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Table of Contents: Volume 12 Number 21 14 November, 2018

ARTICLES

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Full Length Research Paper

Is there a weather effect? Evidence from a panel of emerging countries' stock markets

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A long history of psychological studies has postulated that good (bad) weather induces a positive (negative) mood. Other studies have concluded that mood can influence humankind decision-making process under risk and uncertainty. Several behavioural finance studies have raised the question of whether sunshine, temperature or other weather variables exert an impact on stock prices by affecting the behaviour of market operators, thus challenging the efficient-market hypothesis. However, very few papers on the weather effect, with contradictory results, have concentrated on the stock markets of emerging countries. We fill this gap by conducting a comprehensive analysis of the effect of four weather variables (temperature, cloud cover, humidity and wind) on the stock markets of nine emerging countries located in three climatic and economically different areas of the world. Differently from the existent literature, we extend the analysis by analyzing stock prices' behaviour along with that of stock indexes and by inspecting the opening market activity along with the whole-day activity. Based on our results, we strongly reject the weather effect hypothesis.

Key words: Weather effect, market anomalies, efficient market hypothesis, trading behaviour, sunshine effect.

INTRODUCTION

Since the seminal work of Saunders (1993), a considerable number of papers have studied the effect of the weather on stock market prices. Basically, these studies have relied on two hypotheses tested in many psychological studies, namely: a) that individuals making decisions involving risk and uncertainty allow their emotional state to influence their decisions and, b) that some weather conditions have a not negligible effect on human behaviour. Alongside financial studies arguing that external weather conditions, influencing market operators' mood, have a statistically significant indirect effect on

stock market activity, others have contended that there is no convincing relationship between the weather and the stock prices, volumes and volatility. Notably, only a very small number of these studies have concentrated on emerging markets, with conflicting results.

The effect of the weather on human behaviour can vary across different stock markets, thus being an idiosyncratic feature of each specific country (Keef and Roush, 2007; Pizzutilo and Roncone, 2017). Market participants in emerging markets can be differently affected by emotions and moods in their financial

decision under risk than operators in developed stock markets. Indeed, different locations are exposed to very different climatic conditions, and different populations could react differently to the same weather condition, since their experience and their psychological traits can be particularly diverse (Lo and Repin, 2002; Bassi et al., 2013). Finally, different levels of efficiency of national stock markets could experience different impacts of the weather conditions on the market activity.

All of these considerations motivate the need for an in-depth analysis of the weather effect on the stock markets of emerging countries. We conduct our analysis on the stock markets of a set of relatively young and dynamic modern economies that are playing an expanding role in the world economy and politics, have a relatively developed financial stock market and are located in three different fast-growing areas of the world that are strongly differentiated from each other by their climatic, societal and economic features, namely Latin America (Chile, Colombia and Mexico), Eastern Europe (the Czech Republic, Hungary and Poland) and South East Asia (Malaysia, the Philippines and Thailand). Considering the growing importance of these emerging markets in their regional area and in the global economy, an investigation of the weather effects on these stock markets is quite interesting. Moreover, on a practical perspective, studying this stock market anomaly has useful implications for asset managers and private investors interested in this market.

Rather than only analyzing stock market indices (the focus of the large part of the existing literature on the weather effect) we conduct our study at the stock price level too, due to the fact that the weather effect, if any, is ubiquitous and affects stock prices together with the comprehensive market activity. Moreover, differently from most of the existent literature, we do not limit the analysis to a single weather variable but consider the four weather variables (temperature, humidity, cloudiness and wind) that have been found in previous studies to have a statistically significant relationship with stock market activity. Then, supported by the psychological literature that concludes that extreme weather conditions are one of the major reasons for human mood misattributions (see next section for bibliographic details), we employ different specifications for the weather variables analyzed. Finally, we concentrate on the opening-hour market returns along with the daily ones with the belief that the weather effect, if any, is more able to influence the mood of traders and market operators at the beginning of the day than later on; when many other situations could have happened, new information could have been disclosed to the market and modern indoor facilities could have mitigated the outdoor atmospheric conditions.

We strongly reject the weather effect hypothesis for all the variables considered, for the different moments of the trading day examined and for the different time horizons

analyzed, arguing that the efficiency of these stock markets is not challenged by the behavioural effect of the weather on the market operator's mood.

This paper contributes to the existent literature in two ways. First, to the best of our knowledge, this is the first paper to concentrate on an in-depth analysis of the weather effect on these emerging stock markets, thus filling a not negligible gap in financial studies. Second, it contributes to a greater understanding of the relationship between weather-induced mood misattributions and stock market prices by inspecting a comprehensive set of weather variables, analyzing the effect of the weather on the market-opening activity in conjunction with the whole-day trading activity and determining whether there is a statistically significant effect of weather conditions on stock returns along with index returns.

LITERATURE REVIEW

A long history of psychological literature has shown that external weather conditions are able to influence individual mood and behaviour. Around one-third of the human population is estimated to be weather sensitive (Kals, 1982). Wyndham (1969) and Allen and Fischer (1978) postulated that abilities of people to complete tasks are impaired when they are exposed to extreme cold or hot conditions. Extreme hot or cold conditions have also been found to be related to discomfort, hysteria and aggressive behaviour (Scheider et al., 1980; Rotton and Cohn, 2000; Bell et al., 2005; Page et al., 2007). Cunningham (1979) found that the number of hours of sunshine is inversely related to negative moods. At the same time, several studies suggested that low cloud cover is related to good moods, while high cloud cover is related to bad moods, melancholy and depression (McAndrew, 1993; Eagles, 1994; Kent et al., 2009). Another relevant strand of psychological literature postulated that windy weather conditions deteriorate people moods and cause headaches and insomnia (Cooke et al., 2000; Denissen et al., 2008). Sanders and Brizzolara (1982) associated low levels of humidity with good moods while Howarth and Hoffman (1984) observed that positive human performances are negatively correlated with high humidity levels but positively correlated with the number of hours of sunshine. Although people's well-being does not change daily, Levinson (2012) found a positive effect of temperature on self-reported life satisfaction. At the same time, Kampfer and Mutz (2013) found that respondents surveyed on days with exceptionally sunny weather reported a higher life satisfaction compared to respondents interviewed on days with ordinary weather.

In addition, an extensive literature argued that moods and emotions significantly affect individuals' financial decision-making process (Damasio, 1994; Loewenstein et al., 2001; Harding and He, 2016). Nevertheless, there

is no agreement on the nature of this behavioural relationship. Studies derived from the Mood Maintenance Model of Isen and Patrick (1983) postulate that people in a positive mood wish to maintain their positive state and are more at adverse risk. At the same time, individuals in a negative mood state are tempted to risky behaviours hoping to improve their feelings (Mittal and Ross, 1998; Lin et al., 2006; Yechiam et al., 2016). On the contrary, literature based on the Affect Infusion Model firstly proposed by Forgas (1995) argues that mood substantially influences people's ability to process information especially in complex, unexpected or new situation. According to those studies, people in a good mood are inclined to take risks since they are predisposed to overweight positive elements and to underestimate the likelihood of negative outcomes. The converse is postulated to be true for people in a sad mood since they have a propensity to pay more attention to negative aspects and underestimate future prospects (Hills et al., 2001; Chou et al., 2007; Otto et al., 2016).

In his pioneering study, Saunders (1993) examined the relation between local New York City weather and daily changes in indexes of listed stocks on Wall Street. His results led to the rejection of the null hypothesis that stock prices from the exchanges in New York City have not systematically been affected by the local weather, supporting the conclusion that the weather conditions in New York City, influencing investor psychology, have a systematic impact on Wall Street security markets.

In the following years, researchers have extended this stream of financial studies, as yet with no conclusive results. Along with analyses confirming Saunders (1993)' results (Cao and Wei, 2005; Chang et al., 2008; Goetzmann et al., 2015), a copious body of papers has found very little evidence in favour of the so-called weather effect (Loughran and Schultz, 2004; Goetzmann and Zhu, 2005; Frühwirth and Sögner, 2015; Kaustia and Rantapuska, 2016) or strongly criticized the conclusions that stock markets are influenced by weather-induced investor mood changes (Kramer and Runde, 1997; Pardo and Valor, 2003; Jacobsen and Marquering, 2008; Pizzutilo and Roncone, 2017; Kim, 2017).

Compared with the number of studies examining developed economies, very few have focused on the analysis of the weather effect on the stock markets of emerging economies. Moreover, all of them have limited the analysis to the index level; that is, they have not verified whether the behaviour of stock returns can be supposed to be influenced indirectly by weather variables too. No study has paid attention to the opening-hour market activity.

Hirshleifer and Shumway (2003) examined the relationship between sunshine in the city of a country's leading stock exchange and daily market index returns across 17 developed markets and 9 emerging markets (Argentina, Brazil, Chile, Malaysia, the Philippines, South Africa, Taiwan, Thailand and Turkey) from 1982 to 1997.

For the latter group, they only found little evidence that the returns of the Brazilian index were statistically positively related to sunshine. Nevertheless, they concluded that transaction costs heavily reduce the gains from a weather-based trading strategy. These results as well as those of Saunders (1993) were recently questioned by Kim (2017), who critically evaluated the statistical significance reported in those studies speculating that their findings were highly likely to be spurious and an occurrence of Type I error. He also concluded that the same suspicions concerning spurious statistical significance were likely to be found in many other studies on weather effect.

Shu and Hung (2009) investigated the existence of an underlying relationship between wind and stock market index returns in 18 European countries. The analysis covered 5 emerging financial markets (Russia, Turkey, the Czech Republic, Poland and Hungary) along with continental developed countries for the years 1994 to 2004. Interestingly, the study documented a strong and pervasive negative effect of wind speed on the stock market index performances in many developed countries and no significant effect on the returns of the examined emerging countries' indexes. On the same line, Dowling and Lucey (2008) conducted a comprehensive analysis of the effect of weather and biorhythm variables on the index returns of 37 markets (Argentina, Chile, China, Indonesia, Korea, Malaysia, Mexico, the Philippines, South Africa, Taiwan and Turkey were the emerging economies considered) for the period 1994 to 2004. They found little support for the assertion that weather variables are significantly related to stock indexes' prices and volatility.

The relationship between the weather variables and the Taiwanese stock exchange index has been investigated by different studies with conflicting results. Chang et al. (2006) explored whether there was a relationship between the Taiwan stock index returns and three weather variables: temperature, humidity and cloud cover. Their study covered the period from July 1997 to October 2003. They argued that the Taiwan stock index returns tend to be lower when the weather is extremely hot or extremely cold. In addition to temperature, they concluded that cloud cover is an important factor affecting stock market returns in Taiwan. According to their results, the Taiwan stock index's returns tend to be lower when the cloud cover is too heavy. Lee and Wang (2011) investigated the effectiveness of the sunshine effect on the Taiwan Stock Exchange Value Weighted Index (TAIEX) and eight of its sub-indices. By taking into consideration the impact of the U.S. stock market and employing the GED error distribution, they inspected a very large time period (1986 to 2007) and concluded that, for the pre-1997 Asian crisis period, the effect of sunshine on the TAIEX was limited, while it was more effective in the subsequent years. They also found a significant sunshine effect in six out of eight sector indices in the first

sub-period and three in the second. Different results were obtained by Wang et al. (2012), who analyzed the behaviour of the TAIEX over the years 2001 to 2007. They found that sunshine and temperature significantly affect TAIEX volatility but not its returns. They also found an insignificant relationship between TAIEX and humidity.

Yoon and Kang (2009) examined whether the daily returns on the Korean Composite Stock Price Index (KOSPI 200) were affected by three weather variables (temperature, humidity and cloudiness) over the years 1990 to 2006. They found that, before the 1997 Asian crisis, extremely low temperatures exerted a positive influence on returns, whereas extremely high humidity and heavy cloudiness exerted a negative effect. They also argued that, after the 1997 financial crisis, the evidence for a weather effect became insignificant. Shim et al. (2015) inspected how historical and implied volatilities move in response to unexpected weather changes in the Korean stock market. They concluded that market volatility tends to increase in cloudy or wet weather, and to decrease in windy weather conditions. They also observed that investors asymmetrically react to extremely high and low weather conditions. According to their results, the Korean stock market seems to become riskier in extremely cloudy, wet, cold and windless conditions as opposed to extremely sunny, dry, hot and windy weather.

Studies have been conducted on the Chinese stock market as well. Kang et al. (2010) inspected the relationship between three weather variables (temperature, humidity and sunshine) and the daily stock returns and volatility of the Shanghai A (domestic board) and B (foreign board) share indexes. They argued that the Shanghai weather affected the A-share index returns and volatility over the whole period inspected and the B-share index returns and volatility after the opening in 2001 of its trading to domestic investors. Lu and Chou (2012) examined the association between weather-related mood factors (cloud cover, temperature, humidity, visibility, pressure and wind speed) and the Shanghai Composite Index (SCI) from 2003 to 2008. Their results indicate that the SCI returns were generally unaffected by the changes in mood introduced by weather variables with the exception of extreme weather conditions. Furthermore, they found that many of these variables were strongly correlated with the market turnover and liquidity.

Recently, Sheikh et al. (2017) studied the impact of weather and biorhythmic variables on index returns and volatility in six stock markets of the Indian region (India, Pakistan, Bangladesh and Sri Lanka). Their analysis covered the period 2000-2012. They found little evidence for the effect of the weather on index returns. Nevertheless, they argued that many weather variables have significant relationship with volatility. Interestingly, their analysis led to the conclusion that rainy days in Indian equity markets are related to positive returns and decreasing volatility.

METHODOLOGY

Existing literature (see previous section) has recognized temperature, cloudiness, wind and humidity as weather variables that are able to influence market operators' mood to such an extent that they have a significant effect on stock market activity. We thus examined the effect of these variables on the stock market returns of a sample of emerging economies. Countries have been selected among those classified by Morgan Stanley Capital Index as Emerging Financial Markets (note 1) and located in three different geographical, political and societal areas of the world, Latin America, East Europe and South East Asia so to permit comparison among different emerging financial regions of the world, too. To ensure a higher level of homogeneity and avoid results being affected by the relative size of their stock markets, BRICs and Asian Tigers have been excluded from eligible countries. Finally, the three countries of each region with the higher market capitalization as of 31 December 2015 have been selected. Table 1 reports major macroeconomic data of the countries that are included in our sample. A remarkable increase in the GDP, associated with inflation and unemployment rates not dissimilar to those of developed countries, distinguished the years covered by our analysis. All of the countries in our sample experienced substantial financial markets reforms in the last 20 years.

