Colombian Evidence on REIT Performance Against Inflation

Securitization through real estate investment trust funds (REIT) in the Colombian market remain an under researched topic, given their short history regarding data. New sources of information raise new and interesting questions concerning its usage. This study evaluates the available data regarding REIT's, how international studies have approached to its analysis, and if previous findings in other markets reflects also in the Colombian market. Basically, this study analyzes how REIT's behave with inflation, and a priori hypothesis might tell us that inflation and REIT's are cointegrated in the long run, through the channel of rental income contracts, which have a pre-established periodical increase attached to the inflation.

Key Words: REIT's, VECM, Real Estate Investment Trust

INTRODUCTION

The global financial meltdown triggered in 2007 by real estate assets has caused a fresh wave of research into real estate markets, in areas such as: contagion to equity markets, macro prudential policies, the mispricing of assets, adequate portfolio management, and the newly revamped framework concerning the regulatory and the policy decision environments. The main objective of this renewed research is to mitigate moral hazard issues and make explicit the need to investigate and understand all the channels that can affect real estate markets. Several studies on the subject have been extended by Chaney et al (2012), Chen (2001) and Crowe et al (2011).

Some of the most important findings relating to real estate assets are that they are highly correlated with the business cycle, are the most common assets used as collateral to raise funds, and that changes in the price can impact the consumption cycle, given that broader savings of households are used to fund these assets, one of the examples most commonly cited to introduce these facts is the model developed by Iacoviello (2005).

Real Estate Investments Trusts (REIT's), although only are a small part of real estate markets, are also a very representative of them. REIT's were introduced in the United States (US) in 1960 as a mechanism that allows small investors and individuals to allocate capital in real estate assets. Today, the US is the mainstream benchmark for REIT's, with more than 189 listed on the New York Stock Exchange (NYSE), a combined market capitalization of USD986 billion, and a wide variety of investors including pension funds, life insurance companies, and many other types of funds.

REIT's can be divided into those traded in the public markets and those traded in the private markets. The former are differentiated from the latter by the method used to establish the value of the asset. Basically, the price of an REIT traded in the private markets depends on the appraisal value established by an independent engineer who, as per the market conditions (location, availability of public services, land regulation, prices of similar assets, recent transactions in the location, and experience, among others), releases the estimated value of the asset. In contrast, public REIT's use discount rates and risk premiums to establish the net asset value.

Chiang (2009), in analyzing the information processed in both types of markets, concluded that the information processed in public markets is later transferred and used in the real markets to estimate the value of the asset. In addition, Brau & Rodriguez (2011) assessed both the corporate and capital structure of private and public REIT's and examines through the lens of the corporate finance theory the reason for the migration of REIT's from public markets to private one in the last 45 years.

In Colombia, the introduction of REIT's as an asset class is a relatively new occurrence in the capital markets. Law 1242 of 2013 allows the securitization of real estate assets and defines an REIT as a capital investment product in which at least 75% of the investments must be made in real estate assets such as commercial buildings, hotels, warehouses, residential buildings, retail facilities, health facilities and office spaces, among others. Since, 2009 in Colombia, there have been created, according to the available data, 20 private REIT's and one public REIT. Figure 1. shows the evolution, in terms of value (COP$MM), of the Colombian private REIT market since April 2009 which denote that in basic terms this is leading a market appraised at more than COP$1.4bn in real estate assets.

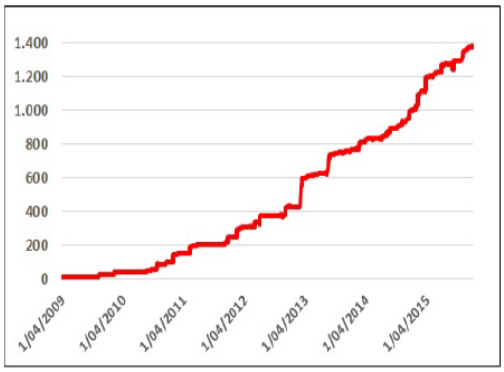

Figure 1: *Value of Colombian REIT Market*
Source: Superintendencia Financiera de Colombia

The purpose of this study is to evaluate Colombian REIT's as an asset class, to form an overview of its behavior according to macroeconomic indicators, to reveal its evolution as a specialized market investment trust, and to determine whether the information contained in its value can serve as a real estate market indicator. This research will provide new insights into this type of asset in Colombia, given that the existing interpretations of its behavior are based on studies performed abroad. The research will contribute to the extant literature by exposing, through formal data and statistical validation, the fact that the Colombian REIT market behaves differently, with great use of macro-economic indicators.

