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Positive Asymmetric Information in Volatile Environments: The Black Market Dollar and Sovereign Bond Yields in Venezuela

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ABSTRACT

Purpose: We test the informational efficiency of Venezuelan USD sovereign bond yields when the black market exchange-rate premium (BMERP) changes.

Design: We use a non-parametric, asymmetric, Granger causality test to test our hypothesis.

Findings: We find that the bond market with less than or equal to 5 years of maturity seems to be efficient when good news is released on the BMERP. However, this market is not informationally efficient, and when combined with unbiased bad news regarding the BMERP, arbitrage opportunities are created.

Originality/value: Capital controls that restrict free exchange-rate mechanisms create arbitrage opportunities with negative news as opposed to positive news.

Keywords: Venezuela; sovereign bonds; black markets exchange rate.

JEL: F31, G10, G18

1. Introduction

In February 2003, with the creation of the Comision de Administración de Divisas (CADIVI), the Government of Venezuela decided to introduce a policy of capital controls to reduce the massive capital flight. In Venezuela, to have access to foreign exchange, consumers of foreign goods have to go through a very complicated bureaucratic procedure in order to be assigned a quota of dollars at the official exchange rate set by the government[1]. This restricted access to foreign exchange has given rise to a foreign-currency black market. The price of the currency on the black market carries a significant premium due to the limited supply of government dollars at the official exchange rate (Malone & Ter Horst, 2010).

The policy of capital controls in Venezuela has become progressively more complicated and restrictive, and by December 2014, the Venezuelan foreign-exchange system included three different exchange rates. The first exchange rate was operated by CENCOEX[2] and was where dollars had the lowest cost (6.3 bolivars for one USD) and could only be used by government entities or importers of vital goods such as food and medicine. The second exchange rate was set at 12 bolivars per USD and was called the SICAD[3] I, and could be used to pay for non-priority imports, but was assigned by auctions. Finally, the third exchange rate was called the SICAD II, in which the dollar was left to fluctuate in a currency band with a floor and ceiling of 49 and 53 bolivars, respectively, and was assigned to the general public by limiting quotas through a complicated system of auctions (*The Economist*, 2014). In February 2015, the system was amended once again, creating the SIMADI[4] and replacing the SICAD II. This last system allows the dollar to fluctuate freely, but individuals have a quota of USD 300 per day, USD 2,000 per month, and USD 10,000 per year, and in the case of entities, they have no limits if they sell foreign currency, but to buy it, they have to abide by the rules of SICAD I. In summary, Venezuela has three legal exchange rates: 1) CENCOEX at 6.3 bolivars per USD, 2) SICAD I at 12 bolivars per USD, and 3) SIMADI at 170 bolivars per USD as of February 12, 2015 (PWC, 2015).

These restrictions imposed by the Venezuelan government resulted in a thriving black market for foreign currency. The huge difference between the black dollar exchange-rate premium and the official exchange rate has had detrimental consequences for the economy of Venezuela (Kamin, 1993; Krugman, 1979; Kharas & Pinto, 1989; Onour & Cameron, 1997).

In Venezuela, as in other parts of the emerging world that have attempted to exert some form of control over the exchange rate, the black market for foreign exchange becomes the proxy variable that reflects inflation expectations. Even with the existence of price controls on basic goods by the government, the fact that there is a foreign-exchange black market shows that there is an excess demand for imported goods that cannot be satisfied through official government channels. This in turn generates a series of problems such as the rise of contraband, a reduction in the collection of tax revenue, and rampant inflation (Fischer & Easterly, 1990). Therefore, a rise in the black market exchange-rate premium (BMERP) is usually a sign of an eroding government budget, which in turn is

[1] The negotiation of sovereign bonds is not regulated in the sense that a national bond holder can sell bonds at any price, since the bonds are not traded in the SITME government system.
[2] National Centre for Foreign Commerce (Centro Nacional de Comercio Exterior).
[3] Complementary System of Foreign Exchange Management (Sistema Complementario de Administración de Divisas).
[4] Marginal System of Foreign Exchange (Sistema Marginal de Divisas).

a negative sign for foreign investors of dollar-denominated sovereign bonds as it raises doubts as to the government's capacity to meet its debt-service obligations.

The objective of this paper is to verify if the black market premium (the black market exchange rate is disclosed by web pages that gather data from the Venezuelan frontiers with Colombia[5]) has an informational effect on the yield of Venezuelan sovereign bonds. In this paper, we analyze the semi-strong informational efficiency of the yield of Venezuelan USD sovereign bonds when changes occur in the black market premium. We assume that the black market exchange rate is informationally efficient in the semi-strong sense, since foreign-exchange markets are homogenous and driven mainly by changes in macroeconomic fundamentals that affect the government budget. Therefore, we hypothesize that if the Venezuelan USD-denominated sovereign bond market is efficient, changes in the black market premium that affect the government budget should be instantaneously reflected in the yield of USD Venezuelan sovereign bonds, and that there should be no Granger causality between the variables[6].