Meteorological data were collected from the archives of the National Centers for Environmental Information (NCEI), the US Federal Centre responsible for hosting and providing access to the world's largest archives of weather and climate data. The weather data refer to the meteorological observation station nearest to the stock exchange inspected (Table 2). The following definitions apply to the weather variables employed in the analysis. Temperature (TMP) is the air temperature measured in degrees Celsius; humidity (HUM) is the relative humidity measured as a percentage; wind (WND) is the wind speed measured in meters per second; and cloudiness (CLD) denotes the fraction of the celestial dome covered by clouds expressed in oktas ranging from 0 (clear sky) to 8 (overcast) (Note 2).

All the values coded by the NCEI as suspect or erroneous were not taken into consideration. Occasional missing values in weather and price data were not replaced. Given the very small number of missing data, this is not believed to have affected the results to a significant extent. The analysis covers the period from 1 January 2006 to 31 December 2015. To avoid the results being affected by the relatively small number of daily trades, the analysis was conducted on the stocks comprised in the most liquid index of each exchange on 31 December 2015. To avoid the results being affected by the relative small number of observations, shares listed later than 1 January 2014 were excluded from the sample. To avoid redundancies, if preference shares were included in the index along with ordinary shares, only the latter were examined. The behaviour of the main index of each stock exchange was analyzed too. The total return prices adjusted for corporate actions were employed for all the time series under inspection but the Colombia Colcap 20. (Note 3) The returns were calculated as the difference in the natural logarithm between the stock prices. For each trading day, we calculated the daily return (RETD) and the opening return (RETO) as the difference in the natural logarithm between day t and day t-1 closing prices and the difference in the natural logarithm between the day t opening price and the day t-1 closing price, respectively. To reduce the possible bias induced by series of null daily returns, only days in which at least one negotiation of the share occurred were included in the analysis. A total of 186 stocks and 9 indices composed our sample. Table 2 summarizes the data of interest. The market data were collected from Datastream.

Table 1. Main macroeconomic figures.

Country	US$ GDP change %					Average annual inflation rate %			Unemployment rate %		
	2015 GDP US$ Mil	2006-2015 (%)	2011-2015	2006-2010	2015 GDP per capita $	2015	2010	2006	2015	2010	2006
Chile	279.650	127.25	28.68	76.60	15.653	3.21	1.41	3.39	7.00	8.15	7.95
Colombia	427.139	191.43	48.82	95.83	8.858	2.60	2.27	4.29	9.00	11.80	12.04
Czech rep.	208.872	60.59	5.23	52.61	19.796	1.90	1.46	2.54	5.97	7.28	7.15
Hungary	132.178	19.81	3.67	15.57	13.433	2.30	4.88	3.88	7.80	11.20	7.50
Malaysia	375.633	161.69	51.75	72.45	12.127	4.10	1.72	3.62	3.00	3.30	3.33
Mexico	1.367.301	57.82	30.08	21.33	11.321	3.61	4.16	3.63	4.50	5.37	3.59
Philippines	330.259	220.41	65.47	93.64	3.256	3.87	3.78	5.47	6.80	7.33	7.95
Poland	593.758	95.36	26.43	54.52	5.771	0.82	2.58	1.03	9.50	9.64	13.84
Thailand	5.771.701	125.39	24.64	80.84	15.406	1.96	3.28	4.65	0.80	1.05	1.52

Source: International monetary fund statistics.

First of all, to obtain comparable results with previous studies, we tested the significance of the following regression model, which is similar to the one employed by most existing literature:

$$RET^Y_{it} = \alpha + \beta_i W^Y_t + \varepsilon_{it} \tag{1}$$

Where, RET^Y_{it} denotes the market response variables inspected (RET^D or RET^O) of day t for stock i or index i. W^Y_t denotes the explanatory weather variable used (TEMP, HUM, CLD or WND) on day t. The average of the observations for each weather variable during the trading hours of day t (W^D_t) and the observation at the market opening hour (or the closest one) of day t (W^O_t) were considered as the weather explanatory variable for the daily and opening analysis, respectively. α is a constant, β_i is the regression coefficient and β is the error term.

The psychological literature has outlined that the most evident mood misattributions are related to very bad or very good weather conditions (Allen and Fischer, 1978; Bell, 1981; Rotton and Cohn, 2000). Saunders (1993) highlighted that almost all the differences in the returns documented in his study were driven by extreme cloud cover conditions. On the same line, other studies have contended that most of the weather effect is due to extreme weather conditions (Chang et al., 2006; Yoon and Kang, 2009; Goetzmann et al., 2015). To verify whether a relationship exists between extreme weather conditions and the returns of the emerging stock markets analysed, we also tested the significance of the following model:

$$RET^Y_{it} = \alpha + \beta_{1i} W^{YH}_t + \beta_{2i} W^{YL}_t + \varepsilon_{it} \tag{2}$$

Where, W^{YH} and W^{YL} are dummy variables that take the value of one if an extremely high (H) or low (L) weather condition is measured on day t (if Y=D) or at the opening hour of day t for the opening analysis (if Y=O) and zero otherwise, and all the rest are as above. To cope with the ambiguity inherent in the definition of an "extreme weather condition", the strong differences in the climate of the countries analysed (for instance, a temperature of 5 degrees Celsius in a day in January is not an extremely low temperature in Poland, while it is of course in the Philippines) and the variability of the weather during the year (a temperature of 30°C is not an extreme condition if in the previous week the average temperature was 32 but can be considered an extreme condition if the average temperature in the previous 7 days was 18), we specify three different thresholds for extreme weather condition: a) the weather

survey is in the first (extreme high weather condition) or the tenth (extreme low weather condition) decile of the distribution (model 2a); b) the weather survey is one standard deviation higher (extreme high weather condition) or lower (extreme low weather condition) than the average of the previous ten days (model 2b); and c) the weather survey is 1.96 standard deviation higher (extreme high weather condition) or lower (extreme low weather condition) than the average of the previous ten days (model 2c).

To gain more insights, all the above analyses were conducted over the whole time period, 2006–2015, and over the two sub-periods of the same extension, 1 January 2006 to 31 December 2010 and 1 January 2011 to 31 December 2015. To identify possible outliers, Cook (1977)'s distance was used. In line with Chatterjee and Hadi (2006), the (1-α) point of the F-distribution with (p+1) and (n-p-1) degrees of freedom was employed as the threshold value with a confidence level of 95%. Excluding from the analysis occasional observations outlined by Cook (1977)'s distance did not significantly change the results; hence, to avoid redundancy, the figures reported hereinafter refer to the whole set of observations only (Note 4). Ordinary least squares (OLS) estimators were employed. The augmented Dickey–Fuller (ADF) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests excluded unit root issues at the usual confidence levels. Since the Durbin and Watson (1950; 1951)'s test and the Breusch and Pagan (1979)'s test raised concerns about serial autocorrelation and heteroskedasticity of the residuals, we employed Newey and West (1994)'s non-parametric bandwidth procedure for heteroskedasticity and autocorrelation consistent covariance estimation to adjust the standard errors and control for unknown forms of heteroskedasticity. The resulting robust standard errors and p-values are shown in the next section and used to discuss the results.

RESULTS AND DISCUSSION

Tables 3, 4 and 5 report the regressions for which significance at the 95% confidence level was found for at least one explanatory variable in the index analysis or, for the stock analysis, significance at the 95% confidence level was found for at least one explanatory variable for a minimum of 40% of the shares of a country. The results are grouped into regional clusters to provide insights into

Table 2. Meteorological and stock exchange data.

| Country | Weather Station | LAT. | LONG. | ELEV. | Stock Exchange | Mrkt Cap* | Listed ** companies | Index | Index change % *** | | | | | Website |
									No. of stocks	2006-2015	2011-2015	2006-10	Trading time	
Chile	Arturo Merino Intl	-33.39	-70.79	474	Bolsa de Comercio de Santiago	190.352	212	INTER-10	10	111.34%	-24.62%	180.36%	9.30 -16.00	http://www.bolsadesantiago.com/Paginas/home.aspx
Colombia	Eldorado Intl	4.7	-74.15	2548	Bolsa de valores de Colombia	85.956	67	COLCAP 20	20	-8.28%	-44.84%	66.29%	9.30 -16.00	http://en.bvc.com.co/pps/tibco/portalbvc/Home
Czech rep.	Praha-Ruzyne	50.1	14.26	380	Burza Cennich Papiru Praha	41847	21	PX	12	-35.08%	-21.92%	-16.85%	9.00 - 16.30	https://www.pse.cz/
Hungary	Ferihegy	47.43	19.26	151	Budapesti Ertektozsde	17.440	32	BUX	14	13.84%	12.16%	1.49%	9.00 - 17.00	https://www.bse.hu/
Malaysia	Sultan Abdul Aziz Shah Intl	3.13	101.55	27	Bursa Malaysia	382.977	891	FTSE Bursa Malaysia	30	130.29%	30.49%	76.48%	9.00 - 17.00	http://www.bursamalaysia.com/market/
Mexico	Licenciado Benito Juarez Intl	19.43	-99.07	2230	Bolsa Mexicana de Valores	402.253	141	INMEX	20	139.71%	9.84%	118.24%	8.30 - 15.00	https://www.bmv.com.mx/
Philippines	Ninoy Aquino Intl	14.51	121.02	23	Pamilihang Sapi ng Pilipinas	238.820	264	PSEi	30	229.52%	65.48%	99.13%	9.30 -16.00	http://www.pse.com.ph/stockMarket/home.html
Poland	Okecie	52.17	20.97	110	Giełda Papierów Wartościowych	129.355	424	WIG 20	20	9.78%	-13.67%	27.16%	9.00 - 17.00	https://www.gpw.pl/
Thailand	Bangkok Intl	13.91	100.61	3	The Stock Exchange of Thailand	348.798	688	FTSE SET Large Cap	30	49.43%	10.07%	35.75%	10.00 - 16.30	http://www.set.or.th/set/mainpage.do?language=en&country=US

*Domestic market capitalisation in US$ Million as of 31/12/2015 - Sources: Stock exchange's websites for European stock exchanges. World Federation of Exchanges annual statistics for the others; ** Domestic market;
** Total return.
Source Datastream

the three geographical areas inspected. To save space, we avoid reporting index regression figures for which any significance at the usual confidence level was found and stock regression figures for which significance was found for fewer than 40% of the shares analysed for each country. Complete data are obviously available to whoever is interested on request.

If the analysis is confined to the index level, as in all the previous research on the weather effect in emerging countries, a strong effect of the weather on these stock markets can be argued. For instance, it can be advocated that extremely high (beta -0.002; Pval 0.048) and extremely low (beta -0.002; Pval 0.048) humidity have a negative effect on Colombian stock markets, that a clear sky in Prague (beta 0.0142; Pval 0.028) exerts such a positive effect on the mood of Czech stock market traders that it is positively reflected in the returns of the PX index or that a very high temperature in Bangkok early in the morning (beta 0.002; Pval 0.046) leads to positive opening prices and so on for the other significant coefficients. Nevertheless, no similar patterns are observable by comparing countries belonging to the same geographical area.

An opposite picture is drawn by the correspondent stock-level analysis. A very small number of stocks can be supposed to have their price behaviour indirectly influenced by the same weather condition that can be statistically argued to have a significant effect on the index price. In all the cases for which a 95% confidence level of significance was found in the index analysis, the percentage of stocks included in the index for which similar significance is measured is very small. For the majority of the cases, this percentage is below 15%, while the maximum percentage is 30%. For the 2006 to 2015 examination, in 4 of a total of 19 significant coefficients in the index analysis none of the stocks included in the index reported a similar

Table 3. Eastern Europe.

Model	Shares			Index		
	% PVal<0.05	AV_R2	MAX_R2	Coeff.	Pval	R2
Panel 1) Czech						
a) 2006-2015 analysis						
2a $RET^O \sim CLD^{Ha} + CLD^{La}$		-0.0007	0.0013			0.0054
CLD^{Ha}	0.00			4.72	0.868	
CLD^{La}	0.00			**0.014**	**0.028**	
2c $RET^D \sim WND^{Hc} + WND^{Lc}$		-0.00046	0.001981			0.00157
WND^{Hc}	16.67			-4.92	0.779	
WND^{Lc}	0.00			**0.421**	**0.022**	
2b $RET^O \sim WND^{Hb} + WND^{Lb}$		-0.00067	0.001774			7E-05
WND^{Hb}	0.00			**-0.212**	**0.047**	
WND^{Lb}	8.33			-1.25	0.926	
b) 2006-2010 analysis						
2c $RET^D \sim WND^{Hc} + WND^{Lc}$		-0.00031	0.002582			0.00497
WND^{Hc}	20.00			0.155	0.597	
WND^{Lc}	0.00			**0.016**	**0.001**	
c) 2011-2015 analysis						
2a $RET^O \sim CLD^{Ha} + CLD^{La}$		-0.0008	0.0021			0.0154
CLD^{Ha}	8.33			6.08	0.992	
CLD^{La}	0.00			**0.923**	**0.212**	
Panel 2) Hungary						
a) 2006-2015 analysis						
2b $RET^D \sim CLD^{D.Hb} + CLD^{D.Lb}$		0.000392	0.003339			0.00075
$CLD^{D.Hb}$	7.14			-0.001	0.541	
$CLD^{D.Lb}$	21.43			**-0.002**	**0.046**	
2c $RET^O \sim HUM^{O.Hc} + HUM^{O.Lc}$		0.000816	0.00957			0.0013
$HUM^{O.Hc}$	7.14			0.001	0.364	
$HUM^{O.Lc}$	14.29			**-0.003**	**0.045**	
b) 2006-2010 analysis						
2b $RET^D \sim CLD^{D.Hb} + CLD^{D.Lb}$		0.002769	0.017686			0.00124
$CLD^{D.Hb}$	7.14			-0.001	0.260	
$CLD^{D.Lb}$	28.57			**-0.003**	**0.034**	
2a $RET^O \sim HUM^{O.Ha} + HUM^{O.La}$		0.001827	0.026849			0.00134
$HUM^{O.Ha}$	0.00			0.001	0.423	
$HUM^{O.La}$	14.29			**0.005**	**0.043**	
2c $RET^D \sim WND^{D.Hc} + WND^{D.Lc}$		-0.00394	0.001494			1.1E-06
$WND^{D.Hc}$	7.14			0.0002	0.900	
$WND^{D.Lc}$	0.00			**0.006**	**0.028**	
2a $RET^O \sim WND^{O.Ha} + WND^{O.La}$		-0.00202	0.003399			0.00203
$WND^{O.Ha}$	21.43			**0.004**	**0.008**	
$WND^{O.La}$	0.00			0.002	0.400	
c) 2011-2015 analysis						
1 $RET^D \sim CLD^D$		0.000816	0.004379			0.00537
CLD^D	14.29			**0.0005**	**0.004**	
1 $RET^O \sim CLD^O$		0.000977	0.007029			0.00351
CLD^O	14.29			**0.0004**	**0.022**	
2a $RET^O \sim CLD^{O.Ha} + CLD^{O.La}$		0.000745	0.006165			0.00394
$CLD^{O.Ha}$	28.57			**0.002**	**0.005**	
$CLD^{O.La}$	7.14			-0.002	0.530	
2c $RET^O \sim CLD^{O.Hc} + CLD^{O.Lc}$		9.52E-05	0.00242			0.00201
$CLD^{O.Hc}$	7.14			**0.003**	**0.033**	

Table 3. Contd.

