Global Finance Journal 41 (2019) 104–112

Contents lists available at ScienceDirect

Global Finance Journal

journal homepage: www.elsevier.com/locate/gfj

Latin American Corporate Emerging Markets Bond Indices (CEMBIs): Their recent evolution☆

Francisco López-Herrera[a,*], Roberto J. Santillán-Salgado[b], Alejandra Cabello[a]

[a] Universidad Nacional Autónoma de México, Mexico
[b] EGADE, Tec de Monterrey, Mexico

ARTICLE INFO

JEL classifications:
G11
G12
G15
G28

Keywords:
Emerging markets bonds
Risk premium
Corporate Emerging Market Bond Index (CEMBI)
Latin American corporate bonds issues

ABSTRACT

This paper studies the stochastic relationship among six Latin American countries' international bond issue risk premium. The analysis exploits a novel Corporate Emerging Markets Bond Indices (CEMBIs) database processed with a VAR-CCC model to clarify the nature of such relationships, and makes an objective interpretation of their characteristics. The countries included in the sample are Argentina, Brazil, Chile, Colombia, Mexico and Peru, and the daily observations period from May 14, 2014, through February 9, 2017. Our findings indicate that the CEMBI returns of Brazil and Mexico are the main influencers on the behavior of the other Latin American CEMBI returns. These insights are valuable to understand the diversification possibilities of CEMBI portfolios, and of interest to Latin American corporate financial managers who consider financing their firms with international bond issues, and for whom the risk premium paid by bond issues is the cost of funding.

1. Introduction

The quality spread of corporate bonds is defined as the excess return paid over the risk-free rate and is a sound indicator of the riskiness of the bond as an investment, but also has an obvious association with the cost of funding for the issuer. Higher spreads are equivalent to greater cost funds and, in that sense, have a significant influence over investment decisions of private firms which, in turn, have an impact on the creation of new jobs, and on other microeconomic and macroeconomic aspects. The investor and portfolio manager's interest lies in the risk, return and potential diversification benefits achieved by different combinations of corporate bond portfolios. Within that context, exploring the trends and characteristics of corporate bond spreads is an issue of great economic and financial importance.

During recent decades, emerging countries' financial markets have registered significant growth and increasing sophistication at a global level, with the corporate bond segment leading, in most cases, that expansion. To have a sense of the magnitude of this growth, after the Global Financial Crisis (2008–2009) the annual issues of non-financial corporate bonds increased by a factor of more than three times during the five-year period from 2009 to 2014, a growth that easily outpaced both equity and syndicated loans (Ayala, Nedeljkovic, & Saborowski, 2015). To a large extent, the global economic recovery was supported by an extraordinarily relaxed monetary policy in the more developed countries that included not only historically low interest rates, but also an active participation of central banks in the purchase of troubled bonds, which is understandable when the most important aim is to create the conditions for aggregate demand and investment growth (Núñez Reyes, Perrotini Hernández, & López-Herrera, 2018). However, these measures

☆ This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
* Corresponding author.
E-mail addresses: francisco_lopez_herrera@yahoo.com.mx (F. López-Herrera), roberto.santillan@tec.mx (R.J. Santillán-Salgado).

https://doi.org/10.1016/j.gfj.2019.03.002
Received 22 November 2018; Received in revised form 5 March 2019; Accepted 6 March 2019
Available online 07 March 2019
1044-0283/

created excess liquidity in international financial markets, which, in turn, favored the development of bond markets in emerging countries and contributed to more risk-taking by investors (IMF, 2014).

The influence of global conditions in the determination of fixed-income flows to emerging markets has been documented extensively in the literature. For example, Ayala et al. (2015) mention different studies which find that global liquidity and interest rates can be more influential than the local fundamentals in explaining the evolution of bond and stock issues in Asia and Latin America during the 1990s. Or, the work of Lim and Mohapatra (2016), who examine the evolution of gross capital inflows to developing countries (emerging markets should be included as a segment of the broader definition of developing countries) between 2000 and 2013, to evaluate the effects of quantitative easing (QE) policies in the more advanced economies, and find evidence of the influence of QE through its impact on market liquidity, portfolio balancing strategies, among others. They report that the lower bound of their baseline estimate of the influence of QE is about 5% of gross inflows.