This paper is organized as follows. In section two ("Literature Review"), its analyzed the extent to which the academic discussion about REIT's has been extended into the international markets; there is also an examination of how the real estate literature has evolved in Colombia and a resume of the current focus points. It also features a description of the data to be analyzed, alongside, an index that includes all private REIT's, which provides some useful insights into their statistical properties. The obtained index is analyzed against past market conditions that have affected the real estate market to deliver arguments for it being a reliable indicator of real estate market conditions. Section Three ("Methodology"), contains a description of the methodology used to obtain the results; in short, a Vector Error Correction Model (VECM) is used to address the

dynamics of REIT's using the consumer price index (CPI), allowing the analysis of both long and short-run dynamics; this will be used to evaluate if previous results also holds for the Colombian market. Finally, sections four and five ("Results-Conclusion") are used to present the information obtained and to delineate the important findings for the market and for future studies.

LITERAURE REVIEW

In Colombia investment trust funds can be differentiated by the type of underlying assets that contain the fund; for example, there are: monetary funds (bonds), general funds (mix of bonds, forex, equity, and so on.), REIT funds (real estate assets), stock funds (shares only), and private equity funds (speculative). Hernandez (2013) made an in-depth study of the investment trust funds in the Colombian market and its regulatory environment. REIT's are a special type of investment trust fund in which at least 75% of the underlying investment must be made in real estate assets; in Colombia, only fiduciary companies and stock broker companies are available to create and manage investment trusts, and are regulated by Superintendencia Financiera. Since April 2009, the value of each private REIT has been reported, along with the number of units in the funds, the value of each unit, and the daily return.

Figure 2 shows the generated REIT Private Market Index for Colombia on a daily basis (For further information in the construction of the REIT Index please refer to the Appendix at the end of the present document.). As can be seen the underlying assets of the different types of REIT's have experienced, since April 2009 an appreciation of approximately 65%. In addition, when comparing the evolution of the index with the past market conditions, its suggested that the generated index is a good representation of the overall real estate market. For example, the index underwent a stagnation period between June 2013 and April 2014; this is consistent with the random policy executed by the mayor of the city of Bogotá, which changed the regulatory use of the land country's main city.

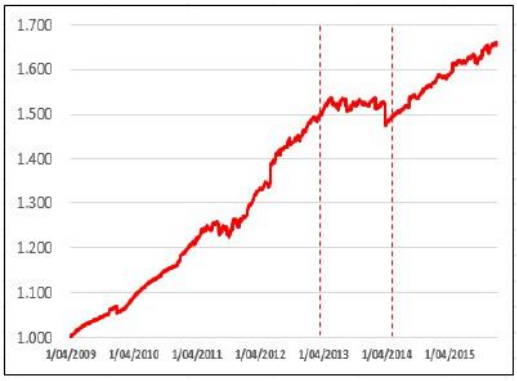

Figure 2: *Private REIT Index*
Source: Author

Lizarazo & Rincón (2015), using a propensity score matching model, and a panel data model with information from the mystery shopper data-base of "Galeria Inmobiliaria", founds evidence disputing the idea that the random changes to the regulatory use of the land positively affect the price of new living properties through a channel of increased direct and indirect costs, and a contraction of the supply of new properties, given the legal gap that was established with the implementation of the new regulation. This material issue was finally resolved by the "Consejo de Estado" in June 2014, when the correct order in which a mayor should develop and change the regulatory use of the land was finally established. As can be seen the lateral channel between May

of 2013 and May of 2014 is consistent with a period of high volatility and uncertainty in real estate markets.

The model to be described in the following sections comprises three main variables: REIT_RETURN, R_CPI_12_M, and R_COLCAP, which describe the returns of the REIT index obtained above, the returns of the CPI, and the returns of the COLCAP. Given that the data from CPI is reported on a monthly basis, our initial data-set of 2,466 daily observations was reduced to 81 monthly observations. In the next section, the study describes the motivation behind the use of each of the variables, taking into account the recent literature review and thoughts on REIT markets.