We use USD Venezuelan sovereign bond yields because their empirical relation with macroeconomic fundamentals such as fiscal conditions, inflation, and interest rates has been well established in the literature (Baldacci & Kumar, 2010; Vargas, González, & Lozano, 2012; Piljak, 2013; Miyajima, Mohanty, & Chan, 2015). Additionally, there are other studies that link sovereign bond yields with the volatility of the exchange rate (Gagnon, 2009; Miyajima et al., 2015; Gadanecz, Miyajima, & Shu, 2014).

The paper is structured as follows: In Section 2, we briefly describe the dataset employed, in Section 3, we explain why the leveraged bootstrap test developed by Hatemi-J (2012) is adequate for testing asymmetric data, in Section 4, we present our results, and finally, in Section 5, we conclude.

2. Channels of Impact

Based on the model by Onour and Cameron (1997), suppose that a small country with a fixed official exchange rate (e) and with capital controls has a black market for foreign exchange (b) as a consequence of the excess in demand for foreign exchange. The price of exports (X) is constant ($P_x = 1$). Additionally, all debt is in foreign currency and the government controls all forms of payment for imported goods.

The proportion of export revenue diverted to the black market is $\phi(\rho)$, where $\rho = \frac{b}{e}$, is the black market premium. When the premium rises, more export revenue is diverted to the black market ($\frac{\partial \phi}{\partial \rho} > 0$). This is because the black market for foreign currency offers higher returns than the official market for foreign currency does.

The change in government reserves ($\dot{R}$) is defined by the balance of payments. Inflows are defined as the proportion of exports going through the official channel ($(1 - \phi(\rho))X$). On the other hand,

[5] One example of these web pages is https://dolartoday.com/, and in a futile attempt to try to block the information from being disseminated, the Venezuelan government has blocked more than 100 similar websites.

[6] This same methodology has been largely used to test the efficiency of both financial and energy markets. See, for example, Hatemi-J and Sarmiento-Sabogal (2013), Hernández-Gamarra, Sarmiento-Sabogal, and Cayon-Fallon (2015), Nguyen, Sousa, and Uddin (2015), Tugcu, Ozturk, and Aslan (2012), and Tiwari, Mutascu, and Albulescu (2013), among others.

outflows are defined as the sum of government expenditure (g), the proportion of import payments going through the official channel (δI), and foreign debt payments (D).

$$\dot{R} = \big(1 - \phi(\rho)\big)X - \delta I - g - D \quad (1)$$

In equation (1), when the premium rises, the number of goods exported through the official channel falls because the black market becomes more profitable for exporters, which in turn reduces the official reserves. In order to protect its reserves, the government has three options: 1) reducing its debt through selective defaults, 2) reducing government expenditure, or 3) reducing the amount of import payments (δ) that go through the official channel. In the specific case of Venezuela, there is much anecdotal evidence in support of the third option, as it is almost impossible for the private sector to pay for its imports trough the official channel of foreign exchange. Some of Venezuela's biggest companies (such as Cervecería Polar, Telefónica, and Digitel) have had to suspend their operations due to the lack of access to foreign exchange through the government channel to pay for raw materials. In addition, the scarcity at the retail level, through the government-controlled retail price channel, is an indication of the dire state of affairs of government foreign-exchange reserves in Venezuela.

In equation (2), we can see that the revenues for the government are taxes (T), monetary expansion ($\dot{M}$), and reserve changes ($\dot{R}$); the expenditures are government spending and external debt (D):

$$T + \dot{M} + \dot{R} = g + D \quad (2)$$

As is the case in Venezuela, most consumer-goods' production depends on the import of foreign raw materials. By simple substitution of equation (1) into (2), we can infer that a rise in the BMERP implies a rise in the price of imports. The consequence of this relationship is a general rise in the price level of domestic products. Therefore, we can state that local inflation is positively correlated to the BMERP $\pi(\rho)$ with $\frac{\partial \pi}{\partial \rho} > 0$.

This positive correlation between inflation and the black market premium increases the deficit in the fiscal budget in two ways: (1) the increase in inflation reduces government revenue through seigniorage[7] (Laffer Curve); and (2) the lack of consumption by national consumers (Tanzi Effect) leads to a decline in tax revenue. The income taxes from exporting companies also fall, as official exports decline due the increase in the black market premium.

As we can observe from Figure 2, when the reserves fall due to a rise in the BMERP, then the only policy option left open to the government is to increase the domestic currency money supply. The immediate effect of this policy is an increase in the inflation rate and further increases in the BMERP. This situation can be observed from Figures 1 and 2, revealing the irrelevance of this specific type of economic policy.[8]

3. Dataset

The dataset contains daily yield information from all available USD-denominated Venezuelan sovereign bonds with maturities of 3 months (Bond3m), 6 months (Bond6m), 1 year (Bond1y), 5 years (Bond5y), 10 years (Bond10y), 20 years (Bond20y), and 30 years (Bond30y). We also use

[7] When the cost of producing and circulating money is greater than the face value of the money in circulation.

