similar to the AVR test from a wild bootstrap and is robust to conditional heteroskedasticity.

Charles & Darné (2011) show through Monte Carlo simulations that these two tests have the best performances against their competitors, the AVR being more powerful in the presence of linear dependencies and the GS test under nonlinear dependencies.

Third, we estimate the Generalized Hurst Exponent (GHE) in order to investigate the long-range dependencies in the series of returns. This method, proposed by Barabasi & Vicsek (1991) and recently re-explored for the financial time series by Di Matteo et al. (2005) and Cajueiro & Tabak (2009), is based on the -th order moments of the increments of the process (with ):

|  |  |
| --- | --- |
|  | (3) |

which scales as

|  |  |
| --- | --- |
| . | (4) |

where the time-interval can vary between and .

We set days and to evaluate (Di Matteo et al., 2007). For , the value of GHE is expected to be closely to the classical Hurst exponent and characterizes the scalingof the absolute deviations of the process (Di Matteo   
et al., 2007). suggest an independent process or a short-term correlated process, suggests a persistent process (a positive return is statistically more likely to be followed by another positive return and vice versa) and suggests an antipersistent one (a positive return is more statistically probable to be followed by a negative return and vice versa). Through Monte Carlo simulations, Barunik & Kristoufek (2010) show that GHE is robust to heavy tails in the underlying process and provides the lowest variance and bias in comparison with other methods.

***Statistical indicator of the degree of market efficiency***

We follow Kristoufek & Vosvrda (2013) and use an Efficiency Index that allows us to control various types of dependencies by combining partial measures of efficiency:

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| --- | --- |
|  | (5) |

where is the *-*th measure of efficiency, is an estimate of the *-*th measure, is an expected value of the *-*th measure for the efficient market and is a range of the *-*th measure. Thus, “the efficiency index is defined on a unit -dimensional cube with the efficient market in the center” (Kristoufek & Vosvrda, 2013:188), i.e. for the efficient market and for the least efficient market, where is the number of measures taken into consideration. In this study, we define based on the three tests employed, as follows:

|  |  |
| --- | --- |
|  | (6) |

The measures of short-term efficiency, and , have the expected value for the efficient market equal to zero, since reflects the proportion of windows in which the hypothesis of MDS is rejected. The measure of long-memory, GHE, must be 0.5 in the ideal case.

***The panel models***

To empirically investigate the relation between press freedom and the degree of informational efficiency, we estimate the following panel regressions:

|  |  |
| --- | --- |
|  | (7) |

where is an inverse measure of informational efficiency for market in the interval , represents a proxy for press freedom, followed by the set of control variables, namely, volatility (), market capitalization () and *de facto* openess measure (. Note that are the country effects and is the error term.

The existence of the fixed effects is tested with the F test, while the random effects are tested with the Breusch-Pagan Lagrange multiplier test. To choose between the two techniques we employe a robust test proposed by Wooldridge (2002) and performed in Stata with the command *xtoverid*. The test has the null hypothesis that the preferred model is random effects versus the alternative of fixed effects. If the effects do not exist (the null hypothesis of both tests is accepted), the pooled OLS regression is favored. To account for within-group correlation and arbitrary heteroskedasticity we follow the recommendations of Petersen (2009) and use the option cluster in all models.

Because all the three tests employed in this study perform well only in large samples, of at least 300 observations for the short-memory tests (Charles et al., 2011) and 500 for the long-memory test (Barunik & Kristoufek, 2010), we divide the whole period in intervals of 2 years length and quantified the efficiency differently. Given the high temporal variability of the *p*-values, we apply the short-memory tests in a rolling window of 300 observations[[4]](#footnote-4), reducing at the same time the sensitivity to the choice of the first day of the sample (Todea & Zoicaș-Ienciu, 2008). Then, we calculate in , for each index, the percentage of time windows in which the null hypothesis of MDS is rejected (*p-value* is less than 5%), denoted as . In contrast, we estimate the generalized Hurst exponent on the whole interval for each index due to the higher stability in time of Hurst exponents and because the rolling window approach requires in this case a window of at least 500 observations.