As a result of an increasing number of issues, and a series of important institutional improvements in many emerging countries, international non-financial emerging corporate bond markets have become a subject of interest for international investors and corporate managers alike. For portfolio managers, the availability of an enlarged set of corporate bonds, once emerging corporate bonds are considered, offers new opportunities to diversify their risk and drive their profitability. For emerging corporate managers, the opportunity to diversify funding sources and reduce their cost of borrowing can influence a more efficient capital allocation, with favorable results in the long term.

Awareness of the potential opportunities for both investors and corporate managers in a dynamic and reliable bond market has aroused interest in better understanding its trends and characteristics. New databases that contain detailed information on emerging countries' corporate bond issue risk premium have been developed and made accessible, creating new opportunities for careful analysis of their markets' evolution. That is precisely the case with the Corporate Emerging Markets Bond Indices (CEMBIs), developed by JP Morgan. CEMBIs, similar to EMBIs (Emerging Markets Sovereign Bond Indices), represent the average market premium of emerging markets' corporate bond issues, traded in international markets and denominated in U.S. dollars.

The first CEMBI, introduced by JP Morgan in November 2007, may be simply described as “a liquid basket of emerging markets corporate issues which included approximately 80 bonds, representing 60 issuers and 16 countries (as of October 31, 2007)”.[1] Since its initial CEMBI launch, JP Morgan has introduced an increasing number of country-specific CEMBIs that follow the same selection criteria, i.e., strict liquidity “in order to provide replicability, tradability, robust pricing and data integrity”.[2] More recently, the availability of country CEMBIs data has opened the possibility to produce original research that improves our understanding of the nature and evolution of emerging markets corporate bond issues, and to analyze the nature of their stochastic relationships.

This paper analyzes a sample of the stochastic relationship of six Latin American countries' international bond issues, through the econometric modeling of their corresponding CEMBIs. Our results illustrate the nature of the underlying relationships among Latin American corporate bond risk premium and develop an objective interpretation of the characteristics and diversification possibilities of this type of assets that may be of interest to international portfolio managers and Latin American corporate financial managers. The next section presents an overview of the literature on the different approaches under which emerging markets' bond issues have been studied. Section 3 describes the characteristics of the database, reports the unit root tests of the original series, and the output results and interpretation of a VAR-CCC model. Section 4 concludes this study.

2. Literature review

The highly significant economic role played by bond markets and bond issues as a source of funding for both corporations and governments in the more developed countries has inspired large numbers of empirical studies aimed at understanding their characteristics. A closer look at the literature on the subject suggests at least two main research avenues: a) works interested in identifying and measuring the determinants of bond prices in the aftermarket, in terms of their sensitivity to environmental variables and diversification potential (e.g., Chen, Lesmond, & Wei, 2007; Schneider, 2011; and, Kim, Li, & Zhang, 2016); and b) those focused on how bond prices interact, integrate, and respond to different types innovations (e.g., Christiansen, 2007; Jiang, Konstantinidi, & Skiadopoulos, 2012; Skintzi & Refenes, 2006; Yang, 2005).

However, in recent years several groundbreaking studies have paved the way towards a better understanding of the specificities of emerging markets bond issues. In this case, the search for the determinants of emerging market bonds' spread has been recurrent in the literature. Some of the early works on this subject include, for example, those of Min (1998), Sy (2002), and Min, Lee, Nam, Park, and Nam (2003). Min's (1998) work finds two groups of variables: a) those that relate to the liquidity and solvency of an economy (Debt/GDP, Debt Service/GDP, net foreign assets, international reserves/GDP) ratio; and b) those that characterize the macroeconomic fundamentals of a country (domestic inflation and terms of trade). Sy (2002) is interested in the relationship between emerging market sovereign spreads and ratings on “long-term foreign currency denominated debt” and, to understand its nature, runs an unbalanced panel data model on sovereign spreads and ratings to find “a one-notch upgrade by rating agencies reduces sovereign spreads on average by 14%”. He then uses the model's residuals to detect the presence of statistically significant deviations from the calculated relationship between the “market views and fundamentals”. He finds that sovereign spreads and ratings adjust differently depending on whether spreads are high or low. Min et al. (2003) study the influence of liquidity and solvency in determining bond spreads in emerging economies, to find that both variables are very influential. Also, they identify U.S. interest rate and