[8] The other policy options the government has in order to balance its budget, are: i) a reduction of government's expenditures (g) and ii) a tax reform (T), such as the one implemented in November 2014. However, both policies imply a loss of political capital and their implementation and effects might take a longer time than a monetary expansion policy.

additional information for robustness purposes such as the Money Supply (M2)[9], the oil price (WTI)[10], sovereign reserves, the interest rate of 1-year US Treasury bonds, and the average rate paid for deposits in Venezuela. These data are extracted from Bloomberg. We also obtained data on the official exchange rate[11] as reported in Bloomberg and the information concerning the black market exchange rate is extracted from dolartoday.com. We select the period between June 2010 and February 2015, since the data on the black market exchange rate started in June 2010, and we select the final date as February 2015, date of the structural change brought about by the creation of SIMADI.

4. Model

For this paper, we use the method developed by Hatemi-J (2003, 2012) that incorporates bootstrap and optimal lag-selection techniques for determining Granger (1969) causality between variables. In this case, we are trying to determine the causality between the yield of Venezuelan USD sovereign bond yields and the black market dollar exchange-rate premium. Granger mathematically defines instant causality as “feedback” between stationary variables. Since Granger, there has been an increasing amount of literature concerning modifications to the original test that can incorporate other innovations such as asymmetric data, which is usually the case for emerging market datasets. One of the most interesting modifications is the one suggested by Hatemi-J (2012), where the author proves that by using bootstrapping, one can address the biases that arise from conditional autoregressive heteroscedasticity. Hatemi-J (2012) argues that traditional causality studies assume that the impact of positive shocks is the same as the impacts of negative shocks in absolute terms, which in the case of financial series[12], becomes a highly restrictive assumption due to the asymmetric nature of the underlying data of this study, which fails the normality test for all variables (see Table 1). Therefore, when we hypothesize that the Venezuelan USD-denominated sovereign bond market is efficient, changes in the black market premium should be instantaneously reflected in the yield of USD Venezuelan sovereign bonds, and there should be no causality between the variables. However, if we fail to reject the null hypothesis of causality, this means that the market is not efficient, and it is possible to set an arbitrage strategy in place between those variables. In order to test for Granger causality between the underlying variables, we use (as mentioned before) the leveraged bootstrap test procedure developed by Hacker and Hatemi-J (2006, 2012), which uses the lag-augmented vector autoregressive (LA-VAR) developed by Toda and Yamamoto (1995). This test starts by defining a vector autoregressive model of order *p*, VAR (*p*), as follows:

$$x_t = v + A_1 x_{t-1} + \ldots + A_p x_{t-p} + e_t \tag{3}$$

Where x_t is an *n*-dimensional vector consisting of the cumulative positive or negative shocks of the studied variables[13], A_r is a matrix $(n \times n)$ of the parameters, and e_t is the error term of the *n*-dimensional vector. These cumulative shocks are obtained by instigating a data transformation:
Let $x_{j,t}$ be an observation of the time series of the variable *j* at period *t*. Thus,

$$x_{j,t} = x_{j,t-1} + v_{j,t} = x_{j,0} + \sum_{i=1}^{t} v_{j,i} \tag{4}$$

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[9] M2 has a weekly frequency.
[10] The WTI price is coded in Bloomberg as CL1.
[11] The exchange rates are expressed as bolivars per 1USD. So the exchange rate rise means that there is a depreciation of the bolivar in respect to the dollar.
[12] Bekaert and Wu (2000), and Campbell and Hentschel (1992) illustrate this asymmetry in equity markets.
[13] This transformation is proposed by Granger and Yoon (2002) to test co-integration. Hatemi-J (2012) extends it to test causality in the Granger sense.

Where $\upsilon_{j,t}$ is the shock. Next, $\upsilon_{j,i}$ is divided into its positive and negative components as follows: $\upsilon_{j,i}^{+} = max(\upsilon_{j,i}, 0)$ and $\upsilon_{j,i}^{-} = min(\upsilon_{j,i}, 0)$. Then, the positive and negative shocks are aggregated to obtain the cumulative positive and negative shocks in each period *t* as $x_{j,t}^{+} = \sum_{i=1}^{t} \upsilon_{j,i}^{+}$ and $x_{j,t}^{-} = \sum_{i=1}^{t} \upsilon_{j,i}^{-}$.