In Colombia, the analysis of real estate markets is new to the literature, despite the shocks triggered at the end of 1999, when households experienced a huge contraction in the value of real estate properties and suffered the effects of the gradual increases in the interest rate, which resulted in higher loan-to-value multiples, with the ultimate consequence of the devaluation of properties, payment in guarantee from the asset holders, and the stagnation of the construction sector.

Anif (2011) made an extensive study of the Colombian real estate meltdown of 1999, including the variables that triggered the crisis and the effects of the policies implemented at that time. Anif concluded from the former study that the three principal outcomes of the crisis could be defined as: i.) the perpetual creation of the 4x1000 tax; ii.) a wave of legal lawsuits between the householders and banks; and iii.) the stagnation of the construction and financial sector in Colombia.

Prior research into real estate markets has focused on constructing a housing price indices, due to their special importance in the decisions of agents and in the control and management of risks in the part of the authorities, their usage for monitoring and following construction activity, which accounts for almost 7.3% of Colombian gross domestic product (GDP), and the fact that their evolution affects household consumption and the development of the financial system. Castano & Morales (2015) analyzed and described the methodologies by which the various public and private entities (Dane-Banrep-DNP-Camacol-CEDE) calculate housing prices Indices, as well as relating the latter to the housing market for both new properties and old properties. The purpose was to determine the advantages of each index, whether they have the desired properties that the market is following, and whether they properly reflect the situation in the real estate market. Other studies that place emphasis on the analysis and adequate development of a housing price index can be found in Castaño et al (2013) and Escobar et al (2006).

Further studies, such as that conducted by Salazar et al (2013), have deployed a structural Vector Autorregresive Model (VAR) to determine whether the housing prices are misaligned against the fundamentals. Strictly speaking, the aim of such research is to attempt to ascertain whether the observed housing prices are correctly reflecting the changes in the prices of land, the index of construction costs, the Gross Domestic Product (GDP), and the mortgage credit disbursements. The authors focus on the interaction between housing prices and land prices; finding that the assessed housing prices in Colombia are notably influenced by the price of the land; causes that might explain the recent dynamics of housing prices could include: i.) scarcity of land available in the cities to develop housing projects; and ii.) the lack of adequate institutional laws that restrict the type of properties that can be developed in some areas.

Studies conducted abroad have investigated two factors: i.) the decision of REIT managers and investors to go either private or public; and ii.) the relationship between REIT returns and inflation. The first of these analysis has tended to be extrapolated as more of a corporate financial decision in which the benefits of going private outweigh those of being private. For example, Chiang (2009) analyzed the fundamental tenets of REIT returns in public and private markets and, via a factor model, established that information occurs first in the former and then is used by the latter. This study is complemented by the one developed by Brau & Rodriguez (2011), who posited that the advantages and disadvantages of remaining in a public market influence the decision to go private. Basically, the authors determined that the past wave of REIT's that went private were provoked by the disadvantages of being public such as a more regulated environment, agency problems, and the advantages of being private such a higher saving in taxes by the fiscal shield, and a better corporate governance in the REIT.

Additionally, the most interesting finding in the literature is the evidence of a negative relationship between REIT's returns and inflation, by which it can be perceived that there is a securitized asset class as an inflation hedging mechanism. This hypothesis is used to sell REIT's to long term investors who seek portfolios that are able to mitigate losses from high and unexpected volatilities in the changes of the consumer price index; these types of investors include: pension fund managers, insurance companies, or investors who are trying to find portfolios with a low market risk or low beta.

Glascock et al (2002) developed a vector error correction model (VECM) to analyze the relationship between REIT prices, real activity, monetary policy, and inflation, with the aim of determining if previous researches, such as the one conducted by Sirmans (1987), Liu et al (1997), and Gyuourko & Linneman (1988) among others, documented empirical findings of negative relationships between REIT returns and inflation were not spurious. The authors found that the negative relationship is derived from the interaction between monetary policies and inflation. In addition, when they included the effects of changes in monetary policies and industrial production, the negative correlation vanished.