		%PVal<0.05	Av_R2	MAX_R2	Coeff	PVal	R2
	CLD$^{O.Lc}$	0.00%			0.002	0.587	
2c	RET^D~HUM$^{D.Hc}$+HUM$^{D.Lc}$		-0.0002	0.002151			0.00069
	HUM$^{D.Hc}$	0.00%			**0.002**	**0.033**	
	HUM$^{D.Lc}$	0.00%			-0.001	0.960	
2c	RET^O~HUM$^{O.Hc}$+HUM$^{O.Lc}$		0.001331	0.009538			0.00668
	HUM$^{O.Hc}$	7.14%			0.002	0.097	
	HUM$^{O.Lc}$	7.14%			**-0.035**	**0.007**	
Panel 3) Poland							
a) 2006-2015 analysis							
b) 2006-2010 analysis							
2a	RET^D~HUM$^{D.Ha}$+HUM$^{D.La}$		0.001747	0.015492			0.00253
	HUM$^{D.Ha}$	11.11%			0.002	0.252	
	HUM$^{D.La}$	22.22%			**0.004**	**0.026**	
c) 2011-2015 analysis							
2c	RET^O~WND$^{O.Hc}$+WND$^{O.Lc}$		-9.1E-06	0.00816			0.00146
	WND$^{O.Hc}$	0.00%			0.0004	0.723	
	WND$^{O.Lc}$	10.00%			**-0.003**	**0.033**	

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations, respectively. RET stands for logarithm return, TMP, CLD, HUM and WND are temperature, cloud cover, humidity and wind speed, respectively. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.05' indicates the percentage of coefficients significant at 5%. 'Coeff.' is the explanatory variable's regression coefficient and 'PVal' is the corresponding p-value. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

statistically significant relationship. None of the regressions, whether or not they were significant in the index analysis, recorded a 95% confidence level for the majority of the stocks included in the same index. In general the stock analysis strongly rejects the existence of any kind of weather effect in the countries under inspection, consistently with Kramer and Runde (1997), Pardo and Valor (2003), Jacobsen and Marquering (2008), Pizzutilo and Roncone (2017) and Kim (2017).

Apart from the very low figures for the stock analysis, other evidence leads us to conclude that a weather effect is not to be postulated for these markets. The sub-period analysis for instance does not describe the same picture as the whole-period analysis. Of a total of 19 significant coefficients for the 2006–2015 index analysis, only 10 have the same significance in 1 of the 2 sub-periods (1 coefficient is significant but with the opposite sign). No coefficients are significant in both of the sub-periods. On the other hand, 32 regressions show significance in 1 of the sub-periods analysed but not in the 2006 to 2015 analysis. None of the models employed show significance in both sub-periods. Hence, the weather effect, if any exists in these countries, can be considered to be highly time dependent; that is, it is manifested over some periods but not others, which, from a practical perspective, means that the weather effect, if any, cannot easily be exploited through a trading strategy. Neither the recent financial crises (that hit the final years of sub-period 1) nor the subsequent years of recovery, austerity and financial reforms (which happened in sub-period 2) seem to have had any influence on this seemingly data driven pattern.

Moreover, consider Tables 6, 7, 8 and 9, which report, for each of the weather variables inspected and for each model employed the comprehensive percentage of significant coefficients. The percentages of significant coefficients are strongly below the 50% even at the 90% confidence level, for the stock (maximum percentage 20%, only 7 coefficients over 336 are significant for more than the 15% of the shares analysed) as well as for the index analysis (maximum percentage 44%, only 28 coefficients over 336 are significant for more than the 15% of the indexes analysed), leading us to conclude in favour of the rejection of the weather effect hypothesis. Moreover, the very low levels of adjusted r-squared (0.21 the highest adjusted r-squared, only 9 regressions over 192 show an adjusted r-squared higher than 0.1) reinforce the conclusion of any kind of weather effect in these countries. A low r-squared is a common feature of all the studies on the weather effect, independently they inspected developed or emerging financial markets, independently they accepted or rejected the weather effect hypothesis and independently of the model employed, raising concerns on the effective nature of the significances eventually found and on the predictive ability (in sample and especially out of sample) of any

Table 4. Latin America.

Model	Shares	Index				
	% PVal<0.05	AV_R2	MAX_R2	Coeff.	Pval	R2
Panel 1) Chile						
a) 2006-2015 analysis						
2c	$RET^O \sim HUM^{O.Hc} + HUM^{O.Lc}$		0.00003	0.00166			0.00205
	$HUM^{O.Hc}$	0.00%			-0.008	0.521	
	$HUM^{O.Lc}$	0.00%			**0.002**	**0.022**	
2a	$RET^D \sim WND^{D.Ha} + WND^{D.La}$		0.00082	0.00318			0.00207
	$WND^{D.Ha}$	30.00%			**0.002**	**0.010**	
	$WND^{D.La}$	0.00%			0.001	0.161	
2b	$RET^D \sim WND^{D.Hb} + WND^{D.Lb}$		0.00043	0.00324			0.00121
	$WND^{D.Hb}$	10.00%			**0.001**	**0.035**	
	$WND^{D.Lb}$	10.00%			0.0007	0.215	
b) 2006-2010 analysis						
2c	$RET^O \sim TMP^{O.Hc} + TMP^{O.Lc}$		-0.00398	0.00124			0.00208
	$TMP^{O.Hc}$	0.00%			-0.001	0.394	
	$TMP^{O.Lc}$	0.00%			**0.002**	**0.029**	
2c	$RET^O \sim HUM^{O.Hc} + HUM^{O.Lc}$		0.00011	0.01478			0.00538
	$HUM^{O.Hc}$	0.00%			0.003	0.121	
	$HUM^{O.Lc}$	0.00%			**0.003**	**0.011**	
c) 2011-2015 analysis						
1	$RET^D \sim TMP^D$		0.00104	0.00267			0.00245
	TMP^D	10.00%			**0.0001**	**0.049**	
1	$RET^O \sim TMP^O$		0.00102	0.00330			0.00371
	TMP^O	20.00%			**0.0002**	**0.021**	
2b	$RET^D \sim CLD^{D.Hb} + CLD^{D.Lb}$		0.00149	0.00444			0.00300
	$CLD^{D.Hb}$	0.00%			0.0006	0.473	
	$CLD^{D.Lb}$	30.00%			**-0.002**	**0.022**	
1	$RET^D \sim HUM^D$		0.00094	0.00322			0.00221
	HUM^D	30.00%			**-0.0004**	**0.034**	
1	$RET^O \sim HUM^O$		0.00119	0.00343			0.00470
	HUM^O	30.00%			**-0.0006**	**0.011**	
2a	$RET^D \sim WND^{D.Ha} + WND^{D.La}$		0.00089	0.00593			0.00316
	$WND^{D.Ha}$	**40.00%**			**0.002**	**0.010**	
	$WND^{D.La}$	0.00%			0.007	0.589	
Panel 2) Colombia						
a) 2006-2015 analysis						
2a	$RET^D \sim HUM^{D.Ha} + HUM^{D.La}$		0.00054	0.00525			0.00309
	$HUM^{D.Ha}$	10.00%			**-0.002**	**0.048**	
	$HUM^{D.La}$	5.00%			**-0.002**	**0.020**	
b) 2006-2010 analysis						
2a	$RET^O \sim TMP^{O.Ha} + TMP^{O.La}$		-0.00043	-0.03153			0.00148
	$TMP^{O.Ha}$	27.78%			**0.003**	**0.020**	
	$TMP^{O.La}$	11.11%			-0.0002	0.861	
2a	$RET^O \sim CLD^{O.Ha} + CLD^{O.La}$		-0.00044	0.00282			0.00129
	$CLD^{O.Ha}$	0.00%			0.001	0.270	
	$CLD^{O.La}$	16.67%			**0.007**	**0.010**	
2c	$RET^O \sim CLD^{O.Hc} + CLD^{O.Lc}$		-0.00094	0.00631			0.00077
	$CLD^{O.Hc}$	0.00%			0.002	0.429	
	$CLD^{O.Lc}$	0.00%			**0.009**	**0.020**	
2a	$RET^D \sim HUM^{D.Ha} + HUM^{D.La}$		-0.00181	0.01958			0.00268
	$HUM^{D.Ha}$	11.11%			**-0.003**	**0.048**	

Table 4. Contd.

		%PVal<0.05	Av_R2	MAX_R2	Coeff.	PVal	R2
	HUM$^{D.La}$	5.56%			-0.002	0.470	
c) 2011-2015 analysis							
2b	RET^{O}~CLD$^{O.Hb}$+CLD$^{O.Lb}$		0.00000	0.00328			0.00223
	CLD$^{O.Hb}$	0.00%			0.0001	0.854	
	CLD$^{O.Lb}$	15.00%			**0.002**	**0.036**	
2a	RET^{O}~HUM$^{O.Ha}$+HUM$^{O.La}$		0.00050	0.00631			0.00168
	HUM$^{O.Ha}$	15.00%			**-0.003**	**0.035**	
	HUM$^{O.La}$	0.00%			-0.0004	0.685	
Panel 3) Mexico							
a) 2006-2015 analysis							
2a	RET^{D}~TMP$^{D.Ha}$+TMP$^{D.La}$		0.00041	0.00307			0.00121
	TMP$^{D.Ha}$	30.00%			**0.004**	**0.035**	
	TMP$^{D.La}$	0.00%			-0.002	0.221	
2b	RET^{D}~TMP$^{D.Hb}$+TMP$^{D.Lb}$		0.00019	0.00238			0.00050
	TMP$^{D.Hb}$	25.00%			**0.004**	**0.030**	
	TMP$^{D.Lb}$	0.00%			-0.003	0.746	
b) 2006-2010 analysis							
2a	RET^{O}~TMP$^{O.Ha}$+TMP$^{O.La}$		0.00156	0.01159			0.00279
	TMP$^{O.Ha}$	15.00%			**0.004**	**0.044**	
	TMP$^{O.La}$	0.00%			-0.002	0.292	
2c	RET^{D}~WND$^{D.Hc}$+WND$^{D.Lc}$		0.00510	0.04136			0.00443
	WND$^{D.Hc}$	25.00%			**0.004**	**0.030**	
	WND$^{D.Lc}$	25.00%			-0.003	0.411	
c) 2011-2015 analysis							
2b	RET^{D}~TMP$^{D.Hb}$+TMP$^{D.Lb}$		0.00113	0.00442			0.00270
	TMP$^{D.Hb}$	25.00%			**0.002**	**0.012**	
	TMP$^{D.Lb}$	5.00%			0.0004	0.599	
2b	RET^{O}~HUM$^{O.Hb}$+HUM$^{O.Lb}$		0.00181	0.00784			0.00537
	HUM$^{O.Hb}$	0.00%			-0.0009	0.251	
	HUM$^{O.Lb}$	30.00%			**0.002**	**0.033**	

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations, respectively. RET stands for logarithm return, TMP, CLD, HUM and WND are temperature, cloud cover, humidity and wind speed, respectively. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.05' indicates the percentage of coefficients significant at 5%. 'Coeff.' is the explanatory variable's regression coefficient and 'PVal' is the corresponding p-value. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

asset pricing model that controls the weather variables.

Adopting the same approach as that followed in the existing literature, we tried to model the indirect effect (the weather that influences the emotional state and the mood of market operators to such an extent that their financial decisions are affected and this is reflected in the stock market prices) in a direct econometric model (how a weather time series explains financial returns). Such an approach, which is the only viable one given the variables involved, in our opinion requires great caution in the discussion of the results and the necessity of finding robust results to confirm the hypothesis. Contrary to a large part of the existing literature on the subject, we do not think that the significance of a model on its own is definite proof of the existence of the weather effect.

Following the conviction that misleading and incorrect conclusions can be drawn by selecting and disclosing only part of the examinations carried out, we follow the American Statistical Association Ethical Guidelines and disclose and discuss the full extent of the tests and results. In our opinion, our results suggest that, without any further evidence, the relationship between weather-related variables and stock returns in the emerging markets analysed is spurious and that the significance recorded for some of the indexes is data driven and cannot be used as evidence of any kind of weather effect, consistently with Kim (2017). We strongly believe that, if a weather effect were present, the same influence of the weather should have been measured for a large portion of the stocks included in the index and should be evident

Table 5. South-East Asia.

