Colombian Evidence on REIT Performance Against Inflation

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Abstract

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

I. 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).

Real estate assets are characterized as being intensive in capital and often reveal higher debt multiples in their balance sheets when compared to other types of assets. Broadly speaking, they are funded by a mix of debt and equity, which varies according to the market in which the asset is being securitized. For example, in the public markets, the usual scenario is that bonds, mortgage-backed securities (MBS), and monetary instruments are used to fund real estate assets from the debt perspective; while in the private markets, bank loans, and venture are the most common

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instruments to finance such assets. Similarly, this occurs from the equity standpoint. In public markets, stock and mutual funds are the common vehicles for raising equity from investors, but in the private markets, private equity and real property are more common.

Ultimately, the type of vehicle is immaterial, as is the type of market used to raise funds; the claim over the capital will always be the same. Equity will be subordinated to the repayment of the debt, but the debt has finite claiming's until the liability is repaid; meanwhile, the equity has perpetual claiming's over the asset and the equity owners exerts a greater amount of control over the asset.

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 USD [1]986 billion[2], 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[3] 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.

As can be inferred, public markets benefit from broader access to capital streams, are more quick to discount the information on the price of the asset, and enjoy wider streams of liquidity channels. That said, it is in the private markets that transactions are processed and the major agreements take place. 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.

[1]United States Dolar

[2]Per the National Association of Real Estate Investment Trusts (NAREIT)

[3]Accepted international reference to describe the services provided by an egineer in the fields of: i.)Construction monitoring, ii.) Drawdown reports, iii.) Projects final inspection, completion review, and iv.) Asset appraisals among other tasks.

In Colombia, the introduction of REIT's as an asset class is a relatively new occurrence in the capital markets. Law 1877 of 2004 allows the securitization of real estate assets and defines an REIT as a capital investment product in which at least 60% 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. In addition, law 1242 of 2013 modifies the percentage of minimum investment to be made in real estate assets from 60% to 75%; the remaining percentage (25%) can be invested in liquid assets such as bonds, equity, forex, or long term deposits [4]. Since, 2004 when the official institutional frame that allows the creation of REIT's 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[5]$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[6] in real estate assets.

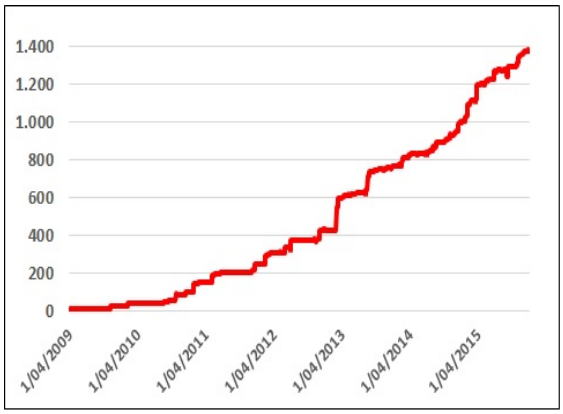

Figure 1: *Value of Colombian REIT Market*
Source: Superintendencia Financiera de Colombia

The purpose of this study is to evaluate Colombian REIT's as an asset class, to form an overview of its behavior according to macro-economic 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. Such situation could be inferred from the past relationship between the dynamics of housing prices in Colombia and inflation, and how the market value of the underlying assets of REIT's is being formed.

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"),

[4] In addition REIT's created abroad are required to pay minimum 90% of their taxable earnings as dividends Chan et al (2003)

[5] Colombian Peso

[6] Billion

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)[7], 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 stuides.

II. Literature 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[8] 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.

This study aggregates the value and number of units contained in each private REIT between April 2009 and December 2015[9]; although data were obtained on a daily basis (intial 2,466 observations), given that the CPI, is released in a monthly basis, in the study the available data for REIT's was reduced to 81 observations. As of today, there is no available a market index for REIT's; therefore, the research pooled the available data and organized it historically. A portfolio index was created in which for the first available date, the index is normalized to 1000, and based on the evolution of the value of each private REIT over time, the index reflects the return of the asset class. The idea behind the index is to show how, under the assumption that an investor allocates $1 proportionally under each available private REIT, the investment will evolve within time. (For further information in the construction of the REIT Index please refer to the Appendix at the end of the present document.)

