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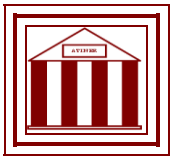

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Long-Term Relationship between Misery Index and Stock Market: The Colombian Case

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Abstract

The main purpose of this article is to examine the potential existence of a long-term relationship between the misery index and the stock market for the Colombian case. We use monthly data for the period between September 2001 and July 2011. After founding the existence of cointegration between both series, we provide evidence that shows that the behavior of the Colombian stock index does respond to economic fundamentals, contrary to what Brugger and Ortiz (2012) found for Argentina, Brazil, Chile and Mexico.
In order to draw our conclusions, we estimate a VAR model, and it`s respective variance decomposition and impulse response functions, as well as Granger causality tests. We also estimate an Error Correction Model. This paper concludes by suggesting the misery index as a tool for predicting the future performance of the stock market for the Colombian case.

Key words: Misery index, stock market, Cointegration, Colombia

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1. Introduction

An economy´s capital market is responsible for the transformation of savings into investment, through the allocation and distribution of resources between households and businesses. The importance of this market for the economic activity has been growing due to globalization, liberalization and financial deregulation. This relationship between capital markets and economic activity in emerging markets has driven several authors to study the relationship between stock markets and economic growth.

On one side, some authors argue that the relationship is beneficial thanks to the stimulus to savings, increase productivity of capital tied to the increase liquidity and encouragement of investment, driven by efficient resource allocation and risk diversification. Meanwhile, authors such as Stiglitz (1985), based on the present problems of asymmetric information in financial markets, establish that the agents' decisions are suboptimal and that monetary and exchange policies are ineffective.

There is a growing empirical literature studying this relationship both for development economies and emerging markets. Fama (1990) in a seminal paper concludes that behavior of real economy determined the stock market returns in the United States between 1953 and 1987. Nasseh and Strauss (2000) find a long-term relationship between stock prices and industrial activity of major European economies. In Latin America, the evidence is scare and limited to few countries. For example, Brugger and Ortiz (2012) study the relationship between stock indexes and the performance of real economy represented by the evolution of gross domestic product in Argentina, Brazil, Chile and Mexico. Brugger and Ortiz (2012) find evidence in favor of a long-term relationship between both variables in each country. Furthermore, they conclude that there is a Granger-causal relationship from the stock market to economic activity, but not the other way around. This result suggests that the behavior of these four stock indexes do not respond to economic fundamentals.

Our objective is to build up on this literature that discusses the relationship between economic activity and capital markets for the Colombian case. In order to reach our goal, using the Misery Index (sum of unemployment rate and inflation rate) as a proxy of the economic environment, we study the long time relationship between economic activity and the stock market for the Colombian case. More precisely, we investigate the cointegration relationship between the Misery Index and Colombian stock market index.

The remainder of this paper is organized as follows. The first part contains this introduction and the description of the Misery index. Section three presents data and its characteristics. Then in section four we present the main results in terms of the long-run relationship between Misery index and the stock market and we conclude presenting some final remarks.

2. Misery Index as a measure of economic discomfort

Janssen (1971) described the Misery Index (MI) created by Arthur Okun, as a measure of economic discontent. This index, constructed through the simple

sum of the unemployment and inflation rates in a given period, become a loss function which reflects the most obvious social costs of a country, recognizing the impact of unemployment and soaring prices in individual's welfare.

While one of the main characteristics of this indicator is the ease of calculation, this simplicity has also been the starting point for the main criticisms that have emerged since its inception. According to Barro (1999), an adequate measure of economic burden should also include economic growth and interest rates. Barro (1999) used this version of the MI to analyze United States' macroeconomic performance in the period 1953-1998 and as a measure of success of the economic policy of different administrations. A downside of using Barro's approach is the availability of GDP's information in a quarterly basis. This fact let not analysts to calculate monthly MI, while Okun's initial idea allows a monthly calculation.

However, the amount and relevance of the included variables is not the only critical observation against the MI. Other authors do not consider correct the assumption implicit in the original MI of a unitary marginal rate of substitution between unemployment and inflation. More precisely, in political and economic cycles literature, MacRae (1977) and Nordhaus (1989) worked with loss functions with quadratic form in unemployment and inflation. Meanwhile, Di Tella (2001) advanced a study that linked the level of satisfaction of individuals surveyed with levels of unemployment and inflation in 12 European countries between 1975 and 1991 and in the United States between 1972 and 1994. He also worked with an unemployment rate with a weight that was considerably higher than the one for the price level variation. The author concluded, using a set of estimated models, that traditional MI undervalues the loss associated with unemployment.