[1] https://www.businesswire.com/news/home/20071108006109/en/JPMorgan-Launches-Corporate-Emerging-Markets-Bond-Index.
[2] ibid.

macroeconomic fundamentals as influential determinants. Finally, they report that in the case of Latin American countries, there is a negative yield-maturity relationship.

A few years later, Baek, Bandopadhyaya, and Du (2005) estimate the Brady bond stripped yield spread as a proxy of sovereign risk premium to show that, besides economic fundamentals as determinants of the bond yield spread, "the market's attitude towards risk is another important determinant". These authors run a standard panel data regression with fixed effects, using quarterly data for a sample of six emerging markets, Argentina, Brazil, Mexico, the Philippines and Venezuela, for the period from 1992 to 1997, where the stripped Brady bond yield spread is the dependent variable, and the explanatory variables include different macroeconomic indicators (solvency is measured by real GDP growth rate, the total external debt to GDP ratio and government budget balance to GDP; liquidity is measured by the international reserves to imports ratio, and the current account balance to GDP ratio; and economic stability is measured with inflation and real exchange rate variations), plus a Risk Appetite Index (RAI), which measures the risk appetite of investors using the Pearson Correlation Coefficient between the return ranking and the volatility ranking of a given market's bond issues (see Baek et al., 2005). The inclusion of the RAI as an empirical measure of the market's attitude towards Brady bonds over time confirms the large impact of market psychology on the yield spread.

The results suggest that, as could be expected, macroeconomic variables significantly explain stripped Brady bond yield spreads. However, the most relevant finding of this work is that the RAI has a relatively large impact on Brady bonds' yield premium, i.e., that the "market's risk attitude plays an integral role in explaining contagion among emerging bond markets". Interestingly, Baek et al. (2005) also find that most economic factors have a significant effect on published country risk ratings, although this is not the case with the RAI, meaning that while this variable is statistically relevant in determining the Brady bonds yield premium, it is not relevant at all in determining country risk ratings.

The work of Baek et al. (2005) opens the possibility to explain "why there is contagion in the Brady bond market" but, more importantly from the perspective of the present study, it contributes to the understanding of the market-determined yield spreads of emerging countries' corporate bond issues. While the study by Baek et al. (2005) focuses on Brady bonds, which represent a relatively small segment of emerging markets' international bonds issues, their findings regarding the frequent deviations of market-determined yield spreads from "published ratings on sovereign creditworthiness" suggest the presence of environmental influences beyond macroeconomic fundamentals in the determination of yield spreads. CEMBIs, in turn, represent the average risk spread of a country's corporate bonds, although the nature of their intrinsic risk is not strictly comparable with that of Brady bonds (the latter reflect a country's sovereign risk premium only, while the former incorporate both, the sovereign risk component plus the individual issuers' risk premium). In that sense, the path-breaking work of Baek et al. (2005) suggests that emerging countries international bonds are subject to important influences beyond macroeconomic fundamentals, and probably common to some or all.

Baldacci, Gupta, and Mati (2008) use a panel with data from 30 emerging countries, for a period from 1997 through 2007, to investigate what the determinants of sovereign bond spreads are and find that both political and fiscal factors influence credit risk in their sample. They find that public expenditure is an important determinant of spreads, as growing public investment lowers risk premiums, as long as a fiscal balance remains controlled. Also, political factors influence observed sovereign bond spreads, particularly in the countries that underwent previous defaults. The policy implications of their findings are that, despite the significant influence that can be attributed to the global financial environment, as well as the agent's attitude towards risk, individual country conditions, particularly those mentioned above, have an important impact on the cost of credit for these countries. If the country's authorities minimize the importance of fiscal imbalances, a negative reaction will come from both the markets, through wider spreads, and the rating agencies, imposing lower ratings to that country's bond issues. The result will be a higher debt service cost burden on that country's externally borrowed resources and higher policy uncertainty. The importance of fiscal health is also shown in case of higher investment spending, which only helps to lower spreads if the fiscal situation is not worsening.