Figure 2 shows the generated REIT Private Market Index for Colombia on a daily basis. 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

[7] Source:"Departamento Nacional de Estadisica (DANE)"

[8] Fiduciary Companies: Financial service companies in charge of celebrating contracts which main subjects can contain: i.) Investment management, ii.) Asset management, ii.) security and mortgage management, among others. Fiduciary companies can also issue private bonds, deliver financial consultancy services and issue and manage investment trust funds. In Colombia Fiduciary Companies are monitored and regulated by "Superintendencia Financiera de Colombia ".

[9] 20 REIT's have been created in the former period.

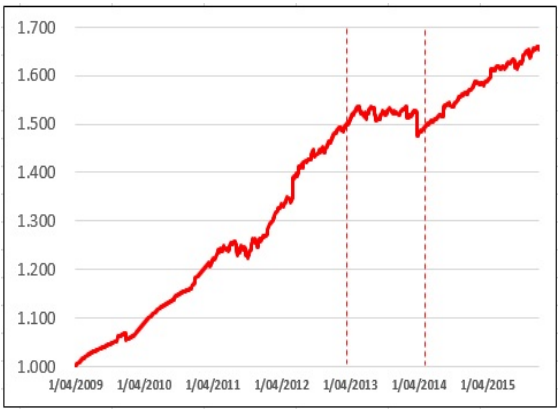

Figure 2: *Private REIT Index*
Source: Author

random policy executed by the mayor of the city of Bogotá, which changed the regulatory use of the land country's main city.

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. Basically, the idea underpinning the stagnation of the index is based on the fact that if the mayor of the main city can derogate and change the use of the land, with adverse impacts on construction projects (more costs, legal gaps, uncertainty, and so on.), almost every mayor of every city in the country could change his own regulatory framework for the development of real estate projects. 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, as triggered by the legal gap established in the city of Bogotá.

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 [10]. 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)[11] 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

[10] Leading stock market indicator for Colombia Stock Exchange; Source: "Bolsa de Valores de Colombia "(BVC)
[11] Asociación Nacional de Instituciones Financieras

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)[12] 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; ii.) the lack of adequate institutional laws that restrict the type of properties that can be developed in some areas; and iii.) the absence of policies for reducing the housing deficit.

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

[12] Banrep calculate the housing price indices based upon the methodology of repeated sales in the existing housing market based in Case & Shiller (1989), CEDE-DNP-Camacol Bogotá constructs another index based upon the stratification methodology, and DANE calculates a housing price index based upon the index methodology.

the advantages of being private such a higher saving in taxes by the fiscal shield [13], 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. Hong & Soo (2011), meanwhile analyzed the asymmetrical relationship from a theoretical perspective, arguing that the change observed is a direct effect of the inflation illusion hypothesis proposed by Modigliani & Cohn (1979), which stated that stock market investors cannot understand the effect of inflation over nominal dividend growth rates, and that this implies that stock prices are undervalued when inflation is high, and overvalued when inflation is low. The authors identied mispricing in REIT markets using linear valuation models, finding evidence of the inflation illusion hypothesis for lineal models.

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. Thus, the rate of interest is a choice of spending and investing, and deciding over how to receive sources of income, this theory replaces the existing believe that the cost of capital (interest) derives from the interaction of supply and demand as previous theories stated, rather the theory of interest revamp the idea that capital is the conversion of future expected income into present cash value. Following the fact that incomes can be indexed to almost every asset (gold, or apples and corn as Fisher indexed the examples in 1930), or commonly a money standard; money plays an important part in determining the rate of interest. The relationship postulated by Fisher is:

$$1 + i = (1 + r)(1 + \Pi) \tag{1}$$

[13] The decision to go private requires to raise financial debt to acquire the equity issued in the market, which will raise the fiscal shield of the REIT. Furthermore, the higher payments of the debt increase the corporate governance of the REIT given the alignment of the administrative incentives

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:

$$1 + i = 1 + r + \Pi + r\Pi \tag{2}$$

$$i = r + \Pi(1 + r) \tag{3}$$

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 symetrical 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, including the returns of REIT assets and inflation. Several studies have been performed to identify the reasons behind this abnormal relationship. 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. In essence, Fama (1983) contended that asset returns are determined by forecasts of real variables, and that the negative relation observed is induced by a negative relation between real variables that affect asset prices and inflation. The proxy hypothesis states that a real activity indicator, such as capital expenditures, dominates the inflation effect when both variables are explanatory in the rate return of assets.

In addition, recently Brandt & Wang (2003), in opposition to the behavioral models such as that developed by Modigliani & Cohn (1979), or the rational models developed by Fama (1983), formulated a pricing model based on consumption, wherein the risk aversion varies over time to characterize the observed correlation between unexpected inflation and asset prices. The authors suggested through a reduced model (representative agent with a risk aversion utility function), that risk aversion varies according to the news about inflation, and that the economy is constituted by averse agents and risk-loving agents, who hold different amounts of wealth in nominal and real assets, depending on their risk aversion. Basically, when an inflation shock occurs the wealth is redistributed and asset returns are eroded.