Model	Shares			Index		
	% PVal<0.05	AV_R2	MAX_R2	Coeff.	Pval	R2
Panel 1) Malaysia						
a) 2006-2015 analysis						
2a $RET^{O}\sim WND^{O.Ha}+WND^{O.La}$		5.24E-05	0.002032			0.00093
$WND^{O.Ha}$	0.00			- 0.000	0.831	
$WND^{O.La}$	13.33			**0.001**	**0.029**	
b) 2006-2010 analysis						
2c $RET^{O}\sim CLD^{O.Hc}+CLD^{O.Lc}$		-0.00056	0.00263			-0.00157
$CLD^{O.Hc}$	3.85			0.0002	0.832	
$CLD^{O.Lc}$	26.92			**-0.0020**	**0.001**	
2c $RET^{D}\sim HUM^{D.Hc}+HUM^{D.Lc}$		-0.00019	0.003463			0.00618
$HUM^{D.Hc}$	3.85			0.0007	0.960	
$HUM^{D.Lc}$	0.00			**-0.0030**	**0.032**	
2a $RET^{O}\sim WND^{O.Ha}+WND^{O.La}$		-0.00014	0.006525			0.00473
$WND^{O.Ha}$	0.00			-0.0003	0.802	
$WND^{O.La}$	26.92			**0.0020**	**0.001**	
c) 2011-2015 analysis						
Panel 2) Philippines						
a) 2006-2015 analysis						
2b $RET^{D}\sim WND^{D.Hb}+WND^{D.Lb}$		0.00045	0.00723			0.00094
$WND^{D.Hb}$	0.00			-0.0005	0.508	
$WND^{D.Lb}$	13.33			**-0.0010**	**0.043**	
b) 2006-2010 analysis						
2a $RET^{D}\sim CLD^{D.Ha}+CLD^{D.La}$		-0.00072	0.004221			-0.00137
$CLD^{D.Ha}$	3.57			-0.0002	0.885	
$CLD^{D.La}$	21.43			**0.0050**	**0.001**	
2a $RET^{O}\sim CLD^{O.Ha}+CLD^{O.La}$		-0.00073	0.001237			0.00035
$CLD^{O.Ha}$	0.00			0.0006	0.525	
$CLD^{O.La}$	3.57			**0.0060**	**0.014**	
Panel 3) Thailand						
c) 2011-2015 analysis						
a) 2006-2015 analysis						
2a $RET^{O}\sim TMP^{O.Ha}+TMP^{O.La}$		-0.0001	0.002702			0.00083
$TMP^{O.Ha}$	10.00			**0.0020**	**0.046**	
$TMP^{O.La}$	0.00			0.0010	0.367	
2c $RET^{O}\sim TMP^{O.Hc}+TMP^{O.Lc}$		-0.00035	0.001172			0.00346
$TMP^{O.Hc}$	0.00			-0.0010	0.480	
$TMP^{O.Lc}$	6.67			**0.0040**	**0.002**	
2c $RET^{O}\sim CLD^{O.Hc}+CLD^{O.Lc}$		-0.0001	0.003961			-0.00061
$CLD^{O.Hc}$	3.33			-0.0060	0.785	
$CLD^{O.Lc}$	10.00			**0.0060**	**0.022**	
2c $RET^{O}\sim HUM^{O.Hc}+HUM^{O.Lc}$		5.73E-05	0.002617			0.003
$HUM^{O.Hc}$	16.67			**0.0030**	**0.004**	
$HUM^{O.Lc}$	0.00%			-0.0060	0.796	
2c $RET^{D}\sim WND^{D.Hc}+WND^{D.Lc}$		0.00027	0.003408			0.00074
$WND^{D.Hc}$	3.33			**-0.0020**	**0.048**	
$WND^{D.Lc}$	13.33			-0.0030	0.270	
b) 2006-2010 analysis						
2a $RET^{O}\sim TMP^{O.Ha}+TMP^{O.La}$		-0.00076	0.006928			0.00431
$TMP^{O.Ha}$	6.90			**0.0070**	**0.005**	
$TMP^{O.La}$	0.00			0.0020	0.622	

Table 5. Contd.

2b	RET^D~HUM$^{D.Hb}$+HUM$^{D.Lb}$		-0.00054	0.002998			0.00557
	HUM$^{D.Hb}$	0.00			-0.0009	0.671	
	HUM$^{D.Lb}$	3.45			**0.0040**	**0.036**	
2c	RET^D~HUM$^{D.Hc}$+HUM$^{D.Lc}$		0.000196	0.004906			0.00259
	HUM$^{D.Hc}$	20.69			**0.0053**	**0.006**	
	HUM$^{D.Lc}$	6.90			0.0010	0.618	
2a	RET^O~HUM$^{O.Ha}$+HUM$^{O.La}$		-0.00061	0.004167			0.00406
	HUM$^{O.Ha}$	0.00			0.0010	0.559	
	HUM$^{O.La}$	3.45			**0.0050**	**0.008**	
2c	RET^O~HUM$^{O.Hc}$+HUM$^{O.Lc}$		7.62E-05	0.002556			0.00433
	HUM$^{O.Hc}$	6.90			**0.0060**	**0.011**	
	HUM$^{O.Lc}$	6.90			0.0020	0.600	
c) 2011-2015 analysis							
2c	RET^O~TMP$^{O.Hc}$+TMP$^{O.Lc}$		-0.00037	0.00393			0.00516
	TMP$^{O.Hc}$	0.00			-0.0030	0.217	
	TMP$^{O.Lc}$	10.00			**0.0030**	**0.016**	
2c	RET^O~CLD$^{O.Hc}$+CLD$^{O.Lc}$		-4.9E-05	0.004515			0.00029
	CLD$^{O.Hc}$	6.67			0.0020	0.335	
	CLD$^{O.Lc}$	10.00			**0.0060**	**0.001**	

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations, respectively. RET stands for logarithm return, TMP, CLD, HUM and WND are temperature, cloud cover, humidity and wind speed, respectively. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.05' indicates the percentage of coefficients significant at 5%. 'Coeff.' is the explanatory variable's regression coefficient and 'PVal' is the corresponding p-value. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

from analysing sub-periods as well. This indeed is not the case.

Our results are not in contrast with psychological literature claiming that mood misattributions induced by external events like weather conditions can influence individual behaviour and decision making under risk. They only postulate that these possible individual misattributions, if any, are arbitraged in a very short period of time by the market and cannot significantly influence stocks' price behaviour. We are thus confident in asserting that the efficient-market hypothesis is not challenged by the indirect effect of the weather on the mood of the stock market operators for the nine emerging countries examined. An important implication of our results is that they do not advocate the inclusion of behavioural weather-related variables in the asset-pricing models to be employed for these countries. Our results also call for a robust and widespread examination that takes into account stocks' price behaviour as well in the assessment of the weather effect for developed and emerging countries.

Conclusions

Many psychological studies have argued that good or bad weather conditions induce shifts in individuals' mood

that can influence their decision-making process under risk and uncertainty. Based on these conclusions, some behavioural finance studies have raised the question of whether sunshine, temperature or other weather variables have an impact on stock prices by affecting the behaviour of market operators, thus challenging the efficient-market hypothesis. However, these studies have not obtained conclusive results. Moreover, very few papers on the weather effect have concentrated on the stock markets of emerging countries, with contradictory results. We conducted a comprehensive analysis of the effect of four weather variables (temperature, cloud cover, humidity and wind) on the stock markets of nine emerging countries located in three climatic, socially, politically and economically different areas of the world, thus filling a not negligible gap in the financial literature. Our analysis covered the years 2006 to 2015. To gain more conclusive results, differently from the existing literature, we extended the analysis by analysing stock prices' behaviour along with that of stock indexes and by inspecting the opening market activity along with the whole-day activity following the belief that: a) the weather effect, if any, affects the prices of the stocks in the same way than the prices of the market indexes given a not lower level of efficiency that is to be recognized in the latter and b) that external weather conditions exert a greater effect on human mood at the beginning of the day

Table 6. Temperature analysis

Model	Shares				Indexes			
	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2
Panel a)								
1 $RET^D \sim TMP^D$			-0.0002	0.0028			-0.0003	0.0003
TMP^D	5.91%	1.61%			0.00%	0.00%		
2a $RET^D \sim TMP^{D.Ha}+TMP^{D.La}$			-0.0003	0.0068			-0.0002	0.0014
$TMP^{D.Ha}$	12.90%	5.91%			22.22%	11.11%		
$TMP^{D.La}$	4.30%	1.08%			0.00%	0.00%		
2b $RET^D \sim TMP^{D.Hb}+TMP^{D.Lb}$			-0.0001	0.0041			-0.0005	0.0005
$TMP^{D.Hb}$	11.29%	7.53%			11.11%	11.11%		
$TMP^{D.Lb}$	5.38%	3.23%			0.00%	0.00%		
2c $RET^D \sim TMP^{D.Hc}+TMP^{D.Lc}$			0.0001	0.0132			-0.0002	0.0005
$TMP^{D.Hc}$	13.44%	6.45%			11.11%	0.00%		
$TMP^{D.Lc}$	9.14%	5.38%			0.00%	0.00%		
1 $RET^O \sim TMP^O$			-0.0001	0.0051			-0.0002	0.0001
TMP^O	8.60%	2.69%			0.00%	0.00%		
2a $RET^O \sim TMP^{O.Ha}+TMP^{O.La}$			-0.0002	0.0080			-0.0003	0.0008
$TMP^{O.Ha}$	11.29%	5.91%			11.11%	11.11%		
$TMP^{O.La}$	6.45%	0.54%			0.00%	0.00%		
2b $RET^O \sim TMP^{O.Hb}+TMP^{O.Lb}$			-0.0001	0.0062			-0.0006	0.0000
$TMP^{O.Hb}$	6.45%	2.15%			0.00%	0.00%		
$TMP^{O.Lb}$	6.45%	2.69%			0.00%	0.00%		
2c $RET^O \sim TMP^{O.Hc}+TMP^{O.Lc}$			-0.0001	0.0048			-0.0001	0.0035
$TMP^{O.Hc}$	9.68%	3.23%			0.00%	0.00%		
$TMP^{O.Lc}$	8.60%	5.38%			11.11%	11.11%		
Panel b)								
1 $RET^D \sim TMP^D$			0.0016	0.1867			0.0001	0.0047
TMP^D	9.83%	5.20%			11.11%	0.00%		
2a $RET^D \sim TMP^{D.Ha}+TMP^{D.La}$			0.0003	0.1332			0.0001	0.0063
$TMP^{D.Ha}$	7.51%	3.47%			11.11%	0.00%		
$TMP^{D.La}$	5.20%	3.47%			0.00%	0.00%		
2b $RET^D \sim TMP^{D.Hb}+TMP^{D.Lb}$			-0.0008	0.0623			-0.0005	0.0069
$TMP^{D.Hb}$	9.25%	4.05%			0.00%	0.00%		
$TMP^{D.Lb}$	6.36%	2.31%			0.00%	0.00%		
2c $RET^D \sim TMP^{D.Hc}+TMP^{D.Lc}$			0.0005	0.1149			0.0003	0.0047
$TMP^{D.Hc}$	8.67%	5.20%			0.00%	0.00%		
$TMP^{D.Lc}$	14.45%	5.78%			11.11%	0.00%		
1 $RET^O \sim TMP^O$			0.0002	0.0907			-0.0006	0.0008
TMP^O	6.94%	2.31%			0.00%	0.00%		
2a $RET^O \sim TMP^{O.Ha}+TMP^{O.La}$			0.0001	0.0609			0.0006	0.0043
$TMP^{O.Ha}$	12.72%	9.25%			44.44%	33.33%		
$TMP^{O.La}$	12.14%	5.20%			0.00%	0.00%		
2b $RET^O \sim TMP^{O.Hb}+TMP^{O.Lb}$			-0.0011	0.0723			-0.0007	0.0023
$TMP^{O.Hb}$	1.73%	0.58%			11.11%	0.00%		
$TMP^{O.Lb}$	10.98%	4.62%			0.00%	0.00%		
2c $RET^O \sim TMP^{O.Hc}+TMP^{O.Lc}$			-0.0001	0.0842			-0.0004	0.0021
$TMP^{O.Hc}$	9.25%	5.20%			0.00%	0.00%		
$TMP^{O.Lc}$	5.78%	4.05%			22.22%	22.22%		
Panel c)								
1 $RET^D \sim TMP^D$			-0.0001	0.0075			-0.0002	0.0024
TMP^D	9.68%	4.30%			11.11%	11.11%		
2a $RET^D \sim TMP^{D.Ha}+TMP^{D.La}$			-0.0003	0.0068			-0.0002	0.0030

Table 6 Cont'd

Model	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2
$TMP^{D.Ha}$	9.14%	4.84%			0.00%	0.00%		
$TMP^{D.La}$	6.99%	2.15%			11.11%	0.00%		
2b $RET^D \sim TMP^{D.Hb}+TMP^{D.Lb}$			-0.0002	0.0051			-0.0001	0.0027
$TMP^{D.Hb}$	10.75%	6.45%			22.22%	11.11%		
$TMP^{D.Lb}$	8.60%	3.23%			11.11%	0.00%		
2c $RET^D \sim TMP^{D.Hc}+TMP^{D.Lc}$			0.0002	0.0132			0.0001	0.0028
$TMP^{D.Hc}$	10.22%	4.84%			22.22%	0.00%		
$TMP^{D.Lc}$	10.75%	3.23%			11.11%	0.00%		
1 $RET^O \sim TMP^O$			0.0000	0.0075			0.0003	0.0037
TMP^O	12.37%	5.91%			11.11%	11.11%		
2a $RET^O \sim TMP^{O.Ha}+TMP^{O.La}$			-0.0001	0.0080			-0.0004	0.0050
$TMP^{O.Ha}$	12.90%	4.84%			0.00%	0.00%		
$TMP^{O.La}$	10.75%	2.69%			11.11%	0.00%		
2b $RET^O \sim TMP^{O.Hb}+TMP^{O.Lb}$			-0.0002	0.0052			-0.0004	0.0017
$TMP^{O.Hb}$	14.52%	6.45%			11.11%	0.00%		
$TMP^{O.Lb}$	4.30%	2.69%			11.11%	0.00%		
2c $RET^O \sim TMP^{O.Hc}+TMP^{O.Lc}$			-0.0001	0.0073			0.0000	0.0052
$TMP^{O.Hc}$	6.45%	4.30%			0.00%	0.00%		
$TMP^{O.Lc}$	10.75%	6.45%			22.22%	11.11%		

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations, respectively. RET stands for logarithm return, TMP is the temperature. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.1' and '%PVal<0.05' indicate the percentage of coefficients significant at 1% and 5%, respectively. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

Table 7. Cloud cover analysis.