Fisher (1930) theory of interest introduced a key economic concept, which is used to evaluate the perception of income between different periods of time; theoretically there exist a rate of interest connecting every pair of possible dates, which is used to evaluate the preference of an immediate source of income over a future stream of incomes or a specific source of income. The relationship postulated by Fisher is:

(1) $1 + i = (1 + r)(1 + \pi)$

Were i relates the nominal interest rate, to the rate of inflation π and the real interest rate (interest rate after adjustment for inflation). Note from the above equation that:

(2) $1 + i = 1 + r + \pi + \pi r$

(3) $i = r + \pi(1 + r)$

Note that the cost of living affects the interest rate and nominally it incorporates the change in prices. Basically, when prices rise the interest rate rise, but not enough to compensate for the change in prices. Note that the former theory establish a symmetrical relationship between the changes of prices and the interest rate.

This theory has been contrasted against the data, whereby some findings have documented reverse relationships of asset returns and inflation. Fama (1983) argued that the negative relationships are associated with an asymmetrical relation between inflation and the real activity, which in turn is explained by a combination of money, demand theory, and quantity theory of money, formerly referred to the literature as a proxy effect hypothesis.

METHODOLOGY

Data Preview

In Table1 the summary statistics of the rates of change of the main variables are described. The study uses, respectively, the names REIT, CPI, and COLCAP to denote the rate of change of each of the variables. Our variable of interest REIT, relates to a maximum return of 3.4% and a minimum return of 1.8%, with an average return in the order of 0.7%.

Table 1: *Summary Statistics of the return of the variables*

Variable	Mean	Standard Deviation	Minimum	Maximum
REIT	0.0069	0.007	-0.018	0.034
CPI	0.031	1.086	0.017	0.067
COLCAP	0.0039	0.0394	-0.079	0.117

Source: Author

The correlation matrix for the data, displayed in Table2, shows the positive correlation between COLCAP and the REIT index, which is consistent with the fact that 25% of the underlying investments in the REIT can be traded in liquid positions such as stocks. Then, we can expect a positive dependence of REIT's with the Colombian stock market index COLCAP. In addition, note the positive index relating the correlation between REIT returns and CPI, which gives some prior insight into the association between the main variables of interest, and as opposed to the findings in international markets, the correlation index between these variables is positive and, whether it is causal or not, this result is not consistent with the inflation hedge hypothesis observed in studies conducted abroad.

Table 2: *Correlation Matrix*

	REIT	CPI	COLCAP
REIT	1	0.041	0.033
CPI	0.041	1	-0.145
COLCAP	0.033	-0.145	1

Source: Author

Unit Root and Cointegration Tests

To address the times series analysis correctly, a unit root test is performed in each variable with an augmented Dickey & Fuller test, which can establish correctly if each variable is a stationary process and the type of methodology that must be implemented to address long term relationships among variables. We use the graphic of each variable to identify if the evolution of the variable in time has drifts or recognized trends, to properly establish the equation in the test. The following equation is estimated for the variables REIT, and CPI:

(4) $\Delta y_t = \gamma y_{t-1} + e_t$

And for the R_COLCAP we identify a long term downward trend in the returns, so a drift term (α_0) is included in the specified equation to address correctly the evolution of the data:

(5) $\Delta y_t = \alpha_0 + \gamma y_{t-1} + e_t$

Table 3 describes the Augmented Dickey & Fuller test for the variables. The null hypothesis of the Augmented Dickey & Fuller test under the absence of a drift term establish $\gamma = 0$, in other words, that there exist in the time series analyzed a unit root (nonstationary). In the case in which is specified a drift term the test equation, two simultaneously hypotheses are tested. i.) $\gamma = 0$ and as before test a unit root, and ii.) $\gamma = \alpha = 0$ which is a combined null hypotheses, testing the drift term and the unit root.

Table 3: *ADF test for the Variables.*

Variable	ADF (t)[a]	P-Value	1Pct[a]	5Pct[a]	10Pct[a]
REIT	-2.7774	0.006**	-2.6	-1.95	-1.61
CPI	0.693	0.49	-2.6	-1.95	-1.61
COLCAP (γ =0)	-4.844	0.00002***	-3.51	-2.89	-2.58
COLCAP (γ=α =0)	10.2783	0.99	6.7	4.71	3.86

In the statistics shown in Table 3, are described mixed result among the variables. As can be shown our main variable of interest (REIT) is stationary under the Augmented Dickey & Fuller test, in which the null hypothesis of at least one unit roots is rejected. Furthermore, note that the variable CPI fails to reject the null hypothesis of non-stationarity confirming almost one unit root in the equation. For the COLCAP variable when the combined hypothesis is tested its failing to reject he null hypothesis of $\gamma = \alpha = 0$ presuming that at least one of this hypothesis is true.