**3. Data and Empirical Results**

***Data***

The database comprises the daily closing values of market value-weighted equity indices for 19 developed and 22 emerging stock markets, using the classification proposed by Standard & Poor’s. The time series cover the sample period from January 1999 to December 2012, except Australia, Bulgaria, Estonia, Philippines, Greece, Ireland and Israel, for which the time series starts in January 2000. All values of these indices extracted from Thomson Datastream are denominated in their local currency units. Based on the closing prices we calculate the series of continuously compounded percentage returns. Table 1 provides an overview of the sample averages.

**Table 1. Summary statistics – sample averages for 1999 – 2012**

| **Country** | **Index** | **GS** | **AVR** | **GHE** | **IE** | **Press** | **MV** | **MC** | **Pf\_GDP** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(%)** | **(%)** | **(%)** | **Bn $** | **(%)** |
| Argentina | MERVAL | 64.29 | 10.98 | 0.54 | 0.34 | 43.36 | 2.2 | 78.72 | 5.65 |
| Australia | S&P/ASX200 | 51.93 | 11.24 | 0.48 | 0.32 | 17.43 | 1.2 | 856.28 | 44.31 |
| Austria | ATX | 63.91 | 17.37 | 0.51 | 0.33 | 20.36 | 1.48 | 84.79 | 33.08 |
| Belgium | BEL20 | 49.79 | 2.31 | 0.48 | 0.23 | 10.5 | 1.35 | 243.35 | 60.93 |
| Bulgaria | SOFIX | 78.74 | 27.37 | 0.61 | 0.49 | 33.14 | 1.83 | 5.89 | 1.99 |
| Canada | S&P/TSX | 62.22 | 6.98 | 0.48 | 0.28 | 17.36 | 1.24 | 1366 | 54.54 |
| Croatia | CROBEX | 70.6 | 12.35 | 0.56 | 0.38 | 41.93 | 1.59 | 18.45 | 5.52 |
| Czech Republic | PX50 | 64.55 | 5.68 | 0.51 | 0.33 | 20.5 | 3.3 | 34.07 | 10.29 |
| Denmark | OMXC20 | 58.11 | 2.18 | 0.48 | 0.27 | 10.43 | 1.34 | 163.74 | 52.9 |
| Egipt | EGX30 | 80.95 | 59.43 | 0.57 | 0.53 | 66.5 | 1.8 | 61.07 | 2.51 |
| Estonia | OMXT | 90.38 | 39.8 | 0.61 | 0.52 | 17.5 | 1.84 | 3.13 | 13.47 |
| Finland | OMXH25 | 62.72 | 5.59 | 0.49 | 0.31 | 10.38 | 1.64 | 202.56 | 107.36 |
| France | CAC40 | 45.93 | 0.05 | 0.44 | 0.22 | 21.14 | 1.54 | 1694 | 52.11 |
| Germany | DAX | 56.47 | 0.07 | 0.48 | 0.29 | 15.71 | 1.61 | 1300 | 41.34 |
| Grecee | ATHEX20 | 70.1 | 15.88 | 0.51 | 0.32 | 29.5 | 1.79 | 115.47 | 14.46 |
| Hungary | BUX | 65.56 | 16.08 | 0.51 | 0.37 | 24.28 | 3.11 | 23.85 | 12.31 |
| India | BSE100 | 68.45 | 17.09 | 0.53 | 0.4 | 38.21 | 1.88 | 725.09 | 12.53 |
| Indonesia | IDX | 81.75 | 2.25 | 0.54 | 0.38 | 53.21 | 1.69 | 152 | 9.55 |
| Irland | ISEQ | 64.18 | 7.98 | 0.49 | 0.29 | 16.14 | 1.52 | 92.52 | 573.15 |