Model	Shares				Indexes			
	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2
Panel a)								
1 $RET^D \sim CLD^D$			-0.0001	0.0090			-0.0003	-0.0001
CLD^D	11.83%	5.91%			0.00%	0.00%		
2a $RET^D \sim CLD^{D.Ha}+CLD^{D.La}$			-0.0002	0.0033			-0.0003	0.0005
$CLD^{D.Ha}$	7.53%	2.15%			0.00%	0.00%		
$CLD^{D.La}$	10.75%	5.91%			0.00%	0.00%		
2b $RET^D \sim CLD^{D.Hb}+CLD^{D.Lb}$			-0.0001	0.0068			-0.0003	0.0008
$CLD^{D.Hb}$	9.68%	4.84%			11.11%	0.00%		
$CLD^{D.Lb}$	5.91%	3.76%			11.11%	11.11%		
2c $RET^D \sim CLD^{D.Hc}+CLD^{D.Lc}$			-0.0003	0.0027			-0.0003	0.0004
$CLD^{D.Hc}$	6.45%	2.15%			11.11%	0.00%		
$CLD^{D.Lc}$	8.06%	1.61%			0.00%	0.00%		
1 $RET^O \sim CLD^O$			-0.0002	0.0083			-0.0003	0.0001
CLD^O	4.84%	2.15%			0.00%	0.00%		
2a $RET^O \sim CLD^{O.Ha}+CLD^{O.La}$			-0.0003	0.0063			0.0002	0.0054
$CLD^{O.Ha}$	4.84%	2.69%			0.00%	0.00%		
$CLD^{O.La}$	6.45%	2.69%			11.11%	11.11%		
2b $RET^O \sim CLD^{O.Hb}+CLD^{O.Lb}$			-0.0001	0.0058			-0.0005	0.0007
$CLD^{O.Hb}$	6.45%	3.23%			0.00%	0.00%		
$CLD^{O.Lb}$	13.98%	7.53%			11.11%	0.00%		
2c $RET^O \sim CLD^{O.Hc}+CLD^{O.Lc}$			0.0001	0.0245			0.0002	0.0038
$CLD^{O.Hc}$	7.53%	2.69%			0.00%	0.00%		

Table 7. Cont'd

$CLD^{O.Lc}$	14.52%	8.60%			22.22%	11.11%		
Panel b)								
1 $RET^{D}{\sim}CLD^{D}$			-0.0004	0.0338			-0.0005	0.0028
CLD^{D}	7.43%	4.57%			0.00%	0.00%		
2a $RET^{D}{\sim}CLD^{D.Ha}+CLD^{D.La}$			0.0000	0.0513			0.0022	0.0195
$CLD^{D.Ha}$	10.86%	4.00%			0.00%	0.00%		
$CLD^{D.La}$	20.00%	16.57%			22.22%	11.11%		
2b $RET^{D}{\sim}CLD^{D.Hb}+CLD^{D.Lb}$			-0.0001	0.0452			-0.0007	0.0027
$CLD^{D.Hb}$	15.43%	9.71%			11.11%	0.00%		
$CLD^{D.Lb}$	8.00%	4.00%			11.11%	11.11%		
2c $RET^{D}{\sim}CLD^{D.Hc}+CLD^{D.Lc}$			0.0001	0.0854			-0.0011	0.0018
$CLD^{D.Hc}$	13.14%	6.86%			11.11%	0.00%		
$CLD^{D.Lc}$	8.57%	5.71%			0.00%	0.00%		
1 $RET^{O}{\sim}CLD^{O}$			-0.0010	0.0337			-0.0005	0.0025
CLD^{O}	8.00%	6.29%			0.00%	0.00%		
2a $RET^{O}{\sim}CLD^{O.Ha}+CLD^{O.La}$			-0.0012	0.0151			-0.0007	0.0035
$CLD^{O.Ha}$	6.86%	3.43%			0.00%	0.00%		
$CLD^{O.La}$	12.57%	9.71%			22.22%	22.22%		
2b $RET^{O}{\sim}CLD^{O.Hb}+CLD^{O.Lb}$			-0.0004	0.0918			-0.0013	-0.0003
$CLD^{O.Hb}$	8.57%	6.86%			0.00%	0.00%		
$CLD^{O.Lb}$	10.29%	6.29%			0.00%	0.00%		
2c $RET^{O}{\sim}CLD^{O.Hc}+CLD^{O.Lc}$			-0.0008	0.0604			-0.0010	0.0008
$CLD^{O.Hc}$	5.14%	2.29%			0.00%	0.00%		
$CLD^{O.Lc}$	16.00%	9.14%			22.22%	22.22%		
Panel c)								
1 $RET^{D}{\sim}CLD^{D}$			0.0002	0.0090			0.0005	0.0054
CLD^{D}	16.67%	7.53%			11.11%	11.11%		
2a $RET^{D}{\sim}CLD^{D.Ha}+CLD^{D.La}$			0.0001	0.0092			-0.0004	0.0012
$CLD^{D.Ha}$	13.44%	4.30%			0.00%	0.00%		
$CLD^{D.La}$	10.22%	5.91%			0.00%	0.00%		
2b $RET^{D}{\sim}CLD^{D.Hb}+CLD^{D.Lb}$			0.0001	0.0068			0.0000	0.0030
$CLD^{D.Hb}$	14.52%	5.38%			0.00%	0.00%		
$CLD^{D.Lb}$	9.14%	4.30%			11.11%	11.11%		
2c $RET^{D}{\sim}CLD^{D.Hc}+CLD^{D.Lc}$			-0.0001	0.0062			-0.0001	0.0018
$CLD^{D.Hc}$	14.52%	7.53%			11.11%	0.00%		
$CLD^{D.Lc}$	10.22%	4.30%			11.11%	0.00%		
1 $RET^{O}{\sim}CLD^{O}$			-0.0002	0.0083			-0.0002	0.0035
CLD^{O}	7.53%	2.69%			11.11%	11.11%		
2a $RET^{O}{\sim}CLD^{O.Ha}+CLD^{O.La}$			-0.0003	0.0063			0.0016	0.0154
$CLD^{O.Ha}$	5.91%	5.38%			11.11%	11.11%		
$CLD^{O.La}$	6.99%	2.15%			11.11%	11.11%		
2b $RET^{O}{\sim}CLD^{O.Hb}+CLD^{O.Lb}$			-0.0002	0.0058			-0.0006	0.0022
$CLD^{O.Hb}$	8.06%	4.30%			0.00%	0.00%		
$CLD^{O.Lb}$	12.37%	5.91%			11.11%	11.11%		
2c $RET^{O}{\sim}CLD^{O.Hc}+CLD^{O.Lc}$			0.0000	0.0245			0.0012	0.0067
$CLD^{O.Hc}$	10.75%	6.45%			11.11%	11.11%		
$CLD^{O.Lc}$	10.75%	4.84%			11.11%	11.11%		

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations, respectively. RET stands for logarithm return, CLD is cloud cover. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.1' and '%PVal<0.05' indicate the percentage of coefficients significant at 1% and 5%, respectively. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

Table 8. Humidity analysis.

Model		Shares				Indexes			
		% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2
Panel a)									
1	$RET^D \sim HUM^D$			-0.0001	0.0020			0.0003	0.0044
	HUM^D	10.22%	2.15%			0.00%	0.00%		
2a	$RET^D \sim HUM^{D.Ha}+HUM^{D.La}$			0.0000	0.0071			0.0007	0.0050
	$HUM^{D.Ha}$	10.22%	4.84%			11.11%	11.11%		
	$HUM^{D.La}$	10.22%	4.30%			11.11%	11.11%		
2b	$RET^D \sim HUM^{D.Hb}+HUM^{D.Lb}$			-0.0002	0.0047			-0.0004	-0.0001
	$HUM^{D.Hb}$	6.99%	3.23%			0.00%	0.00%		
	$HUM^{D.Lb}$	7.53%	3.76%			0.00%	0.00%		
2c	$RET^D \sim HUM^{D.Hc}+HUM^{D.Lc}$			-0.0001	0.0099			-0.0002	0.0010
	$HUM^{D.Hc}$	5.91%	3.76%			0.00%	0.00%		
	$HUM^{D.Lc}$	8.06%	3.76%			11.11%	0.00%		
1	$RET^O \sim HUM^O$			-0.0001	0.0069			0.0003	0.0047
	HUM^O	4.84%	2.69%			0.00%	0.00%		
2a	$RET^O \sim HUM^{O.Ha}+HUM^{O.La}$			-0.0002	0.0038			0.0002	0.0040
	$HUM^{O.Ha}$	8.06%	2.69%			0.00%	0.00%		
	$HUM^{O.La}$	8.06%	3.76%			11.11%	0.00%		
2b	$RET^O \sim HUM^{O.Hb}+HUM^{O.Lb}$			0.0002	0.0113			0.0002	0.0018
	$HUM^{O.Hb}$	9.14%	2.69%			0.00%	0.00%		
	$HUM^{O.Lb}$	10.22%	6.99%			0.00%	0.00%		
2c	$RET^O \sim HUM^{O.Hc}+HUM^{O.Lc}$			-0.0001	0.0096			0.0005	0.0030
	$HUM^{O.Hc}$	10.22%	4.30%			11.11%	11.11%		
	$HUM^{O.Lc}$	8.60%	2.69%			22.22%	22.22%		
Panel b)									
1	$RET^D \sim HUM^D$			-0.0003	0.0398			0.0015	0.0132
	HUM^D	10.40%	4.05%			22.22%	0.00%		
2a	$RET^D \sim HUM^{D.Ha}+HUM^{D.La}$			-0.0001	0.0292			0.0011	0.0095
	$HUM^{D.Ha}$	11.56%	6.94%			11.11%	11.11%		
	$HUM^{D.La}$	10.98%	6.94%			22.22%	11.11%		
2b	$RET^D \sim HUM^{D.Hb}+HUM^{D.Lb}$			-0.0010	0.0194			-0.0002	0.0056
	$HUM^{D.Hb}$	6.36%	0.58%			0.00%	0.00%		
	$HUM^{D.Lb}$	9.25%	4.62%			22.22%	11.11%		
2c	$RET^D \sim HUM^{D.Hc}+HUM^{D.Lc}$			0.0003	0.0636			0.0008	0.0062
	$HUM^{D.Hc}$	9.83%	5.78%			11.11%	11.11%		
	$HUM^{D.Lc}$	9.83%	5.20%			22.22%	11.11%		
1	$RET^O \sim HUM^O$			-0.0012	0.0344			0.0013	0.0127
	HUM^O	6.36%	3.47%			0.00%	0.00%		
2a	$RET^O \sim HUM^{O.Ha}+HUM^{O.La}$			-0.0003	0.0773			0.0005	0.0061
	$HUM^{O.Ha}$	7.51%	3.47%			0.00%	0.00%		
	$HUM^{O.La}$	9.25%	2.89%			22.22%	22.22%		
2b	$RET^O \sim HUM^{O.Hb}+HUM^{O.Lb}$			-0.0002	0.1713			-0.0003	0.0021
	$HUM^{O.Hb}$	8.67%	5.20%			11.11%	0.00%		
	$HUM^{O.Lb}$	10.40%	5.78%			0.00%	0.00%		
2c	$RET^O \sim HUM^{O.Hc}+HUM^{O.Lc}$			-0.0003	0.0397			0.0004	0.0054
	$HUM^{O.Hc}$	12.14%	5.20%			11.11%	11.11%		
	$HUM^{O.Lc}$	12.14%	8.09%			11.11%	11.11%		
Panel c)									
1	$RET^D \sim HUM^D$			0.0000	0.0067			0.0011	0.0084
	HUM^D	13.44%	5.91%			22.22%	11.11%		
2a	$RET^D \sim HUM^{D.Ha}+HUM^{D.La}$			-0.0001	0.0097			0.0009	0.0118

Table 8. Cont'd

Model	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2
$HUM^{D.Ha}$	8.06%	5.38%			0.00%	0.00%		
$HUM^{D.La}$	13.44%	5.91%			11.11%	0.00%		
2b $RET^{D}{\sim}HUM^{D.Hb}+HUM^{D.Lb}$			-0.0002	0.0062			-0.0007	0.0015
$HUM^{D.Hb}$	9.68%	7.53%			0.00%	0.00%		
$HUM^{D.Lb}$	10.22%	4.84%			22.22%	0.00%		
2c $RET^{D}{\sim}HUM^{D.Hc}+HUM^{D.Lc}$			-0.0003	0.0099			-0.0003	0.0020
$HUM^{D.Hc}$	9.14%	3.76%			11.11%	11.11%		
$HUM^{D.Lc}$	8.60%	5.38%			11.11%	0.00%		
1 $RET^{O}{\sim}HUM^{O}$			0.0001	0.0081			0.0014	0.0058
HUM^{O}	11.83%	6.45%			22.22%	11.11%		
2a $RET^{O}{\sim}HUM^{O.Ha}+HUM^{O.La}$			0.0000	0.0087			0.0009	0.0070
$HUM^{O.Ha}$	13.44%	5.91%			22.22%	11.11%		
$HUM^{O.La}$	9.68%	3.76%			11.11%	0.00%		
2b $RET^{O}{\sim}HUM^{O.Hb}+HUM^{O.Lb}$			0.0001	0.0113			0.0005	0.0054
$HUM^{O.Hb}$	9.68%	2.69%			11.11%	0.00%		
$HUM^{O.Lb}$	14.52%	8.60%			11.11%	11.11%		
2c $RET^{O}{\sim}HUM^{O.Hc}+HUM^{O.Lc}$			0.0001	0.0095			0.0013	0.0067
$HUM^{O.Hc}$	12.37%	5.91%			22.22%	0.00%		
$HUM^{O.Lc}$	12.90%	3.76%			11.11%	11.11%		