Given the mixed results obtained from the Dickey & Fuller test, to address long term economic relationships among the variables is needed to include an additional test.

A cointegration test is implemented under the Johansen methodology (Johansen (1988)), the trace test is used instead of the maximum eigenvalue test, given that for every null hypothesis of almost one cointegration vector it can be analyzed exactly in which significance level the test start to reject the null hypothesis. This study evaluates one type of relationship among the variables which is described by the following VAR process:

(6) $x_t = \Sigma A_i x_{t-1} + u_t$

Where $x_t = (REIT_t, CPI_t, COLCAP_t)$ is a matrix with the variables stated before. The aim to analyze if there exists a long term equilibrium among this relationship arise from the idea that there might be a channel in which the REIT value incorporates the information contained in the CPI periodically until an equilibrium is reached.

Table 4: *Johansen Cointegration Test*

Variables	H_0: Cointegrating Vectors	Trace	10Pct	5Pct	1Pct
REIT, CPI, COLCAP	0	47.11	28.71	31.52	37.22
	1	11.99	15.66	17.95	23.52
	2	4.04	6.50	8.18	11.65

Source: Author

The results shown in Table 4. Are used to check how many cointegration vectors exist among the variables specified to test long run relationships. A closer look to Table 4 shows that for the specified equation exist at least one cointegrating vector. Under the Johansen test performed below the formal test of the null hypothesis denotes if there exists one cointegration vector, or at least $n-1$ cointegrating vectors, where n is the number of variables used to describe each equation. Notice that in our main equation of interest denoted by the variables $x_t = (REIT_t, CPI_t, COLCAP_t)$, in the trace test for at least one cointegrating vector the null hypothesis of 0 cointegrating vectors is rejected at all significance levels, which in turn is telling us that among the variables specified exist at least one long run relationship.

VECM

Given that the approach for a model in which a cointegration relationship has been founded is different from a traditional VAR, the following vector error correction model (VECM) is used to test how the variables among the model behave in the long run and in the short run. The process introduced by Engle & Granger (1987) are used to analyze the relationship. Start assuming two variables y_{1t}, and y_{2t}, which are in equilibrium such that:

(7) $y_{1t} = \beta_1 y_{2t}$

Where β_1 is a parameter that allows the variables being in equilibrium, moreover suppose that the changes in y1t depend from the deviations of the equilibrium in $t-1$, such that the change in y_{1t}, was explained from the deviations from the equilibrium in the past period, plus a random noise term u_t:

(8) $\Delta y_{1t} = \alpha_1\left(y_{1,t-1} - \beta_1 y_{2,t-1}\right) + u_{1t}$
(9) $\Delta y_{2t} = \alpha_2\left(y_{1,t-1} - \beta_1 y_{2,t-1}\right) + u_{2t}$

In a VEC model the changes in y_t could also depend upon the past changes of the variables, this methodology allows to introduce the short run dynamics of the variables, and approximate the analysis with stationary effects among the variables. Following the stated before the two equations can be rewritten as follows:

(10) $\Delta y_{1t} = \alpha_1\left(y_{1,t-1} - \beta_1 y_{2,t-1}\right) + \gamma_{11,1}\Delta y_{1,t-1} + \gamma_{12,1}\Delta y_{2,t-1} + u_{1t}$
(11) $\Delta y_{2t} = \alpha_2\left(y_{1,t-1} - \beta_1 y_{2,t-1}\right) + \gamma_{21,1}\Delta y_{1,t-1} + \gamma_{22,1}\Delta y_{2,t-1} + u_{2t}$

In a matrix notation the model described by the equations (7) and (8), can be rewrite as:

(12) $\Delta y_t = \alpha\beta' y_{t-1} + \Gamma(y_{t-1} - y_{t-2}) + u_t$
(13) $y_t - y_{t-1} = \alpha\beta' y_{t-1} + \Gamma(y_{t-1} - y_{t-2}) + u_t$

Where:

(14) $y_t := (y_{1t}, y_{2t})'$

(15) $u_t := (u_{1t}, u_{2t})'$

(16) $\alpha = \begin{matrix} \alpha_1 \\ \alpha_2 \end{matrix}$

(17) $\beta' := (1, -\beta_1)'$

(18) $\Gamma = \begin{bmatrix} \gamma_{11,1} & \gamma_{12,1} \\ \gamma_{21,1} & \gamma_{22,1} \end{bmatrix}$

The matrix β is called the cointegration matrix, when the rank of the matrix is positive it states how many linearly independent rows are found, thus the determination of the rank give us how many cointegration relationships embodies the model. The matrix α is called the loading matrix which generates the error correction term in the VEC model and thus the equilibrium of the model.