| Israel | TA100 | 70.83 | 5.38 | 0.51 | 0.33 | 29.14 | 1.33 | 126.61 | 35.94 |
| Japan | NIKKEI225 | 61.04 | 32.55 | 0.49 | 0.4 | 20.36 | 1.59 | 3616 | 25.99 |
| Malaysia | KLCI | 84.88 | 59.56 | 0.57 | 0.54 | 67.14 | 1.32 | 237.99 | 25.76 |
| Mexico | IPC | 67.25 | 32.25 | 0.51 | 0.37 | 49.93 | 1.53 | 267.83 | 12.77 |
| Netherlands | AEX | 53.71 | 0.26 | 0.48 | 0.26 | 13.07 | 1.58 | 599.22 | 136.43 |
| Norway | OSEBX | 58.22 | 2.7 | 0.49 | 0.26 | 9.21 | 1.58 | 171.92 | 65.58 |
| Oman | MSM30 | 92.73 | 10.63 | 0.65 | 0.43 | 71.43 | 1.18 | 12.32 | 7.01 |
| Peru | IGBVL | 86.89 | 49.52 | 0.6 | 0.54 | 43.93 | 1.43 | 49.12 | 16.46 |
| Philippines | HSBC | 71.66 | 22.77 | 0.53 | 0.32 | 37.93 | 1.58 | 80.86 | 9.47 |
| Poland | WIG | 50.23 | 1.65 | 0.51 | 0.24 | 21.64 | 1.85 | 100.42 | 5.5 |
| Portugal | PSI20 | 76.11 | 15.62 | 0.55 | 0.39 | 15.64 | 1.41 | 73.21 | 34.4 |
| Romania | BET | 70.01 | 45.04 | 0.57 | 0.45 | 42.79 | 1.85 | 17.43 | 1.72 |
| Russia | RTS | 77.28 | 9.37 | 0.54 | 0.36 | 70.57 | 2.74 | 560.94 | 12.87 |
| South Korea | KOSPI | 72.99 | 1.78 | 0.49 | 0.34 | 29.5 | 1.88 | 647.67 | 25.08 |
| Spain | IBEX35 | 50.91 | 0.07 | 0.49 | 0.22 | 21.43 | 1.51 | 932.87 | 31.25 |
| Switzerland | SMI | 55.2 | 1.25 | 0.46 | 0.27 | 10.93 | 1.27 | 915.44 | 214.55 |
| Thailand | SET | 77.5 | 17.44 | 0.54 | 0.43 | 45.57 | 1.53 | 145.74 | 181.8 |
| Tunisia | TUNINDEX | 89.65 | 60.7 | 0.64 | 0.55 | 77.38 | 0.52 | 5.18 | 4.54 |
| Turkey | ISE100 | 66.46 | 6.68 | 0.52 | 0.41 | 54 | 1.85 | 157.26 | 5.64 |
| U.K. | FTSE100 | 43.59 | 2.44 | 0.43 | 0.23 | 18.93 | 1.33 | 2800 | 99 |
| U.S.A. | S&P500 | 47 | 20.51 | 0.45 | 0.32 | 16.36 | 1.36 | 15849 | 43.11 |
| Venezuela | IBC | 79.24 | 36.76 | 0.58 | 0.46 | 63.27 | 1.53 | 7.56 | 2.16 |

*Source: author’s calculations.*

*Note:* The first column presents the analyzed countries; the second column indicates the index representative for each country. The percentages of rolling windows in which the MDS hypothesis is rejected are reported in the third (for the GS test) and forth (for the AVR test) columns. The fifth column contains the Hurst exponent estimated through the GHE test. The values of the Efficiency Index (eq. (6)) are in the sixth column. The last four columns present the exogenous variables employed in the panel regressions, namely press, market volatility, market capitalization (in billions of USD) and the share of foreign portfolio investment in GDP. All these variables are explained below.