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations, respectively. RET stands for logarithm return, HUM is humidity. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.1' and '%PVal<0.05' indicate the percentage of coefficients significant at 1% and 5%, respectively. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

Table 9. Wind analysis

Model	Shares				Indexes			
	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2	% PVal<0.1	% PVal<0.05	AV_R2	MAX_R2
Panel a)								
1 $RET^{D}{\sim}WND^{D}$			0.0000	0.0077			0.0000	0.0015
WND^{D}	12.90%	5.91%			0.00%	0.00%		
2a $RET^{D}{\sim}WND^{D.Ha}+WND^{D.La}$			0.0001	0.0047			0.0002	0.0021
$WND^{D.Ha}$	10.75%	4.84%			11.11%	11.11%		
$WND^{D.La}$	12.90%	8.06%			0.00%	0.00%		
2b $RET^{D}{\sim}WND^{D.Hb}+WND^{D.Lb}$			0.0001	0.0199			0.0001	0.0012
$WND^{D.Hb}$	9.68%	3.23%			11.11%	11.11%		
$WND^{D.Lb}$	10.75%	5.91%			11.11%	11.11%		
2c $RET^{D}{\sim}WND^{D.Hc}+WND^{D.Lc}$			0.0000	0.0046			0.0002	0.0016
$WND^{D.Hc}$	9.14%	3.23%			11.11%	11.11%		
$WND^{D.Lc}$	13.44%	8.60%			22.22%	11.11%		
1 $RET^{O}{\sim}WND^{O}$			-0.0001	0.0050			0.0000	0.0009
WND^{O}	9.14%	3.76%			0.00%	0.00%		
2a $RET^{O}{\sim}WND^{O.Ha}+WND^{O.La}$			-0.0001	0.0053			0.0001	0.0009
$WND^{O.Ha}$	7.53%	3.76%			22.22%	0.00%		
$WND^{O.La}$	10.22%	4.84%			11.11%	11.11%		
2b $RET^{O}{\sim}WND^{O.Hb}+WND^{O.Lb}$			-0.0002	0.0030			-0.0005	0.0001
$WND^{O.Hb}$	10.22%	2.69%			11.11%	11.11%		
$WND^{O.Lb}$	6.45%	3.76%			0.00%	0.00%		
2c $RET^{O}{\sim}WND^{O.Hc}+WND^{O.Lc}$			0.0001	0.0082			-0.0001	0.0006
$WND^{O.Hc}$	8.60%	4.30%			0.00%	0.00%		

Table 9. Cont'd

Model	Formula	SHARES %PVal<0.1	SHARES %PVal<0.05	Av_R2	MAX_R2	INDEX %PVal<0.1	INDEX %PVal<0.05	R2	R2
	WND$^{O.Lc}$	9.68%	4.84%			11.11%	0.00%		
Panel b)									
1	RET^D~WND^D			0.0010	0.1476			-0.0001	0.0010
	WND^D	13.29%	6.94%			11.11%	0.00%		
2a	RET^D~WND$^{D.Ha}$+WND$^{D.La}$			0.0010	0.1702			-0.0007	0.0012
	WND$^{D.Ha}$	8.09%	4.05%			0.00%	0.00%		
	WND$^{D.La}$	13.29%	5.78%			0.00%	0.00%		
2b	RET^D~WND$^{D.Hb}$+WND$^{D.Lb}$			0.0013	0.2123			-0.0007	0.0018
	WND$^{D.Hb}$	9.83%	3.47%			0.00%	0.00%		
	WND$^{D.Lb}$	10.98%	7.51%			0.00%	0.00%		
2c	RET^D~WND$^{D.Hc}$+WND$^{D.Lc}$			0.0018	0.1886			0.0015	0.0050
	WND$^{D.Hc}$	16.18%	6.94%			22.22%	11.11%		
	WND$^{D.Lc}$	15.61%	8.09%			22.22%	22.22%		
1	RET^O~WND^O			-0.0002	0.0256			-0.0001	0.0012
	WND^O	10.98%	5.20%			0.00%	0.00%		
2a	RET^O~WND$^{O.Ha}$+WND$^{O.La}$			-0.0008	0.0361			0.0004	0.0047
	WND$^{O.Ha}$	8.67%	4.05%			11.11%	11.11%		
	WND$^{O.La}$	15.61%	9.83%			22.22%	11.11%		
2b	RET^O~WND$^{O.Hb}$+WND$^{O.Lb}$			-0.0001	0.0411			-0.0009	0.0002
	WND$^{O.Hb}$	10.98%	5.78%			0.00%	0.00%		
	WND$^{O.Lb}$	7.51%	5.20%			0.00%	0.00%		
2c	RET^O~WND$^{O.Hc}$+WND$^{O.Lc}$			0.0001	0.1345			-0.0004	0.0022
	WND$^{O.Hc}$	8.09%	4.05%			0.00%	0.00%		
	WND$^{O.Lc}$	13.87%	7.51%			0.00%	0.00%		
Panel c)									
1	RET^D~WND^D			0.0001	0.0077			-0.0002	0.0016
	WND^D	12.90%	5.91%			0.00%	0.00%		
2a	RET^D~WND$^{D.Ha}$+WND$^{D.La}$			0.0002	0.0088			0.0000	0.0032
	WND$^{D.Ha}$	10.75%	9.68%			22.22%	11.11%		
	WND$^{D.La}$	13.44%	6.99%			0.00%	0.00%		
2b	RET^D~WND$^{D.Hb}$+WND$^{D.Lb}$			-0.0001	0.0199			-0.0006	0.0011
	WND$^{D.Hb}$	9.14%	4.84%			11.11%	0.00%		
	WND$^{D.Lb}$	8.06%	5.91%			0.00%	0.00%		
2c	RET^D~WND$^{D.Hc}$+WND$^{D.Lc}$			-0.0002	0.0069			-0.0004	0.0020
	WND$^{D.Hc}$	11.29%	3.23%			22.22%	0.00%		
	WND$^{D.Lc}$	6.99%	3.76%			0.00%	0.00%		
1	RET^O~WND^O			-0.0001	0.0089			-0.0004	0.0001
	WND^O	8.06%	4.30%			0.00%	0.00%		
2a	RET^O~WND$^{O.Ha}$+WND$^{O.La}$			-0.0003	0.0055			-0.0009	0.0008
	WND$^{O.Ha}$	9.14%	3.23%			0.00%	0.00%		
	WND$^{O.La}$	11.29%	6.99%			0.00%	0.00%		
2b	RET^O~WND$^{O.Hb}$+WND$^{O.Lb}$			-0.0002	0.0088			-0.0011	-0.0004
	WND$^{O.Hb}$	8.60%	3.76%			0.00%	0.00%		
	WND$^{O.Lb}$	6.45%	2.69%			0.00%	0.00%		
2c	RET^O~WND$^{O.Hc}$+WND$^{O.Lc}$			-0.0002	0.0082			-0.0007	0.0015
	WND$^{O.Hc}$	7.53%	4.30%			0.00%	0.00%		
	WND$^{O.Lc}$	11.83%	7.53%			11.11%	11.11%		

The number near each model refers to the formulas in section 3. Superscripts D and O denote daily and open observations. RET stands for logarithm return, WND is wind speed. Superscripts Ha, La, Hb, Lb, Hc and Lc denote extremely high and low temperatures according to the definitions at points a, b and c, model 2, Section 3. The 'SHARES' and the 'INDEX' part of the table report the results for the shares and the index analysis, respectively. '%PVal<0.1' and '%PVal<0.05' indicate the percentage of coefficients significant at 1% and 5%, respectively. 'Av_R2', 'MAX_R2' and 'R2' report the average, the maximum and the actual r-squared for each regression.

rather than later on, when indoor facilities could have mitigated the possible effect of the weather and other news or circumstances may have influenced the market operators' mood. Moreover, supported by the psychological literature that concludes that extreme weather conditions are the major reason for human mood misattributions, we employed different specifications for the weather variables analysed.

We argued that there is no weather effect in the nine emerging markets analysed (Chile, Colombia, the Czech Republic, Hungary, Malaysia, Mexico, the Philippines, Poland and Thailand). Thus, our findings do not contest the notion of efficient markets for these countries or advocate the inclusion of behavioural weather-based variables in asset-pricing models.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Notes

Note 1. Since we are analyzing financial markets, MSCI classification has been preferred to the International Monetary Fund's one.

Note 2. Okta is the unit of measurement for total sky coverage. It refers to the number of eighths of the sky covered by clouds.

Note 3. The total return prices for the Colombia Colcap 20 are not distributed. Prices only adjusted for corporate actions were analyzed for this index.

Note 4. Those interested in the other set of results are welcome to contact the authors.

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African Journal of Business Management

Full Length Research Paper

Entrepreneurship in the rural context: Practical reflection on success and innovation

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Given the important role that entrepreneurship plays in the economy, it is desirable that entrepreneurs succeed. There is a noticeable trend of rural entrepreneurs migrating to urban areas. This study aims to ascertain the factors that contribute to entrepreneurial success. Using quantitative methods fifty respondents participated and data were collected using questionnaires. The collected data were analysed and presented both descriptively and inferentially. The study found that the majority of entrepreneurs agree that factors that positively impact innovation include good customer service; hard work; social skills; a good product at a competitive price; maintenance; and an accurate record. Appropriate training for entrepreneurs also helps to avoid mistakes made by other entrepreneurs. The study, therefore, recommends that government as well as the private sector offer greater support to entrepreneurs.

Key words: Entrepreneurs, finance, performance.

INTRODUCTION

Entrepreneurship contributes greatly to the economy of the country (Tomaa et al., 2014: 437).The opportunity to create wealth and being one's own boss are factors that attract many to entrepreneurship. However, the number of entrepreneurs who actually become successful is low. In a country like South Africa with an unemployment rate of 26.5%, entrepreneurship is essential (Stats SA, 2017; 9). Entrepreneurship contributes greatly to the economy of the country (Tomaa et al., 2014: 437).

Against this backdrop, the government aims to implement policies, strategies and programmes in order to create an enabling environment for small businesses. The Limpopo Province is one of South Africa's most deprived areas, and its personal income per capita is only some 38 percent of South Africa's average, the lowest of all nine provinces (Smith, 2016). According to the Provincial Review 2016, the province has experienced faster than average economic growth in the agriculture, power, tourism and mining sectors. The continuing growth rate economy of Limpopo Province by far surpasses the national one, at an average of 4 percent gross domestic product per region (Provincial Review, 2016). This contribution has had a profound impact in terms of the economic growth and development of the entire country. It is against this background that the researcher sought to investigate factors that impinge on entrepreneurial success and the effect of these factors on innovation.

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Significance of the study

As a direct effect of globalisation, entrepreneurial enterprises face increasing pressure from competition across the world. In line with the changing demand of customers worldwide, it becomes apparent that entrepreneurs face increasing difficulty to maintain and improve their business performance in time. They are often not able to dynamically manage these pressures (Kraus et al., 2012). One way to manage this is to invest in entrepreneurial activities as a strategy to achieve sustainable competitive advantage in today's complex global economy (Iyigun, 2015).

Entrepreneurial organisations involve in risk-taking and they are innovative and proactive in their decision-making styles, practices and methods. This tendency of behaviour is described as "entrepreneurial orientation" (EO), which is considered an essential attribute of high performing firms (Covin and Wales, 2011). At the same time, EO is also an important resource that facilitates a firm to outperform other rivals and yield marketplace positions of competitive advantage (Amiri and Marimaei, 2012: 151). High scores of EO afford firms an opportunity to survive and achieve profitability, market share growth and differentiation (Wiklund and Shepherd, 2003; Paco et al., 2011). With their proactive approach, entrepreneurial firms can anticipate changes of markets and needs of customers. They can also forge new market segments, and introduce new products and services to respond ahead of the competition (Amiri and Marimaei, 2012: 153). In addition, SMEs with higher risk-taking orientation that engage in resources can gain a great and higher investment return (Ngek and van Aardt, 2013).

LITERATURE REVIEW

The purpose of this literature review is to relate established ideas and knowledge to factors that affect entrepreneurial success and to determine how this influences innovation. This is achieved by reporting on entrepreneurial success and innovation, and also on the challenges that rural entrepreneurs face.

Definition of an entrepreneur

An entrepreneur is an individual who notices opportunities and then determines how to mobilise the necessary resources to produce new and improved services and goods (Jones and George, 2011: 235). Amiri and Marimaei (2012:152) define an entrepreneur as someone who "perceives a vision, commits himself to that vision, and almost single-handedly carries the vision to its successful implementation". This definition encapsulates more than simply someone who recognises and meets a need.

Being entrepreneurial means being associated with entrepreneurship. Entrepreneurship is the managerial process in which there is creation and innovation management (Drucker, 2015). This definition only examines the management side. According to Gries and Naudé (2011: 217), a synthetic definition highlights entrepreneurship as "the resource, process and state of being through and in which individuals utilize positive opportunities in the market by creating and growing new business firms." However, a more acceptable and people-orientated definition outlines entrepreneurship as "involving innovation, development, recognition, seizing opportunities and converting opportunities to marketable ideas while bearing the risk of competition." (Amiri, and Marimaei, 2012: 151).

Characteristics of an entrepreneur

Need for achievement

The entrepreneur seeks to establish a sense of achievement for him- or herself and others. This has been positively correlated with business success (Cubico et al., 2010: 427).

Risk taking propensity

Carland and Carland (2015) highlight that an entrepreneur is one who organises a new venture, manages it, and assumes the associated risk. At times, the entrepreneur will face opportunities that may not look profitable at a particular moment but have potential to be profitable later on. An entrepreneur needs to realise these opportunities. Risk includes not only financial considerations, but also career opportunities and family relations (Carland and Carland, 2015).

Self-confidence

According to Greathouse (2011), entrepreneurs ought to have this kind of quality as they are expected to possess a sense of self-esteem as well as competence in conjunction with their business affairs. An entrepreneur must believe in his or her own work. Greathouse further points out that "legitimate entrepreneurial confidence is derived from one's ability to execute, just as a musician gain self-assurance by practicing their instrument". These views are also shared by Asoni (2011) who explains that self-confidence is necessary in order to increase the probability of owning and managing an organisation, which in turn has an effect on business survival.