α and β matrixes embodies the matrix π, which is the term in the VEC equation that describes according to its statistical validation if there exists and holds a relationship between the variables in the model. This term relates how the long run relationship in the model hold, by relating the speed of adjustment from one period to another when the variables are out of the equilibrium.

RESULTS

The model is estimated using a VECM model in which the order of the process is determined by the implementation of the Akaike criteria (AIC). The initial examination concentrates in the coefficient relating the error correction term, a posterior approach analyzes the significance of the CPI index which allows us to study if the relationship between REIT's and inflation in turn is asymmetrical, or symmetrical. The first aim is to establish if a long run relationship holds among the variables and which is the effect of inflation over the real estate investment trusts. The estimation incorporates the REIT, CPI and the COLCAP indexes.

Table 5 estimate a VECM among the three variables REIT, CPI, and COLCAP. The results show that an error correction term exists for these variables. Moreover the π coefficient, which in turn relates the error correction term is negative and significant at the 1 percent level which indicates that when a disequilibrium among the three variables takes places in the previous period, the REIT index will adjust in the posterior period by the incorporation of the CPI and COLCAP data. Thus, the CPI and COLCAP series play a role of convergence to a long term stable equilibrium among the variables, this means that for this system of variables there exist statistical evidence against a long-term adjustment mechanism in which the matrix π controls the cointegration characters. But turning back to the error correction term it relates a speed of adjustment of 97% to the equilibrium. Then the REIT index is adjusted by 97% of the past month deviation from equilibrium, between CPI and COLCAP variables.

Table 5: *Model 1: REIT,CPI and Colcap*

Lagged Variables and Error Correction Term	REIT	CPI	Variables COLCAP
Intercept	-0.0071*** (0.0007)	-0.0001 (0.7777)	0.0103 (0.2687)
Π	-0.9762*** (0.0003)	-0.0815 (0.3277)	1.8285 (0.1235)
$REIT_{t-1}$	-1.0019*** (0.0000)	-0.0827 (0.0908)	-0.0771 (0.9095)
$REIT_{t-2}$	-0.9247*** (0.0000)	-0.1503 (0.8255)	-0.5470 (0.5707)
$REIT_{t-3}$	-0.8649*** (0.0005)	-0.8599 (0.2654)	1.2445 (0.2541)
$REIT_{t-4}$	-0.9166*** (0.0009)	-0.0580 (0.4989)	0.7253 (0.5494)
$REIT_{t-5}$	-0.7875** (0.0046)	-0.0629 (0.4736)	2.1048 (0.0945)
$REIT_{t-6}$	-0.9566*** (0.0008)	-0.0999 (0.2641)	1.6110 (0.2012)
$REIT_{t-7}$	-1.0476*** (0.0004)	-0.08214 (0.3751)	0.9295 (0.4767)
$REIT_{t-8}$	-1.1299*** (0.0002)	-0.0526 (0.5770)	1.7489 (0.1932)
$REIT_{t-9}$	-1.2180*** (0.0000)	-0.0211 (0.8220)	0.6549 (0.6218)
CPI_{t-1}	-0.4270 (0.3755)	0.0493** (0.0031)	-4.5306** (0.0480)
CPI_{t-2}	0.6666 (0.2487)	-0.0150 (0.4296)	4.2020 (0.1217)
CPI_{t-3}	-0.5972 (0.2906)	0.0164 (0.9291)	1.1962 (0.6483)
CPI_{t-4}	1.5236** (0.006)	0.01272 (0.9429)	0.4026 (0.8726)
CPI_{t-5}	0.1020 (0.8520)	-0.04601 (0.7991)	-0.0421 (0.9868)
CPI_{t-6}	0.6299 (0.2386)	0.01989 (0.9095)	0.1910 (0.9384)
CPI_{t-7}	0.0640 (0.9037)	0.02387 (0.1772)	-1.4344 (0.5625)
CPI_{t-8}	0.0947 (0.8614)	0.03193 (0.8585)	-2.2661 (0.3729)
CPI_{t-9}	0.7949 (0.1044)	0.2215 (0.1684)	-2.6729 (0.2384)
$COLCAP_{t-1}$	0.0270 (0.3944)	0.00973 (0.3548)	-0.3922* (0.0107)
$COLCAP_{t-2}$	0.6666 (0.2487)	0.0040 (0.7212)	-0.5838*** (0.0006)
$COLCAP_{t-3}$	0.1034** (0.0074)	0.0000 (0.999)	-0.3686* (0.0375)
$COLCAP_{t-4}$	0.1274** (0.0029)	0.00597 (0.6560)	-0.7726*** (0.0001)
$COLCAP_{t-5}$	0.2087*** (0.0001)	0.00718 (0.6684)	-0.4824* (0.0467)
$COLCAP_{t-6}$	0.2099*** (0.0003)	0.01313 (0.4682)	-0.4501 (0.0829)
$COLCAP_{t-7}$	0.2060** (0.0018)	0.0238 (0.2495)	-0.5828 (0.0501)
$COLCAP_{t-8}$	0.2178** (0.0025)	0.0293 (0.1986)	-0.5032 (0.1204)
$COLCAP_{t-9}$	0.2853** (0.002)	0.02441 (0.2975)	-0.6689* (0.0471)