Given these criticisms of the specification and the functional form as well as the used weights, authors like Lovell and Tien (2000) show evidence that the relationship is not quadratic but linear, while Welsch (2007) found that similar weights for both rates allow to correctly capture this trade-off between unemployment and inflation. Based on this, they conclude that the MI originally proposed by Okun, is actually a good approximation to the level of economic malaise that is faced by the population, but emphasize the need to include additional variables.

Other literature from which Okun's MI is criticized is distributive justice. Authors like Asher et al (1993) state that the MI is not an accurate indicator through which to make an assessment of government management in macroeconomics as it presents two major problems: i) does not recognize the impact of supply shocks on inflation and unemployment (MI components) and ii) it focuses on growth and stability of the economy, ignoring the fundamental role of distributive justice, that is, the equitable distribution of profits growth among members of society.

Finally, due to its nature MI has been used traditionally, among others, to analyze its relationship with the level of consumption in the United States (Lovell and Tien, 2000), the level of satisfaction of population in 12 European countries between 1992 and 2002 (Welsch, 2007) and its hysteresis under the

effect of induced demand in 45 countries and 12 Colombian municipalities (Riascos, 2009). As far as we know the IM has not been used to study the relationship between economic environment and capital markets.

3. Source and characteristics of data

We use monthly data for the period 2001:9 and 2011:7 of the following variables: Colombian stock market index (IGBC), moving quarter unemployment rate and inflation rate. Colombian Misery Index (MI) is calculated as the simple sum of unemployment and inflation rates for each month. Information for the IGBC and inflation rates is obtained from Colombia's Central Bank, while unemployment rate data comes from the National Bureau of Statistics (DANE). Both MI and IGBC are expressed in logarithms.

When working with time series, the first step is to identify the order of integration of the data generating process (DGP). In order to determine the existence of unit roots, augmented Dickey Fuller test was initially used (ADF, 1981). Given the historical behavior of both series, the null hypothesis of unit root with drift was tested versus the alternative hypothesis of a stationary process around a trend. In addition to ADF, we used the Phillips-Perron test (1988), KPSS (Kwatkowsky et al, 1992), Zivot and Andrews test (1992) and Breitung's nonparametric test (2002). Table 1 shows results for both series at their levels and their first differences. The evidence contained in Table 1 suggests that both DGPs are integrated of order 1 (I (1)).

Table 1. Unit root test

	Levels					First differences				
	ADF	PP	KPSS	Breitung (2002)/2	ZA	ADF	PP	KPSS	Breitung (2002)	ZA
Ln(IGBC)	-1,54	-1,1586	0,232 (++	0,02138	-3,8159	-9,782 (***)	-10,120 (***)	0,3761	0,00387 (**)	10,8067 (***)
Ln(MI)	-2,95	-2,5095	0,094	0,00600	-4,7282	-7,272 (***)	-6,7243 (***)	0,0655	0,00042 (**)	-5,9663 (***)

(+++): Null hypotheses of stationary process with trend is rejected with a 99% confidence level

(**): Null hypotheses of non stationary process is rejected with a 95% confidence level

(***): Null hypotheses of non stationary process is rejected with a 99% confidence level

4. Long-term relationship

Once established the order of integration of both series, we proceed to rule out possible spurious relationship. Using Engle and Granger (1987) and Johansen (1988) tests we prove the existence or not of cointegration relationship. In the presence of such relationship, even if a series is affected by different shocks, in the long run the two will remain "united". Conversely, no-cointegration indicates that each of the variables is having an independent behavior. If results suggest that indeed both variables are cointegrated, it is possible to use the Granger causality test, impulse response function and variance decomposition, as well as the error correction model to see how variables adjust in the short term to long-term imbalances.

Table 2 shows results of Engle and Granger (1987) test, indicating that there is enough evidence in favor of the existence of a long-term relationship between both variables (95% confidence level).

Table 2. Engle and Granger cointegration test

	t-statistic
Ln(IGBC)~Ln(MI)	-3,451 (**)

(**): Null hypotheses of no cointegration is rejected with a 95% confidence level

For the case of Johansen's multivariate test, the first step is to identify the number of lags included in the VAR model and therefore resort to minimizing different information criteria. Akaike information criterion (AIC) and Final Prediction Error (FPE) suggest a total of seven lags, while Hannan-Quinn criterion (HQ) and Schwarz (SC) state two lags as optimal. Given the divergence in results, we test for auto-correlation in the different specifications using Breusch-Godfrey (1978) and Edgerton and Shukur (1999) tests. Both tests, suggest that the model with two lags has autocorrelated errors. On the other hand, the one with seven lags is free of serial correlation.

Once checked that the VAR model is correctly specified, we test for cointegration using Johansen (1988) Lambda max and Trace tests. Both results are presented in Table 3.