Pro-activeness

In Schillo (2011)'s words, pro-activeness is the "characteristic of entrepreneurial actions to anticipate

future opportunities, both in terms of products or technologies and in terms of markets and consumer demand". Dess et al. (2014) support this as they view proactiveness as a forward-looking perspective that characterises a marketplace leader with the foresight of seizing opportunities, while anticipating future demand. The entrepreneur should always be on the lookout for possible opportunities. The idea of being proactive was central to early economic thinking in the field: the entrepreneur was thought of as someone who would identify opportunities in the marketplace and pursue them proactively (Lumpkin and Dess, 1996). Organisations that compass proactiveness are therefore considered as leaders and not followers.

Competitive aggressiveness

Competitive aggressiveness embraces the "company's way of engaging with its competitors, distinguishing between companies that shy away from direct competition with other companies and those that aggressively pursue their competitors' target markets" (Schillo, 2011). By starting new businesses, entrepreneurs intensify competition for existing businesses. This leads to decreased prices of goods and a wider variety of goods for consumers (Kritikos, 2014). Consumers also benefit from this. Competition is enhanced as it pushes existing or established organisations to improve their performance.

Internal locus of control

"People with an internal locus of control believe that they shape their future outcomes through their own actions" (Kritikos, 2014). Entrepreneurs should, therefore, have an internal locus of control to propel them. People with an external locus of control believe their fate is maintained by external factors (Northouse, 2013: 141). People with an internal locus of control have self-efficacy. This is the belief one has about being able to do something successfully. On the other hand, people with an external locus of control consider their behaviours and lives as being controlled by luck or fate (Donatelle, 2011). Having an internal locus of control can help to successfully differentiate between effective and ineffective leaders, managers, and employees.

Leadership

While leaders are not necessarily entrepreneurs, entrepreneurs are leaders in their own right (EL-Annan, 2013: 151). Jones and George (2011) refer to leadership as the process wherein an individual exerts influence over other people, thereby inspiring, motivating, and directing their abilities to help achieve group or organisational goals. Certain leadership styles produce behaviours that are better suited to entrepreneurship. According to Salzarulo and Newman (2012), self-leadership has to do with the knowledge of oneself better and steering oneself towards objectives and better life. Ashenbaum et al. (2012) and Gordon et al. (2008) posit that research recently discovered a significant and positive connection between behaviours displayed by self-leadership and orientation towards entrepreneurship. Transactional leadership refers to the process where a leader and his or her followers through the clarification of their role and duties obtain certain agreed outcomes (Currie, 2008). It differs from transformational leadership in that transformational leadership makes subordinates aware of the importance of their jobs and performance to the organization (Jones and George, 2011). This implies that both the transactional and transformational leadership styles are highly proactive. The transactional leadership style produces an external drive while the transformational style produces internal drive (EL-Annan, 2013: 151).

Tolerance for ambiguity

Tolerance of ambiguity depicts the behaviour of individuals in situations where one has to act when there is lack of clarity or lack of information (Stoycheva, 2010). Ambiguity may be experienced in a range of settings and may be unpredictable. According to Mastura et al. (2009), the manner in which an entrepreneur approaches a situation and administers it, reflects the extent to which he or she tolerates ambiguity. An entrepreneur who has a high tolerance for ambiguity may find ambiguous situations challenging but will strive to overcome situations in order to perform well. Past studies reveal that the majority of entrepreneurially inclined individuals have a higher tolerance of ambiguity than others (Sexton and Bowman, 1985). Individuals who are intolerant of ambiguity may experience a sense of psychological discomfort when they are confronted with an ambiguous situation (Stoycheva, 2010).

Entrepreneurial success

Success can be defined in many ways. Some studies define success as surviving the first two or three years that a company is in business (Olakitan and Ayobami, 2011: 96). Hornaday and Bunker (1970), for example, typified a successful entrepreneur as an individual who starts a business, builds it up to where no previous business has functioned, and then continues for a period of at least five years to create a profit-making structure. Other studies on entrepreneurial personality (Gatewood et al., 1995) defined success in financial terms. These researchers thus linked the common characteristics found among entrepreneurs to measures like return on

investment, growth in sales, and profit every year, or to the personal income of the manager or owner of the business. "Although many indices might be used as criteria of success, continuity in business is the all persuasive quality" (Hornaday and Bunker, 1970). Nevertheless, statistics about newly founded organisations show that most of them do not survive the first few years (Olakitan and Ayobami, 2011:96).

The current study adopts the definition of Klubeck (2017:190), who suggested that success is defined by the reason for the organisation's existence. Furthermore, there is success in how well the business owner is fulfilling his or her purpose in life, how well they are answering their calling.

Factors that contribute to entrepreneurial success

Decision-making

Entrepreneurs have to deal with decision-making opportunities on a daily basis. Decision-making has gone as far as being called the 'backbone of entrepreneurship' (Talebi et al., 2014:59). According to Talebi et al. (2014: 59), all individuals make decisions, but entrepreneurial decision-making is biased. Furthermore, these biased decisions are influenced by many factors. While Brundin and Gustafsson (2013:5) also attest to the biases displayed by entrepreneurs when making decisions, they found that emotions were the main cause of these biases. These biases ultimately will influence how the business is run. Just as decision-making can determine the trajectory of one's life, it can also determine whether an entrepreneur will become successful or not.

Government support

In its major role in all nations of the world, entrepreneurship contributes to national economies through starting up and running small and medium sized enterprises (SMEs). These enterprises potentially make up to 95% of the total number of enterprises and provide jobs to more than 60% of all employees within different countries (Stefanovića et al., 2011: 79). Obaji and Olugu (2014: 110) confirm this. The significance of entrepreneurship to economic development compels the government to continue in facilitating its growth through necessary means (Stefanovića et al., 2011: 79).

Some of the ways the government achieves the above-mentioned objectives include enacting entrepreneur-friendly policies (Obaji and Olugu, 2014: 110). Different countries around the world implement some sort of efforts towards entrepreneurship. However not all of these efforts turn out to be successful, as was the case with Nigeria, due to corruption and other factors (Ihugba, Odii and Njoku, 2014). Furthermore, Friedman (2011) observed contradictory findings about government policy that can be negatively related to entrepreneurship.

Motivation

Jones and George (2011:400) define motivation as the psychological force determining the direction of a person's behaviour within an organisation, a person's level of effort, as well as a level of persistence when faced with obstacles. Everybody has needs to be met, which may explain the reason for motivation at different stages. It is important to know the motivational factors behind entrepreneurs because it may explain why certain entrepreneurs persist while others quit. While motivational factors of entrepreneurs are generic worldwide; there are differences that depend on the current situation in local environment (Stefanovića et al., 2011: 79).

Theories of needs maintain that entrepreneurs satisfy needs by being motivated to achieve certain outcomes at work. According to Maslow's hierarchy of needs, people's behaviour is motivated by five basic needs, namely physiological, safety, belongingness, esteem and self-actualisation. Each need is motivational at a time (Jones and George, 2011:406). However, Alderfer proposes three universal categories of needs including existence, relatedness and growth. Alderfer's needs further differ from Maslow's in that needs at more than one level can be motivational at the same time (Nel et al., 2011:292). Other theories of needs that have been studied include Herzberg's motivator-hygiene theory and McClelland's needs for achievement, affiliation, and power (Jones and George, 2011: 406). Scholars through the years have critiqued all the mentioned needs theories and it must be mentioned that no single theory explains everything.

Position in society

Different people have different standings in society. This contributes to business success through linking with a number of decision-makers in profit and non-profit organisations, government agencies and institutions (Stefanovic et al., 2010:262). Customers are likely to trust people with a higher societal standing.

Interpersonal skills

According to Khan and Ahmad (2012:297), interpersonal skills refer to the entrepreneur's ability to motivate, communicate, and build the team. Some of the interpersonal skills identified by authors (Ameen et al., 2015) are communication, self-disclosure, self-management and conflict management. These skills have a positive effect on organisational change and entrepreneurial effectiveness. These are the life skills anentrepreneur uses to communicate and interact with other people. These skills include a variety of social abilities, like understanding others, empowering, motivating and directing others (Stefanovic et al., 2010: 262). According to Bonnstetter (2012), a lack of

interpersonal skills would limit entrepreneurs in that they would relate only to those who share their exact communication style, thereby restricting their ability to convey their goals and vision. Ray (1993) discovered that entrepreneurs with strong interpersonal skills were usually more successful in both their professional and personal lives. Customers will always prefer to support the entrepreneur whom they feel understands them the most. Even when the entrepreneur is not able to meet the needs of a customer, a pleasant experience can still be maintained.

Leadership skills

Leadership skills are increasingly being recognized as important to the business enterprise. Arham et al. (2013: 118) have recognized that entrepreneurs cannot successfully develop new ventures in the absence of effective leadership behaviour. Entrepreneurs need to develop solid leadership behaviour in order to take their enterprises through different times. This may help to ensure that employees stay motivated within the enterprise. A key component of effective leadership is found in the leader's power (Jones and George, 2011).

Approval and support

Entrepreneurship means one is walking on unsecured terrain without secured income or employment. Therefore, support for entrepreneurs' actions is needed (Stefanovic et al., 2010: 263). For entrepreneurs to be successful they need to be approved by both the people being catered for and the community at large. This approval and support may be shown in many ways to the entrepreneur. For example, approval and support can be shown by buying their products and services which can also be repeated. Support can also come from different agencies in the form of funding of just professional advice. Agencies such as the National Youth Development Agency (NYDA) offer grants to deserving candidates.

Business reputation

Business reputation may take a long time to build. It can be established through long-term experience in business and through as maintaining professional relationships with stakeholders (Stefanovic et al., 2010: 263). Once an entrepreneur is known for providing a service perceived as superior more customers will be attracted.

Education and experience

In South Africa the Global Entrepreneurship Monitor (GEM) found a positive correlation between opportunity-driven entrepreneurship and education levels in 2013 (Dludla, 2014). Entrepreneurship is now offered as a subject at school and has been expanding as a stand-alone module or a major subject. Informal education also exists among entrepreneurs. Some entrepreneurs have heaped major success despite their non-educational background. Some of these entrepreneurs include Sir Richard Branson (founder of the Virgin group). Some are successful in areas that differ from their educational specialty. Naqvi (2011) support the notion that entrepreneurs with prior experience manage their current organisations with greater success than inexperienced entrepreneurs.

Luck

The luck factor is an uncontrollable force that can impact both the success and failure of entrepreneurship (usually in hindsight). From research it is clear that luck is not considered as a main factor in entrepreneurial success because entrepreneurs tend to underestimate the role of chance in events (Kahneman and Egan, 2011). It can also be argued that bad luck is often considered the reason for entrepreneurial failure. However, Morris (2012: 12) challenges this with his finding that luck indeed plays a part in the fortunes of an entrepreneur. The impact of the luck factor is therefore very subjective.

Innovation

Innovation is a significant factor, as it has led and continues to lead to the development of many of the world's products. It is also vital as it helps organisations achieve competitive advantage. "Innovation is invariably identified as the key driver of long-term economic growth, competitiveness and a better quality of life" (Moses, et al., 2012:1). A setting therefore needs to be created wherein people will be encouraged to innovate. However, it is hard to manage innovation and create a work setting that encourages risk taking (Jones and George, 2011: 62).

Entrepreneurial innovation

The innovation factor may establishthe activities that will take place within an organisation. According to Baregheh et al. (2009:1334), "innovation is the multi-stage process whereby organizations transform ideas into improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace." Similarly, George defines it as the process of (1) creating new or improved services and goods that are sought by customers or (2) developing better ways to produce of producing services and goods (Jones and George, 2011:62). Kotler and Keller go further in that they define innovation as any idea, good or service that someone may perceive as new, regardless of

its history (2012: 611). Change is therefore integral to innovation. Such change can range from small incremental improvements to radical breakthroughs.

According to Drucker (2015), innovation is a vital instrument of entrepreneurship. "Entrepreneurship is, therefore, the innovatory process involved in the creation of an economic enterprise based on a new product or service which differs significantly from products or services offered by other suppliers in content or in the way its production is organized or in its marketing" (Curran and Burroughs, 1986). In addition, both entrepreneurship and innovation have need of creativity (Okpara, 2007: 2). Innovation is vital to successful entrepreneurship, and today's changing and competitive environment further reinforces this view. An organisation that is not creative and innovative will never survive in the market place (Okpara, 2007:2). Thus, entrepreneurs and enterprises have to constantly be creative and innovative in order to stay relevant to their customers, which is the primary purpose of every business. Successful future entrepreneurs are likely to integrate innovation into their strategic goal.

In 2008a study was conducted in the Kermanshah province in Iran. The aim was to study factors that determined the success of rural entrepreneurs in the township Mahidasht, where a census of 70 rural entrepreneurs was conducted. The study found that internal factors (such as innovativeness, need for achievement, internal locus of control) and external factors (such as bureaucracy and marketing opportunities), accounted for 88% of the entrepreneurs' success.

Challenges that confront rural entrepreneurs

Administrative bureaucracy: Among the factors that hinder entrepreneurship is bureaucracy. In particular, bureaucracy makes it hard for entrepreneurs to stay in business. According to Boshoff (2015), bureaucracy together with intricate 'red tape' remains key elements among the hurdles that entrepreneurs and small business owners are faced with currently. One form of bureaucracy involves obtaining finances and can lead to entrepreneurs have to surrender their dreams. Bureaucracy must be reduced by an enabling environment, where small businesses are allowed to trade.

Lack of finances: Ngorora and Mago (2013) found financial constraints as the primary hindering factor for entrepreneurship in the rural area of the Eastern Cape (2013: 1). Finances are vital to entrepreneurship and the lifeblood of an enterprise (Sharma et al. 2013: 1037). However, obtaining a business' financial support from the bank is actually as difficult as obtaining vehicle finance. Also, rural entrepreneurs tend to have no tangible security and credit in the market (Sharma et al., 2013: 1037). Due to this lack of sufficient finances, they may not be able to adopt an advertisement strategy for the product and so cannot increase their sales turn-over (Venkateswarlu and Ravindra, 2014: 465). Accordingly, some entrepreneurs resort to obtaining finances from village money lenders. These lenders charge inflated interest amounts. The government should step in where private financial institutions are falling short. Such action by the government will develop rural entrepreneurship, which in turn would lead to the economic development of the nation as a whole.