Furthermore, note that for the CPI and COLCAP variables the error correction model coefficient is not significant at any percentage level, so it means that the REIT index do not play a role of convergence to a long term stable equilibrium among the variables in which the changes of CPI and COLCAP are mean to be studied. Given that the purpose of this study focus on the relationship of the changes of the REIT index given the past changes of the CPI, REIT, COLCAP, and an error correction coefficient, the main object of study will be the equation that relates the REIT changes.

$$(19)\quad \Delta REIT_t = \underset{0.0007}{\overset{-0.007}{}}\alpha + \underset{0.0003}{\overset{-0.9762}{}}\pi + \underset{0.000}{\overset{-1.001}{}}REIT_{t-1} + \underset{0.3755}{\overset{-0.427}{}}CPI_{t-1} + \underset{0.394}{\overset{0.027}{}}COLCAP_{t-1} + \underset{0.000}{\overset{-0.924}{}}REIT_{t-2} + \underset{0.248}{\overset{0.666}{}}CPI_{t-2} + \underset{0.248}{\overset{0.666}{}}COLCAP_{t-2} + \underset{0.0005}{\overset{-0.864}{}}REIT_{t-3} + \underset{0.29}{\overset{-0.59}{}}CPI_{t-3} + \underset{0.007}{\overset{0.103}{}}COLCAP_{t-3} + \underset{0.0009}{\overset{-0.916}{}}REIT_{t-4} + \underset{0.006}{\overset{1.5236}{}}CPI_{t-4} + \underset{0.002}{\overset{0.127}{}}COLCAP_{t-4} + \cdots + u_{REIT}$$

The equation stated before confirms that in the long run the CPI index, and the COLCAP index play a significant role in the determination of the REIT index, connecting the changes in prices and the changes in the main stock market index with the real estate investment index, implying a channel between the indicators, which may act from the price index to REIT index by the rental income contracts channel. This channel acts by the existence of a pre-established contract between

the REIT's managers and the tenants of the underlying properties that generates value for the investment trust, such contract usually have a covenant that states a periodical increase of the rentals which is attached to the change of the CPI of the last 12 months. Furthermore, not every underlying property of the REIT is generating rents in a periodical basis, given that there exists a vacancy rate and some properties are passing through a new rental process, and such new rental contract will incorporate the latest CPI new.

In Equation 11 there is also presented the short run parameters of the REIT equation. It relates the CPI variable with a positive term and significant at the 5 percent level lagged at four periods, relating a stationary relationship on a quarterly basis (given the absence of significance of the CPI variable at other lagged values). The behavior presented in the short run between REIT's and CPI can be an effect of periodical appraisal of the underlying properties of REIT's. Prearranged appraisals are made on a periodical basis to confirm the estimated market value of the assets, thus not every month the value of the property is incorporating the information of the change in prices, only when an appraisal is made by an independent engineer.