In this study we employed the following variables:

*Press freedom* () – as proxy for press freedom we use the ratings established annually by Freedom House. They are determined based on scores assessed to a set of 23 questions that try to capture the different ways in which pressure can be exert on the flow of information and the ability to broadcast without fear of repercussions. Issues considered include the legal environment, the degree of control over news content, political influences on transmission and access to information, the ability of the public to access various sources of information, economic pressures on content and the dissemination of news. The ratings reflect not only government actions and policies, but also the behavior of the press itself in more restrictive environments. Each country obtains a score[[5]](#footnote-5) between 0 (most free) and 100 (least free) which serves to designate its state as regards press freedom: free (0-30 points), partly free (31-60 points) or not free (61-100 points). Of the 41 countries analyzed in this study, 24 are free, 11 partly free and 6 not free, with Norway at the top of the ranking and Tunisia at the bottom. It is important to note that since 2012, Tunisia has moved from the ‘not free’ to ‘partly free’ category. The Constitution’s new draft gives greater importance to freedom of expression while the repression of journalists is declining. However, the authorities have increased the number of legal cases against journalists using unreformed libel laws and exorbitant fees for renewal of licenses. Of the six countries where the press is not free, four are of Islamic origin (Egypt, Malaysia, Oman and Tunisia), while the other two are Russia and Venezuela. In the case of Venezuela, the new president continued his predecessor's efforts to control the media, while the media environment in Russia is distinguished by actions to prosecute independent journalists, impunity for the physical harassment of journalists and continuous state control over almost all traditional media outlets.

*The share of foreign portfolio investment in GDP*( – the first control variable is a *de facto* measure of the degree of market openness and quantifies the presence of foreign investors in the market. The foreign portfolio investments have an impact on stock prices because the foreign investors hold information that is not yet incorporated into prices, or have a superior ability to process information. Todea & Pleșoianu (2013) find a direct and significant relation between foreign portfolio investment and efficiency, regardless of considering short or long run dependence. Foreign investors will hold only domestic stock if their returns are more attractive than those of external stock (Dornbusch, 1988) because they are concerned about the inherent risks such as macroeconomic and political instability, corruption, war, and so on (Senbet & Otchere, 2010). The data for portfolio investment is obtained from the database of Lane and Milesi-Ferretti. We consider both portfolio equity assets and portfolio equity liabilities. The top 10 positions in the ranking are dominated by European stock markets (with two exceptions – Thailand and Canada ranked second and ninth place). The least preferred stock market by foreign investors is the Romanian market, followed at a short distance by the Bulgarian market.

*Market capitalization* (, in logarithmic form) – is the second control variable used as a proxy for market size. A high market capitalization indirectly reflects the level of investors’ participation in that market and we expect this to have a positive impact on informational efficiency.

*Volatility*() – the third control variable is measured as the standard deviation of daily returns of stock markets in the interval . As regards the sign of the link between volatility and efficiency there is no consensus in the literature. In the sample analyzed the emerging markets are more volatile than the developed markets, with few exceptions: the stock markets from Tunisia, Oman, Peru, Philippines, Mexico, Thailand and Venezuela which, although an apparently attractive alternative for risk aversion investors, do not provide high freedom of information.

For the endogenous variable,, we use four proxies:

* , when we account for linear dependencies only;
* , when we consider just the nonlinear dependencies;

In this two cases we apply a logistic transformation to which is bounded within the interval ), so that takes values between and .

* , when we investigate the long memory;
* when we employ the generalized measure of efficiency proposed by Kristoufek and Vosvrda (2013).

Figure 1 presents graphically the deviation from efficiency for the all of the proxies used to assess the informational efficiency.