The optimal lag order *p* in equation (3) is obtained by minimizing the following information criterion (Hatemi-J, 2003):

$$HJC = \ln\left(det\widehat{\Omega}_j\right) + j\left(\frac{n^2 lnT + 2n^2 \ln(lnT)}{2T}\right), \qquad j = 0,1, \dots, p \qquad (5)$$

Here, $det\,\widehat{\Omega}_j$ is the determinant of the variance–covariance matrix of the residuals in the VAR(*j*) model. *n* represents the number of the variables, *T* is the sample size, and *ln* is the natural logarithm.

The null hypothesis (*Ho*) is that the *k*th element of x_t does not Granger-cause the *m*th element of x_t. Thus:

$$Ho\text{: the row m, column k element in } A_r \text{ equals zero for } r = 1,2, \dots, p \qquad (6)$$

By employing some additional mathematical denotations, it is possible to represent the *VAR(p)* model compactly as follows:

$$Y = DZ + \varepsilon \qquad (7)$$

Where Y (for positive shocks) is a $(n \times T)$ matrix containing $x_{j,t}^{+}$, D is a $\left(n \times (1 + np)\right)$ matrix of v and A_1 *to* A_p, Z_t is a column vector of $1 + np$ rows, and Z is a matrix of $((1 + np) \times T)$ defined as $Z := (Z_0, \dots, Z_{T-1})$. Finally, ε is an $(n \times T)$ errors (e) matrix[14].

Consequently, the null hypothesis is:

$$H_0: \quad C\beta = 0 \qquad (8)$$

This can be tested via the following Wald statistic, since we are working with a LA-VAR model:

$$Wald = (C\beta)'\left[C\left((Z'Z)^{-1} \otimes S_U\right)C'\right]^{-1}(C\beta) \sim \chi_p^2 \qquad (9)$$

Here, $\beta = vec(D)$, where *vec* is the column-stacking operator with dimension $(1 + np) \times n$, $\otimes$ is the Kronecker product, and *C* is a $p \times n(1 + pn)$ indicator matrix that has elements of ones for the restricted parameters and zeroes for the others. The variance–covariance matrix from the VAR model that is unrestricted is defined as $S_U = \frac{\hat{\varepsilon}_U{}' \hat{\varepsilon}_U}{T - b}$. Note that *b* represents the number of estimated parameters in the model. Assuming normal distribution, the Wald statistic of equation (9) is distributed as χ^2 asymptotically with degrees of freedom equal to the lag order *p*. However, if the normal assumption is not fulfilled and the volatility is time-varying, then the asymptotic critical values based on the χ^2 distribution are not accurate. We apply a bootstrap test with leverage adjustments as developed by Hacker and Hatemi-J (2006, 2012) to remedy this possible shortcoming. Simulations conducted by the mentioned authors show that this test has good size and power properties, even if the lag order is selected endogenously. To conduct this test, the following steps need to be taken:

[14] For more details about this transformation, see Lütkepohl (2007).

Estimate the VAR model in equation (3) based on the optimal lag order, *p*, imposing the *Ho* and obtain the residuals ($\hat{e}_t$).

Next, produce the simulated data, denoted by X_t^*, by the following expression:

$$X_t^* = \hat{A}_0 + \hat{A}_1 X_{t-1} + \ldots + \hat{A}_p X_{t-p} + \hat{e}_t^*, \tag{10}$$

Note that the circumflex above any variable indicates the estimated value of that variable. The denotation $\hat{e}_t^*$ represents the bootstrapped residuals, which are obtained via *T* random draws with replacement from the regression's modified residuals (defined below), each drawn with equal likelihood of 1/*T*. These residuals are mean adjusted in each replication in order to make sure that the expected value of the residuals is equal to zero. The original residuals from the regression are adjusted via *leverages* in order to fulfill the assumption of constant variance.

Before presenting the leverages, we need to introduce additional denotations. Let $Y_{-p} = (X_{1-L}, \cdots, X_{T-p})$ and let $Y_{i,-p}$ be the *i*th row of Y_{-p}. Therefore, $Y_{i,-p}$ is created as a row vector of the lag *p* values for variable X_{it} across the sample period *t* = 1, . . ., *T*. Also let $W = (Y_{-1}', \cdots, Y_{-p}')$ and $W_i = (Y_{i,-1}', \cdots, Y_{i,-p}')$ for *i* = 1,2.

Note that in the equation that is defined by X_{1t}, the independent variable matrix in the estimated regression is W_1. This equation is restricted by the *Ho* of no Granger causality. In the equation that is defined by X_{2t}, the independent variable matrix for the regression is *W*. This equation is the unrestricted one. By using these denotations, the *T*×1 *leverage* vectors for X_{1t} and X_{2t} are defined as follows:

$$l_1 = \mathrm{diag}\left(W_1 \left(W_1' W_1 \right)^{-1} W_1' \right) \quad \text{and} \quad l_2 = \mathrm{diag}\left(W \left(W' W \right)^{-1} W' \right) \tag{11}$$

By using these leverages to modify the residuals, we will account for the potential effect of time-varying volatility. The modified residual for X_{it} is produced as

$$\hat{e}_{it}^m = \frac{\hat{e}_{it}}{\sqrt{1 - l_{it}}}, \tag{12}$$

Here, l_{it} represents the *t*th element of l_i, and $\hat{e}_{it}$ signifies the raw residual from the regression for X_{it}[15].