In simple terms, the theory review tells us that the negative relationship between inflation and asset prices tends to occur more frequently in industries that are tied, to market cycles, wherein future cash flows depend to a greater extent on real variables and have a relatively low tendency to occur in markets with stable cash flows, which are more independent of the market cycle and in which future cash flows rely less on real variables. Even given that, it is worth noting that the construction cluster is highly attached to the market cycle and depends on variables such as home consumption, industrial activity, and disposable income; in other words, variables that strongly influence the economic cycle. Finally, the proxy hypothesis is widely quoted in the literature and the idea that inflation

may worsen future economic conditions is consistently invoked to explain why real returns are negative when inflation is positive.

Finally, Brunnermeier & Julliard (2006) documented how changes in prices impact the housing market by suggesting that the mispricing in said market is a direct effect of money illusion. Basically, the author argued that an investor when is deciding to buy or rent a home, usually compares the price of rent with the monthly mortgage fee. In their analysis, they supposed that real and nominal interest rates move together; therefore, they attributed a decrease in inflation to a reduction in real interest rates, and consequently a fall in future mortgage rates, which trigger bull investors in the housing market and an upward tendency in prices.

III. Methodology

i. 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%. The data, as has been stated is organized by months, given the restriction imposed by the variables related to the CPI, which is released to the market on a monthly basis. This study, then, relates 81 observations of each variable, which are sufficient to run the VEC model.

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 [14] 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.

ii. 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,:

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

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:

[14] Most followed and common market index for the stock exchange in the Colombian market, it reflects the variation of the price of the 20 most liquid stocks, where the capitalization rate of each stock determines the weight in the index.

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

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

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

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.

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.

These results are consistent with the type of variables that the study is dealing, as can be inferred the REIT index behaves like a financial asset in which the data generating process is similar to a random walk sequence. Even that note that REIT's are not traded in a public market, and the conditions under which the asset is appraised are different from the valuation of financial assets, meanwhile note that REIT variable tends to revert the long-term values. 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. In a previous hypothesis, it can be inferred that there exists a long-term equilibrium between the returns of REIT's and the inflation, by the channel of rental income contracts, in which periodically by negotiation between the managers of the REIT and the tenants of the properties an increase

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

The statistics of the Dickey & Fuller test do not follow a standar t-distribution, so t-test have to be computed using monte carlo techinques.
Source: Author

in the rental income is stipulated. Other channels can have an impact in the long run relationship such as the periodical appraisals made by an independent engineer which should incorporate the increase in prices in the estimated value of the property.

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:

$$x_t = \sum A_i x_{t-1} + u_t \tag{6}$$

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.

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, or in a different way to look the data, that there exist an equilibrium between the variables.

iii. 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

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

(1987) are used to analyze the relationship. Start assuming two variables Y_{1t}, and Y_{2t}, which are in equilibrium such that:

$$y_{1t} = \beta_1 y_{2t} \tag{7}$$

Where β_1 is a parameter that allows the variables being in equilibrium, moreover suppose that the changes in y_{1t} 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[15] :

$$\Delta y_{1t} = \alpha_1(y_{1,t-1} - \beta_1 y_{2,t-1}) + u_{1t} \tag{8}$$

$$\Delta y_{2t} = \alpha_2(y_{1,t-1} - \beta_1 y_{2,t-1}) + u_{2t} \tag{9}$$

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:

$$\Delta y_{1t} = \alpha_1(y_{1,t-1} - \beta_1 y_{2,t-1}) + \gamma_{11,1}\Delta y_{1,t-1} + \gamma_{12,1}\Delta y_{2,t-1} u_{1t} \tag{10}$$

$$\Delta y_{2t} = \alpha_2(y_{1,t-1} - \beta_1 y_{2,t-1}) + \gamma_{21,1}\Delta y_{1,t-1} + \gamma_{22,1}\Delta y_{2,t-1} u_{2t} \tag{11}$$

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

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

Or:

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

Where:

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

[15]This relationship holds also for y_{2t}

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

$$\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} \tag{16}$$

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

and:

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

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 cointegration matrix is useful to construct the Johansen test developed above which lead us to the exact number of vectors that allows several no stationary series to be stationary in the long run. 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[16], 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. Basically, the term not only tells us how strong is the equilibrium in terms of statistical significance, it also tells us how strong the relationship among the variables is by showing us the speed of adjustment.