The centers of the circle represent no deviation from the efficient market. The further the red line is from the center, the higher the deviation. The figures are rescaled to make the results more obvious. From the Efficiency Index, we find that France, Spain and Belgium have the most efficient stock markets, whereas Malaysia, Peru and Tunisia have the least efficient ones. To see the contribution of the partial measures of the Index to the overall ranking, we calculate Spearman's rank correlation. For the linear dependencies and the long-term memory, the rank correlations are 0.44 and 0.36, respectively, while for the nonlinear component the rank correlations is 0.86. Therefore, it seems that the nonlinear dependencies are the main driver of the potential inefficiency of stock markets. This could have been conceive from the high percentages of rolling windows in which the null hypothesis of MDS of the GS test is rejected and also from the average values of the Hurst exponents which fluctuate around 0.5, with small deviations downwards in the case of developed stock markets and upwards for the emerging ones. In practice, it is hard to believe that stock indices would be persistent as such persistence would be quickly arbitraged out by profit-seeking traders (Kristoufek, 2014).

**Fig. 1.Deviation from efficiency – Efficiency Index, GS, AVR and GHE tests**

*Source: author’s calculations*

***Main results***

Table 2 presents the results of panel regressions in which we included all four proxies of informational efficiency. Since the dependent variable () is an inverse measure of informational efficiency and the independent variable () is an inverse measure of press freedom the positive sign of the estimated parameter of the variable indicates a significant direct link between informational efficiency and freedom of the press. This suggests that an independent press increases the stock prices’ ability to incorporate all available information. Regardless of how we estimate the efficiency the relation remains significant and increases in intensity when we consider only the short-term behavior of returns. Because the dependent variable is an inverse measure of informational efficiency for country *i* in the interval *t*, the negative sign of the estimated parameters indicates a direct relation between the informational efficiency and the exogenous variables

**Table 2. Press freedom and efficiency – main results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Efficiency** | **IE** | **GS** | **AVR** | **GHE** |
| **Press** | 0.0022\*\*\*  (3.99) | 0.0147\*\*\*  (5.87) | 0.0193\*\*\*  (2.70) | 0.0009\*\*\*  (6.26) |
| **MV** | -5.1382\*\*\*  (-3.66) | -40.3819\*\*\*  (-4.25) | -32.7614\*\*  (-2.27) | -1.7448\*\*\*  (-3.59) |
| **MC** | -0.0258\*\*\*  (-3.92) | -0.2457\*\*  (-2.51) | -0.2514  (-1.22) | -0.0026  (-0.51) |
| **Pf\_GDP** | -0.0052  (-1.37) | -0.0114  (-0.30) | -0.0914  (-1.50) | 0.0030\*  (1.67) |
| **Constant** | 1.0262\*\*\*  (5.87) | 0.6725\*\*\*  (3.78) | -1.5944\*\*\*  (-4.51) | 0.0462\*\*\*  (4.55) |
| **Prob > F** | 0.0001 | 0.1444 | 0.0000 | 0.2198 |
| **Prob > chi-square** | 0.0058 | 0.2895 | 0.0001 | 0.1265 |
| **xtoverid** | 0.1033 | - | 0.1190 | - |
| **Cross-section effects** | Random | None | Random | None |
| **R2** | 0.2904 | 0.2297 | 0.1549 | 0.2123 |

*Source: author’s calculations.*

The negative sign of the other estimated parameters indicates a direct link between the informational efficiency and the control variables since is an inverse measure of informational efficiency. The relation is significant in case of volatility and market capitalization. The direct link between efficiency and market capitalization is in line with our expectations and the theoretical literature: the higher the degree of development of stock markets (the higher the market capitalization) the faster is their response to new information. The direct relation between volatility and efficiency is consistent with Sentana and Wadhawani’s (1992) model prediction which sustains that during volatile periods positive feedback traders exert a greater influence on price movements, resulting a higher degree of predictability. is the only insignificant variable, with one exception: when the degree of informational efficiency was estimated only on the basis of long-term behavior of returns. In this case, the relation between efficiency and the degree of market openness is an indirect one suggesting that the presence of investors in the market induces long memory. One possible explanation is based on the fact that the interaction between investors with different investment horizons generates various effects like volatility cluster or trend persistence.