The additional step is to repeat the bootstrap simulations 10,000 times and calculate the Wald test each time. In this way, an approximate distribution for the Wald test statistic is estimated based on the sample data. After implementing these 10,000 replications, we find the (α)*th* upper quantile of the distribution of the bootstrapped Wald test. This quantile provides the α level of significance "bootstrap critical value" (c_α^*).

Finally, we compare the estimated Wald statistic based on the original one simulated with the bootstrap critical value. If the estimated Wald statistic is higher than the bootstrap critical value c_α^*, it means that the null hypothesis of non-causality can be rejected at the α level of significance. The

[15] For more details about this bootstrap procedure, see Davison and Hinkley (1997).

bootstrap simulations are implemented via a module that is written in Gauss by Hacker and Hatemi-J (2010). This statistical software component is available online.

5. Results

We test for causality using the model described in Section 3 where a vector of two variables (Black market premium and bond yield) is tested for level data, negative shocks, and positive shocks. The model is sensitive to the number of parameters because the estimation becomes less efficient as the probability of having a type II error increases. Initially, we test for stationarity in the series using the augmented Dickey and Fuller (1979) unit root test. As expected, all the series of yield bonds and the black market premium in Figure 1 show evidence of unit roots. Additionally, we test the series for multivariate normality using Doornik and Hansen (2008), and ARCH effects using Hacker and Hatemi-J (2005). In all cases, we reject the hypothesis of normality in the series and there is evidence of autoregressive conditional heteroscedasticity in eleven of the twenty-one cases in the conventional significance levels. This analysis supports our proposed methodology, since any critical value assuming the normal distribution will be biased. These results are presented in Table 1:

Note: A+ for positive shocks and A- for negative shocks.

We run a base regression for USD-denominated sovereign bond yields against the BMERP (Black Market Exchange Rate/Official Exchange Rate). The maximum lag for the optimal lag is 10. With the data in levels, we find that the yield for bonds with less than 20 years' maturity is caused in the Granger sense by the premium with a significance level of 5%. For bonds with a 20-year and 30-year maturity, the significance levels rise to 10%. This evidence supports the hypothesis that when the BMERP rises, the government budget deteriorates, causing a rise in the yields of the bonds for all maturities, as we explain in Section 2; this also reflects how it is possible to predict the bond yields better as the market premium reflects an inefficiency in the bond market. The results are summarized in Table 2:

Note: The symbol ??⇏?? means that variable A does not Granger-cause B.
A+ for positive shocks and A- for negative shocks.

As we are working with financial markets, we analyzed possible asymmetric effects, as shown in Table 2. For positive shocks, the premium Granger-causes the bond yield for all maturities at a 5% significance level, while for negatives shocks, the premium exclusively Granger-causes the bond yields of the two bonds with the longest maturities (Bond20y and Bond30y), even at the 1% significance level. These differences between positive and negative shocks can be explained by the expectations of the market. The expectations for the Venezuelan economy have been falling due to poor performance, for instance, the annual growth in GDP in 2011 was 4.2% and in 2014 it was −4%[16]. This means that for positive shocks in the premium, which are bad news for the economy, the magnitude of the price changes is greater than that of negative shocks that are good news for the economy. There is also evidence that negative shocks are relevant in the long term. The inquiry as to why this is the case is the subject of an additional study.

6. Robustness Tests

In Section 6.1, we test if the Granger causality found in Section 5 is not a feedback effect. As an example, suppose that we found that the premium causally affects Bond1y, then Bond1y cannot under any circumstances affect the premium in order for this to be an actual Granger causality.

[16] http://data.worldbank.org

Additionally, in Section 6.2, we test if the Granger causality found in Section 5 is not distorted by other types of variables.

6.1 Feedback Test

We already know that the premium adds significant information to bond yields, now we would like to know if the bond yields add significant information to the premium. If this is not the case, then we can start to consider a causality relation in the Granger sense.

In table 3 for the data under analysis, we found a feedback effect for all the maturities except for the bond yield with a maturity of 5 years. This feedback effect also occurred for positive and negative shocks with bonds with a maturity of more than 5 years (Bond10y, Bond20y, and Bond30y). This means that the actual causality relation comes from (i) positive shocks to the bond yields with a maturity of less than or equal to 5 years, and (ii) level data to the bond yields with a maturity of 5 years. The cases of Granger causality are: (Premium+⇏Bond3m+), (Premium+⇏Bond6m+), (Premium+⇏Bond1y+), (Premium+⇏Bond5y+), and (Premium⇏Bond5y).