Furthermore, note that the short run relationship between REIT and CPI is positive. Meaning that changes in the CPI index in last quarter affect positively the REIT index in the present period. This finding breaks the hypothesis that REIT's are hedging assets against inflation in the Colombian market. The first approach to this result might tell us that this result is a confirmation that the Colombian market not usually behaves as international markets for many reasons (institutional, financial market sophistication, legal burdens, etc.), and such this is another argument for why international studies don't have to be incorporated as established parameters.

Moreover, this result can be the effect of the fact that we are only dealing with information regarding private REIT's, so behavioral bias formed in the public market is not affecting the data. In a broader sense the data presented have an absence of animal spirits, financial manipulation, and crow investor behaviors. Additionally, the data presented is formed by the appraisals made on a periodical basis, and it's not influenced by third party appraisals made by REIT investors.

CONCLUSIONS

The present study extends prior literature in Colombia by the incorporation of a data set that treats private Real Estate Investment Trust. This special vehicle is supposed to have certain behavior due to previous findings, and contrary to prior results documented in the international literature using a constructed REIT index it's find that the believing of an asymmetrical relationship between REIT 's and inflation does not hold for the Colombian market.

This symmetrical behavior may be presented by the absence of behavioral bias that investors cause, given that the data generating process is made in a private market. Furthermore, periodical independent appraisals made by REIT managers can influence this positive relationship, and more importantly a long run relationship relating an equilibrium between the variables is founded which is explained by the rental income contracts channel. Given previous results, posterior studies can focus in the treatment of public and private data for further analysis, moreover additional statistical techniques such a granger causality procedure with the incorporation of additional macroeconomic variables can be induced to analyze the available data.

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APENDIX

Since April 2009, twenty REIT's have been created by fiduciary societies and stock broker companies according to the information gathered by Superintendencia Financiera de Colombia, the former entity reports daily the value and number of units of each REIT. Given the above, the value of the REIT index will be the summation of the price of each REIT (value of the REIT divided into number of units), divided by a pre-determined fraction (γ) which, normalizes the index in the first date (April 2009) to 1000.

$$REIT\ INDEX_t = \frac{\sum_{i=1}^{n} \frac{EMV_t^i}{n_t^i}}{\gamma} \quad (20)$$

Where EMV_t^i states for the estimated market value of REIT, n_i relates the number of units in the REIT, and γ is an objective number (established by iteration) to set the initial value of the index in 1000.

Note from the above construction that each asset has the same weight; the equally weighted construction derives from the fact that given that the value of each REIT is computed by appraisals made by independent engineers the equally weighted index mitigates overvalued appraisals.

Given the nature of the analyzed REIT's dataset (private and special purpose vehicles) they are created randomly in time and liquidated according to the specifications of each contract, so the former index is rebalanced each time a new REIT is created, and each time a REIT is liquidated.

As such, assume (as an example to show how the index is computed), that there are two time periods t, and t+1; and that in the period t+1 one new REIT was created, so to incorporate the new REIT in the index we first compute the REIT index in t:

$$REIT\ INDEX_t = \frac{EMV_t^1}{\frac{n_t^1}{\gamma}} \tag{21}$$

Given that in t + 1 another REIT is going to enter in the computing of the index, by construction:

$$REIT\ INDEX_t = \frac{\frac{EMV_{t+1}^1}{n_{t+1}^1} + \frac{EMV_{t+1}^2}{n_{t+1}^2}}{\gamma'} \tag{22}$$

As can be shown the parameter γ serves as the rebalancing factor when a REIT is included or excluded from the index; and the computing of γ' is as follows:

$$\gamma' = \frac{\frac{EMV_{t+1}^1}{n_{t+1}^1} + \frac{EMV_{t+1}^2}{n_{t+1}^2}}{REIT\ INDEX_{t+1}'} \tag{23}$$

Where $REIT\ INDEX_{t+1}'$ is:

$$REIT\ INDEX_{t+1}' = \frac{\frac{EMV_{t+1}^1}{n_{t+1}^1}}{\gamma} \tag{24}$$

As can be seen the parameter γ will change every time the index is rebalanced, furthermore the idea behind the construction of the rebalancing is to maintain the movement of the former REIT in t + 1, given that the new REIT that is going to be included in t + 1 have not created value to the index; so until t + 3 the new REIT is going to create o destruct value to the index under the construction of a new γ.