Table 3. Johansen cointegration test

		λ-max	Trace statistic
Ho	Ha	statistic	statistic
r=0	r≥1	20,17 (**)	26,22 (***)
r≤1	r=2	6,06	6,06

(**): Null hypotheses is rejected with a 95% level of confidence

(***): Null hypotheses is rejected with a 99% level of confidence

According to Lambda max version there is evidence to reject the null hypothesis of no cointegration with a 95% level of confidence, while this level is of 99% for the trace statistics version. Therefore, it is possible to conclude that Colombian stock market index and Misery Index are cointegrated.

Characteristics of the relationship between MI and IGBC

Granger causality tests between the log of Colombian stock index and the log of Misery Index show that there is evidence in favor of a causal relationship from the IM to the stock market index (90% confidence level) (see Table 4). On the other hand, there is no causal relationship in the reverse direction. These results suggest that changes in the MI precede changes in IGBC, but not vice versa. Therefore, the MI could be used as a tool to predict future behavior of Colombian stock market.

Table 4. Granger Causality test

Granger causality test: Ln(IGBC) ~ Ln(MI)			
Res. Df	Df	F	P-value
104	-7	1,8046	0,09494
Granger causality test: Ln(IM) ~ Ln(IGBC)			
Res. Df	Df	F	P-value
104	-7	1,0038	0,4334

Figure 1 shows the response of IGBC (in logs) to an impulse of an unexpected one-standard-deviation in the log of the MI in a 12-period horizon. With a 99% level of confidence, between three and six months after an increase in the Misery Index, the Colombian stock market index decreases. Meanwhile, Figure 2 shows that the response of the MI to an unexpected innovation of IGBC is not statistically different from zero during the next twelve months after the shock.

Figure 1. Response of IGBC to an impulse of MI (in logs)

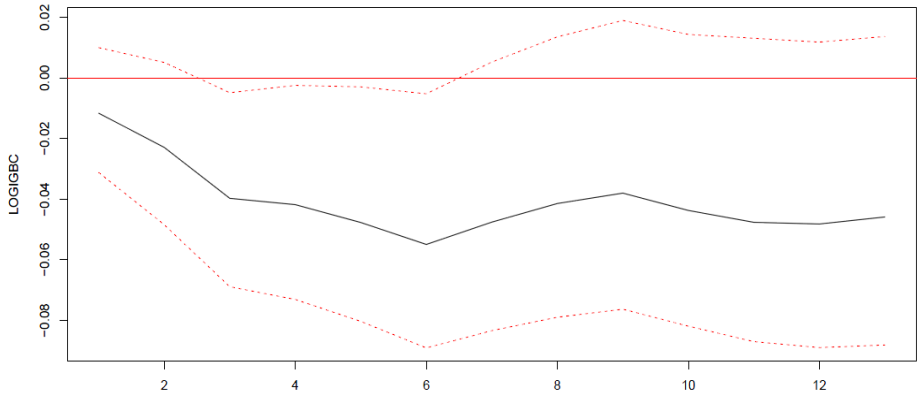
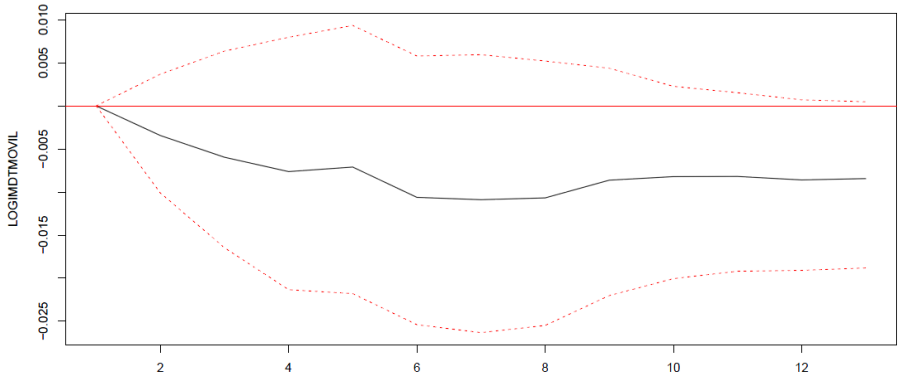


Figure 2. Response of MI to an impulse of IGBC (in logs)



Another useful tool in the analysis of short-term relationship between Misery Index and stock market performance in Colombia is the forecast error Variance Decomposition (VD). This decomposition allows to determine how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variable. Figure 3 shows that for the case of MI, the effect of a shock in IGBC does not represent more than 10% of its total variance. Meanwhile, the exogenous change in the MI explains 40% of the IGBC forecast variance, after 8 periods. In other words, 40% of what happens after 12 periods with the Colombian stock index can be explained by the MI.