[16] $\alpha\beta' = \Pi$

IV. 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: *Model 1: REIT,CPI and Colcap*

.	.	.	Variables
Lagged Variables and Error Correction Term	REIT	CPI	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)

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. The measure of the variable is high and the statistical evidence confirms the stability of the system, where we can conclude an equilibrium between the variables, and a highly significant adjustment.

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.

$$\begin{aligned}\Delta REIT_t = & \underset{0.0007}{-0.0071}\alpha + \underset{0.0003}{-0.9762}\Pi + \underset{0.000}{-1.001}REIT_{t-1} + \underset{0.3755}{-0.427}CPI_{t-1} + \underset{0.394}{0.027}COLCAP_{t-1} + \\ & \underset{0.000}{-0.924}REIT_{t-2} + \underset{0.248}{0.666}CPI_{t-2} + \underset{0.248}{0.666}COLCAP_{t-2} + \underset{0.0005}{-0.864}REIT_{t-3} + \underset{0.29}{-0.59}CPI_{t-3} + \\ & \underset{0.007}{0.103}COLCAP_{t-3} + \underset{0.0009}{-0.916}REIT_{t-4} + \underset{0.006}{1.5236}CPI_{t-4} + \underset{0.002}{0.127}COLCAP_{t-4} + \cdots + u_{REIT_t}\end{aligned} \tag{19}$$

The equation stated before confirm 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 [17]. 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 with a new tenant, and

[17] Bigger contracts can be reviewed in a more often periodical basis.

such new rental contract will incorporate the latest CPI new. This periodical covenant which can be found in almost every rental contract, and this turnover of properties that are vacant may act as the channel in which the variables reach a long-term equilibrium.

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. We don't have information on how often the REIT managers establish the periodical reviews and appraisal by independent engineers, given that actual laws, neither establish how often periodical reviews should be made, but per the data quarterly reviews are a good approximation of how often appraisals are made given that in each quarter economic conditions change sufficient to affect real estate prices.

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. Note that in the international markets given the measure, and amount of the investments, additionally appraisals are made not by order of the REIT manager, but furthermore by order of specific investors, such appraisals can interfere in the data generating process, giving an asymmetrical relationship as the one presented by the existing literature.

V. 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.

Appendices

1. REIT Index Construction

The REIT index is an equally weighted market index which indicates the evolution of the REIT market in function of all the assets [18]. The index main objective is to capture all the characteristics and movements from the assets that compose the index and it is also a measure of the return of all the assets during a specific period.

The main appliances of the index to be specified are: i.) Identification and perception against the behavior of real estate assets, ii.) Portfolio management through a performance approximation of the real estate market, iv.) Efficient market management.

Construction.

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 [19], 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.

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

Where EMV_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 each asset (office, residential unit, hotel, and others) that include each REIT provides information about the performance of the real estate market, and given that the value of each REIT is computed by appraisals made by independent engineers the equally weighted index mitigates overvalued appraisals (as opposite from market capitalization indexes which are affected by overvalued assets).

Given the nature of the analyzed REIT's dataset (private and special purpose vehicles) they are created randomly in time and liqui-

[18] As opposite from traditional market indexes (market capitalization, liquidity or mixed)

[19] Governmental public entity in charge of monitoring the financial system

dated according to the specifications of each contract [20], 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:

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

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

$$REIT\ INDEX_{t+1} = \frac{\frac{EMV_{t+1}^1}{n_{t+1}^1} + \frac{EMV_{t+1}^2}{n_{t+1}^2}}{\gamma\prime} \tag{22}$$

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 $\gamma\prime$ is as follows:

$$\gamma\prime = \frac{\frac{EMV_{t+1}^1}{n_{t+1}^1} + \frac{EMV_{t+1}^2}{n_{t+1}^2}}{REIT\ INDEX_{t+1}\prime} \tag{23}$$

Where $REIT\ INDEX_{t+1}\prime$ is:

$$REIT\ INDEX_{t+1}\prime = \frac{\frac{EMV_{t+1}^1}{n_{t+1}^1}}{\gamma} \tag{24}$$

[20] REIT's are created by contracts that estipulate: i.) Minimum investment, ii.)Term, iii.)Selling conditions, iv.) Monitoring, v.)Asset valuation (appraisal by an Independent Engineer) and, vi.)Fiduciary or stock broker commission.

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 mantain 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 (under the former example: $\gamma\prime$).

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