Poor infrastructure: Certain industries, for example the agricultural industry, rely on transportation. The crafts industry also needs a good transportation system for tourists and manufactures to access the market. In many rural areas the transportation system is too poorly developed to properly support sustainable development. According to Mugobo and Ukpere (2012: 832), such challenges include poor road networks, absence of reliable telecommunication and postal services. Another area of poor infrastructure is electricity.

Poor information networks: Entrepreneurship does not mean that contact with people (who may provide the necessary information to the entrepreneur) is readily available. This means the rural entrepreneur may have to rely on other methods of connecting with sources of advice. The role of internet has been growing throughout, but it remains expensive in rural areas. As a result, rural communities are marginalised. For the reason that rural entrepreneurs lack market information, intermediaries may end up taking advantage of them. As a result, networking has become an important tool, in that it allows entrepreneurship to fulfil its welfare.

Jones and George (2011: 518) consider *competition* as a conflict handling approach, which is ineffective where all parties try to maximize their own gain but have little interest in understanding the other party's position and arriving at a solution that allows all parties to attain their goals. In particular, rural entrepreneurs are likely to face severe competition from large-sized organisations and urban entrepreneurs. They incur high production costs due to high cost of input. The major problems faced by marketers are those of standardisation and competition from large-scale units (Das, 2014: 180). Competition from large-scale units also makes it difficult for new ventures to survive. Such new ventures have constrained financial resources and therefore cannot afford to spend a lot on sales promotion. These units furthermore lack standard brand names under which they can sell their products (Das, 2014: 180). In addition, rural consumers' literacy rate is low (Venkateswarlu and Ravindra, 2014: 464).

METHODOLOGY

Type of research

This study uses quantitative research for the reason that it tests objective theories through comparing relationships among variables. The researchers sought to explore the phenomenon of factors and their impact. The outcomes of this research are

furthermore measurable and quantifiable, which makes it quantitative in nature.

Sampling method

Non-probability sampling strategy was used, since the study did not involve random selection. In line with non-probability study, a convenient sampling strategy was used given that it was more convenient and inexpensive. Not every entrepreneur had an equal chance of participating in the study.

In this study the target population was entrepreneurs from Bungeni, a rural area in the Limpopo province. Since hundreds of entrepreneurs operate at Bungeni, and the majority have their own informal businesses, it would be very difficult to conduct a study to include all entrepreneurs. For example, additional resources would need to be utilised in order to get all the entrepreneurs to participate.

The study included a sample of 50 entrepreneurs from the target population at this was more manageable. A sample refers to a group of people, objects, or items that are taken from a larger population for measurement and should be representative of the population to ensure that the findings from the research sample can be generalised to the population as a whole (Flick, 2015). The findings obtained from the sampled 50 entrepreneurs will be generalised to the hundreds of entrepreneurs at Bungeni village.

Questionnaires

Questionnaires were used as research instruments. Based on the literature review, seventeen factors were used as a measurement instrument. This instrument examined two variables to determine their relationship. The first variable looked at how the importance of these factors was considered for entrepreneurial success, while the second variable looked at how they influenced innovation. With reference to the above stated factors, 17 statements were made and measured according to the five point ordinal scale (Linkert scale), which is strongly disagree, disagree, neutral, agree and strongly agree.

Data analysis

Schwandt (2014) explains that data analysis is the activity of making sense of, theorising and interpreting data that signifies a search for general statements among categories of data. The one-tailed test (t-test) statistical tool was used to process the data and obtain preliminary results. An analysis of the response variables to a categorical analysis of ordinal and nominal data will follow and this will be presented both descriptively and inferentially.

Descriptive analysis involves summarising data with the purpose of describing what occurred in the sample in such a way that (for example) patterns might emerge from the *data* (Thompson, 2008:57*). Inferential analysis* focuses on drawing conclusions about the population on the basis of sample analysis and observation (Neelankavil, 2015). Once the data was collected, it was organised and analysed according to the IBM SPSS 21 analysis system. Tables and charts were designed to present the data.

Validity and reliability

Validity is concerned with whether researchers actually measure what they intended to measure (Drost, 2011: 114). To achieve this validity, questionnaires contained a variety of questions on the factors that affect entrepreneurial success and how this impacts on innovation, in line with the subject of the literature review. Validity was further ensured by the consistency of administering these questionnaires. The researcher personally distributed all the questionnaires to the respondents. For ease of understanding and for clarity, the questions were formulated in a simple language. Clear instructions were offered to the subjects and the researcher offered assistance to those respondents who could not read or understand. All the respondents completed the questionnaires in the presence of the researcher as a way to ensure that the participants completed the questionnaires themselves.

Reliability is "the extent to which measurements are repeatable – when different persons perform the measurements, on different occasions, under different conditions, with supposedly alternative instruments which measure the same thing" (Drost, 2011:106). The response yielded was consistent and reliability was further ensured by minimising sources of measurement error like data collector bias. Data collector bias was minimised in that the researcher was the only person who administered the questionnaires, and since the researcher reflected similar personal attributes to that of all the respondents, including friendliness and support. The respondents were enabled to be part of a comfortable environment while they completed the questionnaires, which ensured privacy and confidentiality.

RESULTS AND DISCUSSION

Good management skills

Good management skills are some of the factors that affect success among entrepreneurs. Thirty-nine percent (39%) of the respondents strongly agreed with the statement, while 31% agreed and 15% disagreed (10% strongly disagreed, 5% disagreed) and 15% remained neutral. The results of the respondents are in line with Khan and Ahmad (2012:297)'s assertion on good management skills for entrepreneurs. According to Khan and Ahmad (2012:297), good management skills have the ability to motivate, communicate, and build a team. Such management skills and have a positive effect on organisational change and entrepreneurship effectiveness. These are the life skills that an entrepreneur uses to communicate and interact with other people. These skills include a variety of social abilities, like understanding, empowering, motivating and directing others (Stefanovic et al., 2010: 262) Appendix 1.

Charisma and friendliness

Fifty-one percent of the respondents strongly agreed and 45% agreed, while 5% strongly disagreed. These figures cumulatively indicate why a good entrepreneur is an individual who knows he or she is human and who understands the importance of being that way. Friendly natured people unconsciously surround themselves around positive people and this naturally helps them to build a solid network. The influence of personality traits may be stronger within entrepreneurs than within most other professions (Brandstätter, 2011) Appendix 2.

Satisfactory government support

Eighteen percent of the respondents agreed, 18% strongly agreed, and 15% remained neutral, while 33% disagreed and 15% strongly disagreed. The response ratio reveals that the respondents fully understand the support government ought to render to entrepreneurs. The response reflects a lack of government support to entrepreneurs. Entrepreneurship contributes to national economies through starting up and running small and medium sized enterprises (SMEs), which could make up to 95% of the total number of enterprises and which could provide jobs to more than 60% of all employees within each country (Stefanovića et al., 2011: 79). Government support is therefore a vital factor for entrepreneurial success. Some of the ways the government achieves the above-mentioned objectives include enacting entrepreneur-friendly policies (Obaji and Olugu, 2014: 110).

Access to capital

The access to capital factor affects entrepreneurial success. Overall, 97% agreed (71% strongly agreeable, 26% agreeable to the statement) and only 3% strongly disagreed. Therefore, the lack of capital challenges the growth and development of the entrepreneurial sector. Due to lack of the necessary capital, the owner is the centre of the business, and therefore makes all or most of the decisions in the small business, As a result, an entrepreneur's access to capital depends on the support government has put in place (Modimogale and Jan, 2011:4).

Previous business experience

The respondents' previous business experience varied across groups. The results indicate that 23% strongly agreed, and 41% agreed and 28% disagreed. Thus, the real potential for entrepreneurs is informal education, which exists amongst entrepreneurs (Ucbasaran et al., 2010). Levels in entrepreneurship exist where individuals with more education and those from higher income households are more likely to partake in opportunity entrepreneurship. On the other hand, those from lower income households and those with less education, pursue necessity entrepreneurship (Venter et al., 2010: 22).

Support of family and friends

The support of family and friends is vital aspect for the success of entrepreneurs. Overall, 64% agreed (33% strongly agreeable, 31% agreeable to the statement) and 23% were disagreeable (15% disagreed and 8% strongly

disagreed). Thirteen percent remained neutral. The results show that small business owners need a lot of support to succeed, irrespective of whether it this support is financial, operational or emotional. One of the most important sources of this support for many entrepreneurs is their network of friends and family members (Cakula et al., 2013). Emotional support can be similarly important to a small business owner as financial support, simply because the stresses that come along with building and growing a business cannot always be solved with money.

Marketing sales and promotions

The majority of the respondents strongly agreed that the marketing of sales and promotions was a major factor entrepreneurial success. Eighty-two percent agreed (41% agreed, 41% strongly agreed) and 3% disagreed. Marketing therefore play a key role in business success. Entrepreneurs need to decide which customers to target. They need to work out how to reach and win new customers and they also need to make sure that they keep their existing customers happy.

Firstly, all marketing involves the formulation and implementation of the basic policies, which are known as the 4 P's: product, price, place, and promotion. Secondly, international marketing, unlike domestic marketing, transpires to be carried out "across borders". Marketing is about identifying customers' needs and wants in different markets and cultures. In addition, it means providing products, services, technologies, and ideas to offer the organisation a competitive marketing advantage. Likewise, it involves imparting information about these products and services and then distributing and exchanging them internationally by one or a combination of the foreign market modes of entry (Kotler and Keller, 2012).

Good customer service

The majority of the participants agreed that excellent customer service affected the entrepreneur's success (28% agreed and 64% strongly agreed), 3% remained neutral. According to Gebauer and Fleisch (2007), people are a crucial variable in the entrepreneurial world. The excellence of people who deal directly with your customers clearly differentiates an entrepreneur from his or her competitors. Customer service is about taking care of the customers' needs by providing and delivering not only professional service, but also service that helpful and of high quality. Customer assistance also includes service before, during and after the customer's requirements are met.

Maintenance of accurate records

The results depicted mixed results as 23% agreed, 13%

strongly disagreed, 31% disagreed and 28% remained neutral, while 5% strongly agreed. For most entrepreneurs, maintenance of accurate records for entrepreneurs was the least fun part of the job. When managing a growing business, it is often tempting to ignore some of the administrative formalities in order to stay focused on sales, customer satisfaction and new product development. However, while staying on top of the business, the maintenance of accurate records for entrepreneurs becomes essential for both legal and strategic reasons (Penn, Pennix and Coulson, 2016).

Ability to manage personnel

The statement attracted mixed responses as 18% strongly agreed, 36% agreed, 28% disagreed and 18% were remained neutral. The ability to manage personnel is probably the most important trait or skill required for entrepreneurship is. According to Barba-Sánchez and Atienza-Sahuquillo (2012), successful entrepreneurs must have the managerial skills necessary to evaluate potential employees, hire and train workers and put them in appropriate positions in the organisation. This means being a good judge of character, finding people who will work well together, and ensuring that staffers are qualified for their jobs. Once employees are on the job, a successful entrepreneur must be able to manage teams, oversee conflict, dispute resolution, and provide ongoing training to encourage high-quality performance.

CONCLUSION AND RECOMMENDATIONS

A closer look into the results reveals that environmental and demographic factors affect success among entrepreneurs. Hosts of environmental factors impede the success of entrepreneurs in Limpopo. For example, Singh-Sandhu et al (2011) reported a lack of government support and incentives. Several studies (Williams and Williams, 2011; Fatoki and Patswawairi, 2012; Webb et al., 2013) also reported on the absence of appropriate support.

The current study established that bureaucratic obstacles such asaccess to capital, political involvement and satisfactory government support, are some of the challenges that entrepreneurs face in their quest to starting and maintaining a business. A host of factors are identified, including lack of long-term capital (Chowdhury and Amin 2011); limited friendly and family support (Mahajan, 2013); limited access to marketing and sales promotions; lack ofprevious business experience (Sumra et al., 2011; Clarysse et al., 2011; Samuel, Ernest and Awuah, 2013); technology (Duru, 2011; Griskevicius et al., 2012); and lack of information (Kozlinska, 2011; Preisendörfer et al., 2012). These factors have been found as impeding to the success of entrepreneurs in Limpopo. The foregoing discussion thus reveals that

entrepreneurial success is influenced by environmental factors. The following recommendations are suggested to enhance entrepreneurial success:

(i) The government, society, and particularly private organisations need to be more supportive to the activities of entrepreneurs.
(ii) In Limpopo, entrepreneurs require appropriate entrepreneurial training so that they can experience greater success and hence avoid obvious the mistakes that other entrepreneurs make.
(iii) Local consumers must be encouraged to support local entrepreneurs by transacting with them.
(iv) Local entrepreneurs should participate in social initiatives that are aimed at uplifting communities.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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ANNEXURE A: QUESTIONNAIRE Appendix 1 Success Variables for Entrepreneur

Success variables	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. Good management skills					
2. Charisma: friendliness					
3. Satisfactory government support					
4. Appropriate training					
5. Access to capital					
6. Previous business experience					
7. Support of family and friends					
8. Marketing/sales promotion					
9. Good product at competitive price					
10. Good customer service					
11. Hard work					
12. Position in society					
13. Maintenance of accurate records					
14. Ability to manage personnel					
15. Social skills					
16. Political involvement					
17. Reputation for honesty					
Other					

Mark with X.

Source: Stefanovic et al. (2010).

Appendix 2 Impact of Innovation on Entrepreneur

	Impact on innovation		
Success variables	**Optimises innovation**	**Neutral**	**Hampers innovation**
1. Good management skills			
2. Charisma: friendliness			
3. Satisfactory government support			
4. Appropriate training			
5. Access to capital			
6. Previous business experience			
7. Support of family and friends			
8. Marketing/sales promotion			
9. Good product at competitive price			
10. Good customer service			
11. Hard work			
12. Position in society			
13. Maintenance of accurate records			
14. Ability to manage personnel			
15. Social skills			
16. Political involvement			
17. Reputation for honesty			
Other			

Source: Stefanovic et al. (2010).

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