Finally, the error correction model presented in Table 5, let us study how the variables adjust in the short-run to long-run disequilibria. In case of positive imbalances in long-term relationship between IGBC and MI, with 99% level of confidence, the stock market will be matched downward in the short term to

return to equilibrium. On the other hand, the real sector of the economy (represented by MI) has no statistically significant adjustment to imbalances in the long-term relationship. In other words, when long-run disequilibrium appears, the stock market adjusts and the economy does not.

Figure 3. Variance Decomposition

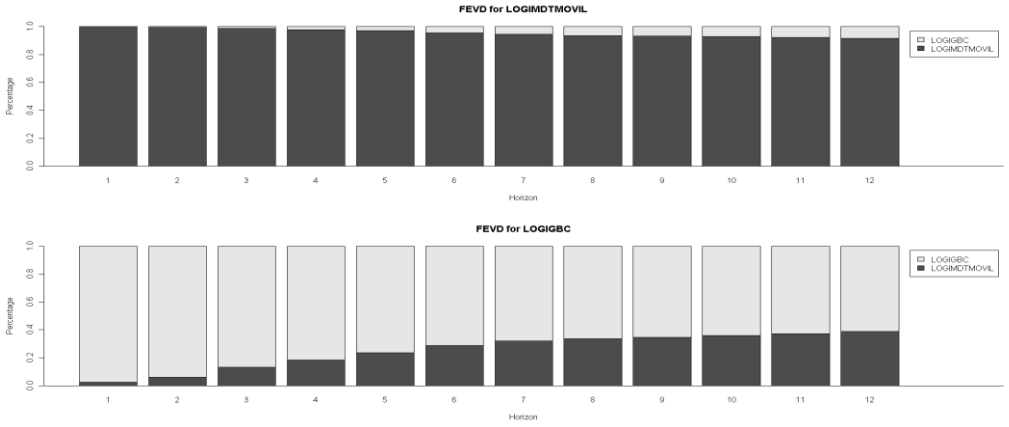


Table 5. Error Correction Model

	Error Correction Model	
	t-statistic in parentheses	
	FIML	
	ΔLn(IGBC)	ΔLn(MI)
TCE	-0,347	-0,041
	(-3,992)***	(-1,161)
ΔLn(MI)t-1	-0,435	0,430
	(-1,745)*	(4,234)***
ΔLn(IGBC)t-1	0,009	-0,056
	(0,095)	(-1,386)
ΔLn(MI)t-2	-0,491	-0,144
	(-1,827)*	(-1,320)
ΔLn(IGBC)t-2	-0,105	-0,021
	(-1,068)	(-0,516)
ΔLn(MI)t-3	-0,006	-0,462
	(-0,023)	(-4,237)***
ΔLn(IGBC)t-3	-0,167	-0,024
	(-1,699)*	(-0,589)
ΔLn(MI)t-4	-0,632	0,2
	(-2,287)**	(1,770)*
ΔLn(IGBC)t-4	-0,104	-0,021
	(-1,048)	(-0,513)
ΔLn(MI)t-5	-0,578	-0,047
	(-2,045)**	(-0,409)
ΔLn(IGBC)t-5	-0,084	-0,071
	(-0,854)	(-1,755)*
ΔLn(MI)t-6	0,114	0,008
	(0,433)	(0,074)
ΔLn(IGBC)t-6	-0,250	0,004
	(-2,573)**	(0,107)
R^2	0,2509	0,4196
Adjusted R^2	0,1525	0,3433
P-value	0,004519	2,05e-07

* Significance level 10%
** Significance level 5%
*** Significance level 1%
FIML: *Full Information Maximum Likelihood*

5. Final remarks

The Misery Index has been used as an indicator of economic discontent for about forty years. For example, it has helped in analyzing the relationship between consumption and perceived wellbeing of individuals from different countries around the world. In this paper, we work with Okun's misery index original approach (simple sum of unemployment and inflation rates) in order to determine the existence of a long-term relationship between this and Colombian stock exchange index (IGBC).

Our results indicate that indeed both series are cointegrated. We also found that changes in MI precede changes in IGBC, but not the other way around. The

evidence indicates that the dynamics of prices and employment in Colombia are not determined by the capital market. These results differ from Brugger and Ortiz (2012). The authors found for Argentina, Brazil, Chile and Mexico evidence in favor of a causality relationship from the stock market to economic activity, but not the other way around.

For the Colombian case we found that the behavior of the Colombian stock index does respond to economic fundamentals, contrary to what Brugger and Ortiz (2012) found for Argentina, Brazil, Chile and Mexico.

Our results from Granger-causality analysis are confirmed by the variance decomposition, impulse response function and Error Correction model. In fact, our main finding that the behavior of the Colombian stock index responds to economic fundamentals suggests that MI could be used as a tool to predict the behavior of the Colombian stock market. Future research may explore this relationship to model future behavior of the Colombian stock market.

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