***Robustness checks***

We noticed that the dependent variable, , regardless of how it is defined in this study, does not follow a normal distribution, but is closer to a beta distribution. The beta distribution is defined on the interval by two positive parameters and which do not correspond directly to either the mean or variance of the distribution, but appear as exponents of the random variable and control the form of the distribution. Furthermore, the mean and variance of a beta distribution are functions of the two parameters, and therefore estimating and by maximum likelihood as a function of the whole set of covariates should generate better estimates of the data.

To investigate the relationship between press freedom and informational efficiency with this method, the endogenous variable should take values in the interval . Thus, when we took into account only the linear correlations and we considered the nonlinear correlations . The other two proxies remain unchanged, respectively and , but we applied a transformation in the end so that the variables take values between 0 and 1. The results in Table 3 confirm the significant direct link between press freedom and informational efficiency, and between efficiency and two of the control variables - market capitalization and volatility. As in the previous case, the presence of investors matters only in the long term.

**Table 3. Press freedom and efficiency – robustness tests**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Efficiency** | **IE** | **GS** | **AVR** | **GHE** |
| **Press** | 0.0146\*\*  (5.58) | 0.0169\*\*\*  (4.85) | 0.0147\*\*\*  (2.69) | 0.0163\*\*\*  (6.88) |
| **MV** | -29.3714\*\*\*  (-3.33) | -46.5679\*\*\*  (-3.94) | -23.2797  (-1.25) | -25.3091\*\*\*  (-2.69) |
| **MC** | -0.1299\*\*\*  (-4.91) | -0.4185\*\*\*  (-2.96) | -0.1462  (-0.55) | -0.0104  (-0.09) |
| **Pf\_GDP** | -0.0367  (-0.80) | -0.0125  (-0.21) | 0.0586  (0.33) | 0.0665\*  (1.79) |
| **Constant** | 3.2522\*\*\*  (4.55) | 5.0102\*\*\*  (5.39) | -0.8969\*\*  (-2.12) | -2.4438\*\*\*  (-12.27) |
| **Wald chi-square** | 93.40 | 50.22 | 10.49 | 55.25 |

*Source: author’s calculations.*

**4. Conclusions**

To the best of our knowledge this study is the second (after Kim et al., 2014) to investigate the relationship between informational efficiency and press freedom on a sample of 41 stock markets over the period 1999 - 2012. Our major contribution is the use of an Efficiency Index proposed by Kristoufek and Vosvrda (2013) which combines partial measures of efficiency controlling for different types of correlations (short term - linear and nonlinear - and long term). In the simplest approach, an efficient market is a market in which there is no correlation structure of returns. Thus, we can determine the expected values of long memory and of percentage of windows in which linear or nonlinear dependencies occur for an efficient market to construct an efficient measure based on distance from the efficient market state. The empirical results indicate that nonlinear dependencies occur with greater intensity than the linear or the long term dependencies. But regardless of how we quantify the degree of informational efficiency, we find a direct relation between press freedom and efficiency which is confirmed by the robustness tests also. Market capitalization and volatility are two other determinants of efficiency whereas the degree of market openness has influence only on the long-run by generating long memory in series of returns. These results warrant the attention of investors to choose the best trading strategy (active or passive), of regulatory authorities to optimally design the trading protocols and of policymakers to encourage the freedom of expression with positive implications on the allocation of investment resources.

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2. The arguments concerning the sufficiency to test the if stock prices follow a Martingale model for the weak-form efficiency are found in Escanciano and Lobato (2009). [↑](#footnote-ref-2)
3. For more details, see the recent survey of Charles & Darné (2009). [↑](#footnote-ref-3)
4. This length is a compromise between the need to maximize the power of the tests and the length of the interval *t*. [↑](#footnote-ref-4)
5. For more methodological details, see http://www.freedomhouse.org/ report/freedom-press-2014/ methodology. [↑](#footnote-ref-5)