Note: The symbol ??⇏?? means that variable A does not Granger-cause B.
A+ for positive shocks and A- for negative shocks.

6.2 Possible Omitted Variables

Since we are testing a Granger causal relation between two variables without any control variables, we would like to know if it is really the BMERP that causally affects the bond yield. In other words, we want to test if this relationship is not related to a third variable such as the oil price. So we test the hypothesis that an omitted variable will have a relationship with the BMERP, which in turn affects the bond yield. If we accept the hypothesis of a causal relationship for a third variable, then we would say that the relation between the premium and bond yield could be attributed to an omitted variable.

Let us assume that variable A causally affects variable C ($A \Longrightarrow C$) and A has a relation with B. Therefore, a third variable, B, can affect the relationship between A and C if B causally affects variable C ($B \Longrightarrow C$).

Note: The symbol ??⇏?? means that variable A does not Granger-cause B.
A+ for positive shocks and A- for negative shocks.

We test for omitted variables for the cases where we found a Granger causality in Table 1 and did not have a feedback effect (Table 2). The variables chosen, and the relation between A (Premium) and B (example, reserves), is given by the model in Section 2. For the omitted variable test, we choose oil prices (COil), given that this commodity is Venezuela's primary export, the change in the money supply expressed in US dollars at the official exchange rate (CM2/Official Exchange Rate), the change in reserves (CReserves) as a proxy for financing the government deficit, and the differential in local interest rates adjusted by deprecation (idi)[17]. This last variable is included to test if there is any difference between the local and the foreign interest rate and if this can be a cause for changes in bond yields.

The results report in table 4 shows that any rise in the reserves and the oil price should cause a drop in bond yields, the positive shocks to bond yields are tested with negative shocks due to changes in reserves and negative changes in oil prices. We only used weekly data for the change in the monetary supply (CM2) variable.

[17] The construction of this variable comes from Malone and Ter Horst (2010): idi = 1-year US Treasury Bond - average rate of deposits in Venezuela + change in the black market exchange rate.

For level data, the variables (CReserves) and (Coil) causally affect the 5-year bond yields in the Granger sense. However, the positive shocks to the bond yields result in causality being maintained with the BMERP, therefore revealing an inefficiency in the sovereign Venezuelan bond market for maturities of less than or equal to 5 years. The inefficiency is related to the incorporation of the BMERP in the prices of the bonds.

7. Conclusions

After testing the efficient market hypothesis (EMH) in the semi-strong form using the Granger causality framework suggested by Hatemi-J (2012), there is empirical evidence that can lead us to fail to reject the null hypothesis of non-causality between the black market premium and the bond yields of less than or equal to 5 years of maturity at the 5% significance level for positive shocks, even when we take into account feedback effects and omitted variables that can affect the causality. Therefore, there is evidence that due to informational inefficiencies, it is possible to create an arbitrage strategy based on the time that it takes for negative news (positive shocks, such as devaluation of the local currency in the black market) that affects the BMERP to impact the USD Venezuelan sovereign short-term bond yields (5 years or less). This relation is expected in our model since any change in the BMERP leads to an increase in the government budget deficit. This in turn increases the uncertainty regarding the ability of the Venezuelan government to meet their sovereign debt obligations. For positive news (negative shocks) or a fall in the BMERP, there is no significant effect on bond yields, at least in the short term.

As a result of this analysis, the BMERP is a relevant signal in the sovereign bond market in Venezuela as we expect that the bond yields do respond to changes in the BMERP. These changes can be attributed to the ongoing concern of default risk. This relationship has become even more evident as the premium consistently hits record levels in Venezuela.

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Figure 1. Black market exchange-rate premium or BMERP (Black Market Exchange Rate/ Official Exchange Rate).