Cavallo and Valenzuela (2009) study the determinants of corporate spreads in a sample of 139 bonds, issued by 65 corporations in 10 emerging market economies (including six Latin American and four East Asian), and find that "firm-specific variables, bond characteristics, macroeconomic conditions, sovereign risk, and global factors are all determinants of corporate risk". They use a variance decomposition analysis and, based on its results, conclude that firm-level performance variables are more important in the explanation of the variance, and report that spreads respond in greater measure to both sovereign and global risk upward movements, which is not the case with downward movements. These two asymmetries are interpreted by the authors as meaning that: a) sovereign risk remains a significant factor of corporate risk; and b) in the case of emerging markets, herding behavior is more prevalent. Methodologically, this work introduces an interesting innovation originated by the problem of matching corporate bonds with risk free issues of similar maturity due to the fact that the former contains option-like features, so the determination of their maturity is simply not possible. What this work proposes is to use the option-adjusted spread (OAS) analysis from Bloomberg which, simply stated, is "the spread over an issuer's spot rate curve". This allows them to make bonds with a variety of cash flow characteristics more comparable with risk-free securities, in order to obtain a more precise risk premium estimation.

Sovereign bond spreads have been documented to be sensitive to "large public interventions in support of domestic financial systems and fiscal stimulus packages" (Bellas, Papaioannou, & Petrova, 2011). Their evolution through the turbulent period of the global financial crisis widened significantly and the evident culprit seems to be the rapid growth of public debt, as well as the obvious associated balance-sheet risks. Bellas et al. (2011) study the effects of macroeconomic and financial market determinants of sovereign bond spreads using JP Morgan's Emerging Markets Bond Index (EMBI) in a sample of 14 countries between 1997 and 2009. These authors noticeably highlight the role played by high indebtedness and unsound banks in the determination of EMBI evolution. To do so, they use a fixed-effects model along with a Pooled Mean Group (PMG) estimator to distinguish short- and long-term effects. While the model imposes commonality on the long-run coefficients, it does not restrict the short-term coefficients. In the regression equations, EMBIs are the dependent variables and, a list of macroeconomic fundamentals (external debt/GDP, interest payments on

external debt/reserves, short-term debt/reserves, etc.), including a financial stress index developed by IMF staff, and the Emerging Markets Financial Stress Index (Balakrishnan, Danninger, Elekdag, & Tytell, 2009), the explanatory variables. Their findings, according to the regression output, are that "in the short run, financial volatility is a more important determinant of spreads than fundamental indicators".

González-Rozada and Levy-Yeyati (2008) also address the question of the determinants of emerging market bond spreads as measured by J.P. Morgan's EMBI Global index, for 33 emerging economies (with data for different periods in each case) and find that the main explanatory variables include risk appetite, global liquidity and contagion from systemic events. However, the evolution of credit ratings, measured based on Standard & Poor's ratings for long-term debt in foreign currency, seems to lag the spread movements and does not significantly affect bond pricing. This is possibly because spreads are market-determined on a real-time basis and immediately respond to the arrival of new relevant information, while ratings are changed only every so many days (usually, one month), making the lead-lag relationship easy to understand.

Ayala et al. (2015) study the sensitivity of bonds' share among non-financial corporations' use of funding in emerging countries, and present evidence that institutions and macroeconomic fundamentals play an important role in the creation of favorable conditions for bond markets' development, but, during the period of their analysis, global cyclical factors account for most of the variation of bond participation in total corporate debt funding. Bond share in corporations' funding in emerging markets also seems to be influenced by the size of the domestic bond market. Adopting a market microstructure perspective, they report that the true underlying factor may be liquidity and ease of access to each market. A relevant conclusion of their study is that there is a risk of capital flow reversals in emerging markets, and that their recent growth may be explained more by their liquid market than the existence of strong fundamentals.