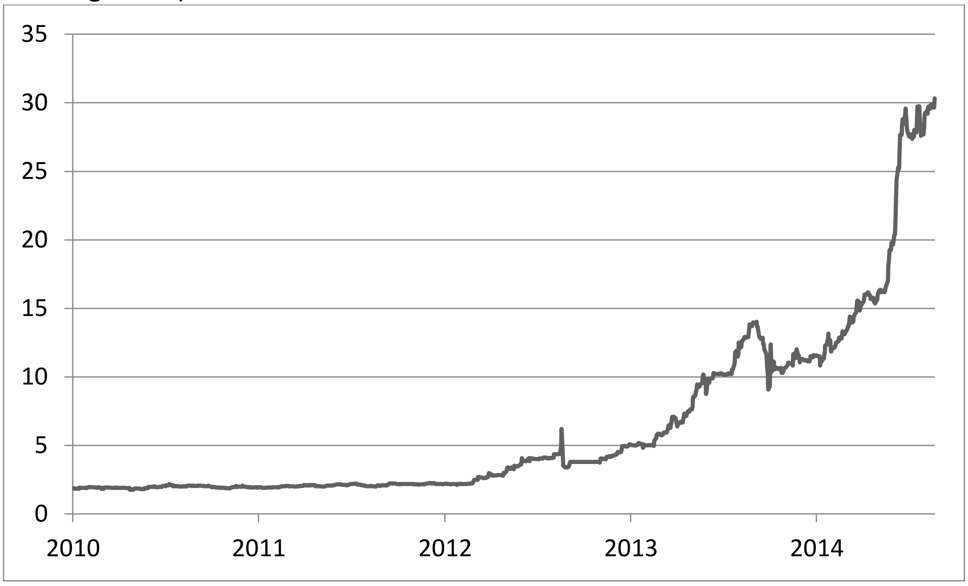

Figure 2. Annual inflation in Venezuela.

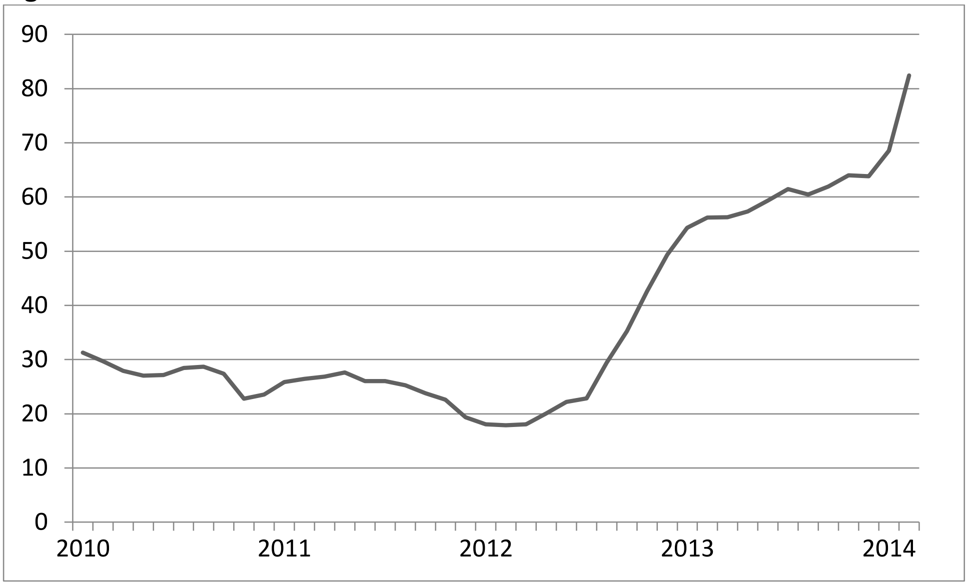

Table 1. P-value of multivariate normality and ARCH effects

	Normality	ARCH Effects
(Bono3m, Premium)	0.000	0.007
(Bono3m+, Premium+)	0.000	0.000
(Bono3m-, Premium-)	0.000	0.001
(Bono6m, Premium)	0.000	0.004
(Bono6m+, Premium+)	0.000	0.102
(Bono6m-, Premium-)	0.000	0.004
(Bono1y, Premium)	0.000	0.010
(Bono1y+, Premium+)	0.000	0.014
(Bono1y-, Premium-)	0.000	0.001
(Bono5y, Premium)	0.000	0.005
(Bono5y+, Premium+)	0.000	0.255
(Bono5y-, Premium-)	0.000	0.231
(Bono10y, Premium)	0.000	0.002
(Bono10y+, Premium+)	0.000	0.128
(Bono10y-, Premium-)	0.000	0.559
(Bono20y, Premium)	0.000	0.000
(Bono20y+, Premium+)	0.000	0.128
(Bono20y-, Premium-)	0.000	0.681
(Bono30y, Premium)	0.000	0.009
(Bono30y+, Premium+)	0.000	0.412
(Bono30y-, Premium-)	0.000	0.927

Table 2. Test value and bootstrap critical values for positive and negative shocks for the model: $Bond_t = v + A_1 Premium_{t-1} + e_t$

	Test Value	Bootstrap 1%	Bootstrap 5%	Bootstrap 10%	Lags
Premium⇏Bond3m	21.400	24.433	12.865	9.580	5
Premium+⇏Bond3m+	47.585	31.671	13.774	9.788	5
Premium-⇏Bond3m-	0.814	12.105	3.264	2.011	1
Premium⇏Bond6m	21.782	25.327	13.010	9.649	5
Premium+⇏Bond6m+	49.180	32.050	13.791	9.832	5
Premium-⇏Bond6m-	0.679	11.821	3.283	1.989	1
Premium⇏Bond1y	22.240	25.617	13.074	9.643	5
Premium+⇏Bond1y+	49.562	32.483	13.852	9.808	5
Premium-⇏Bond1y-	0.534	12.167	3.248	1.992	1
Premium⇏Bond5y	19.976	20.723	12.262	9.575	5
Premium+⇏Bond5y+	51.453	24.418	12.763	9.541	5
Premium-⇏Bond5y-	0.253	10.825	3.558	2.253	1
Premium⇏Bond10y	16.529	22.224	12.965	9.748	5
Premium+⇏Bond10y+	43.495	25.766	14.930	11.457	6
Premium-⇏Bond10y-	2.728	41.073	14.165	9.351	5
Premium⇏Bond20y	12.151	30.912	15.882	11.587	6
Premium+⇏Bond20y+	17.329	36.723	16.403	11.355	6
Premium-⇏Bond20y-	32.436	47.438	17.599	12.094	7
Premium⇏Bond30y	17.139	36.390	17.193	12.094	6
Premium+⇏Bond30y+	22.017	43.630	18.287	12.252	6
Premium-⇏Bond30y-	63.388	59.238	25.203	17.553	9

Table 3. Test value and bootstrap critical values for positive and negative shocks for the model: $Premium_t = v + A_1 Bond_{t-1} + e_t$

	Test Value	Bootstrap 1%	Bootstrap 5%	Bootstrap 10%	Lags
Bond3m ⇏Premium	17.568	24.659	12.718	9.644	5
Bond3m+ ⇏Premium+	4.514	32.066	13.735	9.639	5
Bond3m- ⇏Premium-	0.247	11.407	3.525	2.139	1
Bond6m ⇏Premium	18.592	25.262	12.774	9.668	5
Bond6m+ ⇏Premium+	4.491	33.299	13.833	9.622	5
Bond6m- ⇏Premium-	0.148	11.777	3.539	2.144	1
Bond1y ⇏Premium	19.207	25.856	12.742	9.679	5
Bond1y+ ⇏Premium+	4.334	34.726	13.858	9.610	5
Bond1y- ⇏Premium-	0.149	11.966	3.534	2.128	1
Bond5y ⇏Premium	6.486	20.621	12.098	9.619	5
Bond5y+ ⇏Premium+	6.092	24.987	12.743	9.637	5
Bond5y- ⇏Premium-	0.250	10.393	3.803	2.382	1
Bond10y ⇏Premium	51.072	22.617	12.973	9.810	5
Bond10y+ ⇏Premium+	21.312	26.209	14.597	11.152	6
Bond10y- ⇏Premium-	67.091	44.067	14.817	9.282	5
Bond20y ⇏Premium	43.317	29.612	15.649	11.729	6
Bond20y+ ⇏Premium+	30.247	35.346	16.128	11.373	6
Bond20y- ⇏Premium-	72.993	51.370	18.416	12.680	7
Bond30y ⇏Premium	40.703	35.768	16.850	12.055	6
Bond30y+ ⇏Premium+	33.518	40.818	17.404	11.642	6
Bond30y- ⇏Premium-	70.101	52.452	24.767	17.135	9

Table 4. Test value and bootstrap critical values for positive and negative shocks for the model: $Bond_t = v + A_1 ControlVariable_{t-1} + e_t$

	Test Value	Bootstrap 1%	Bootstrap 5%	Bootstrap 10%	Lags
CM2+⇏ Bond3m+	5.776	15.660	8.809	6.501	3
CReserves-⇏Bond3m+	2.152	22.087	8.919	5.987	3
COil-⇏ Bond3m+	1.903	15.684	8.442	6.372	3
idi⇏ Bond3m+	0.258	23.018	10.509	6.553	3
CM2+⇏ Bond6m+	6.233	16.027	8.842	6.464	3
CReserves-⇏Bond6m+	2.144	22.407	8.966	5.957	3
COil-⇏ Bond6m+	1.544	15.970	8.488	6.360	3
idi+⇏ Bond6m+	0.337	27.383	12.960	8.371	4
CM2+⇏ Bond1y+	6.085	16.300	8.863	6.453	3
CReserves-⇏Bond1y+	2.004	22.742	8.919	5.976	3
COil-⇏ Bond1y+	1.409	16.372	8.446	6.349	3
idi+⇏ Bond1y+	0.349	27.745	13.214	8.412	4
CM2+⇏ Bond5y+	6.019	14.479	8.681	6.533	3
CReserves-⇏Bond5y+	2.316	17.678	8.503	6.049	3
COil-⇏ Bond5y+	3.519	15.764	10.047	7.903	4
idi+⇏ Bond5y+	0.808	21.198	11.238	8.019	4
CM2⇏ Bond5y	3.569	10.129	6.216	4.685	2
CReserves⇏Bond5y	11.236	15.886	10.091	7.903	4
COil⇏ Bond5y	23.750	9.667	6.236	4.797	2
idi⇏ Bond5y	3.845	18.932	13.215	10.957	6