3. Data, econometric results and interpretation

Our database was obtained from JP Morgan services and retrieved through a Bloomberg terminal, and consists of daily observations of CEMBI indices for Argentina, Brazil, Chile, Colombia, Mexico and Peru for the period from May 14, 2014, through February 9, 2017. After cleaning the database from observations in which any of the six CEMBIs has missing data, the sample includes 663 useful observations.

The graphic representation of the index series for the period of analysis reveals interesting insights (see Fig. 1). The highest-level path corresponds to Brazil; Argentina index dynamics is at the lowest level throughout the period, followed very closely by Chile and Colombia. The trajectory of the Mexican and Peruvian indices unfolds in the same range, with a similar pattern. At the same time, the swings observed in the indices for Brazil, Colombia, Mexico and Peru are more volatile than those of Argentina and Chile. The latter two show a relatively smoother upward trend, while not devoid of some intense volatility sub-periods. Notably, the indices of Brazil and Colombia, whose time pattern is somewhat similar, end the period of observation at a level that is close to the one they had at the beginning, sharing sharp decline and recovery patterns in between. Although relatively stable during the first part of the period, all six Latin American CEMBIs show a strong rising pattern during the first semester of 2016, an effect probably associated with the strengthening electoral position of then Presidential candidate Donald Trump, and his aggressive rhetoric on a number of sensitive issues for Latin American countries (including undocumented immigrant deportation, as well as his threat to abandon NAFTA, in the case of Mexico).

However, in the aggregate, the impression conveyed by the graphical representation of Latin American CEMBIs is that there is a relatively high heterogeneity among the different countries' corporate bond issues risk premium performance even though they belong to the same geographical region, have similar economic development levels, and share significant economic and political ties.

Both the CEMBI series in levels and their log-returns are tested for stationarity with a battery of Phillips-Perron (PP), Augmented Dickey Fuller (ADF) and KPSS unit root tests. According to the test results (see Table 1), the level series are not stationary, but their log-returns suggest that the relationships of the returns can be modelled by means of a VAR.

As the first step to determine the characteristics of the VAR component or mean equation of the model, the time series are tested to determine the optimal number of lags to be included in the model's specification. According to the Akaike criterion, the correct number of lags is two, but Schwarz and Hannan-Quinn criteria suggest only one lag, i.e. a first order VAR would be the best choice (see Table 2).

Table 3 shows that the ARCH-LM test performed on a pre-estimated first-order VAR suggests the presence of ARCH effects, and the adequacy of a Multivariate GARCH model. The multivariate Jarque-Bera (J-B) test shows non-normality of the residuals and Engle and Sheppard's (2001) test suggests a constant conditional correlation process specification instead of a dynamic conditional correlation process. Based on the previous results, the decision was to estimate a VAR-CCC model with *t*-Student errors, whose mean equation is represented as:

$$\begin{pmatrix} r_{1,t} \\ r_{2,t} \\ r_{3,t} \\ r_{4,t} \\ r_{5,t} \\ r_{6,t} \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \end{pmatrix} + \begin{pmatrix} f_{11} & f_{12} & f_{13} & f_{14} & f_{15} & f_{16} \\ f_{21} & f_{22} & f_{23} & f_{24} & f_{25} & f_{26} \\ f_{31} & f_{32} & f_{33} & f_{34} & f_{35} & f_{36} \\ f_{41} & f_{42} & f_{43} & f_{44} & f_{45} & f_{46} \\ f_{51} & f_{52} & f_{53} & f_{54} & f_{55} & f_{56} \\ f_{61} & f_{62} & f_{63} & f_{64} & f_{65} & f_{66} \end{pmatrix} \begin{pmatrix} r_{1,t-1} \\ r_{2,t-1} \\ r_{3,t-1} \\ r_{4,t-1} \\ r_{5,t-1} \\ r_{6,t-1} \end{pmatrix} + \begin{pmatrix} e_{1,t} \\ e_{2,t} \\ e_{3,t} \\ e_{4,t} \\ e_{5,t} \\ e_{6,t} \end{pmatrix}$$

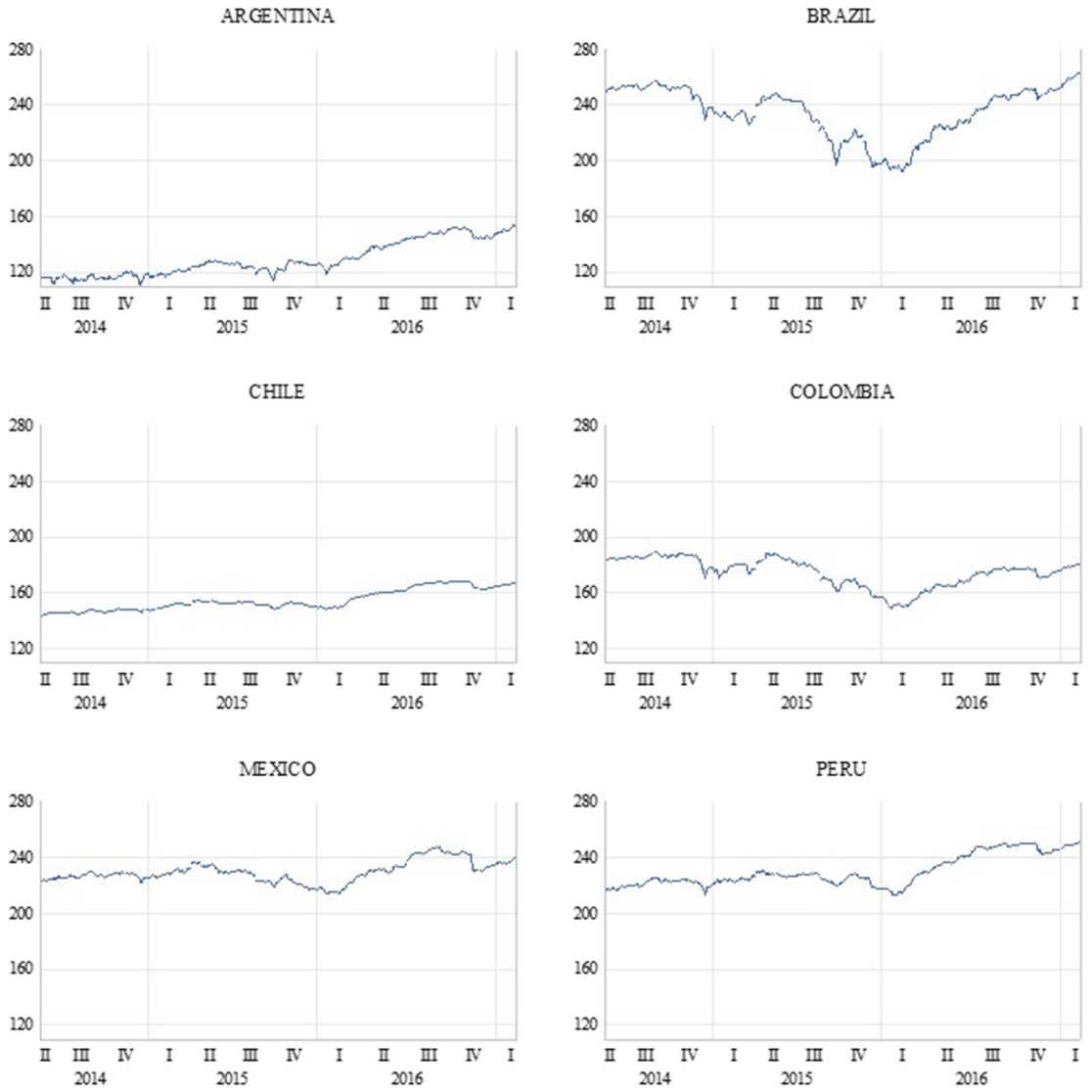

Fig. 1. CEMBIs for Argentina, Brazil, Chile, Colombia, Mexico and Peru (MAY 2014–FEBRUARY 2017).
Source: Data retrieved from a Bloomberg terminal, and generated by Standard and Poor's.

1 = Argentina, 2 = Brazil, 3 = Chile, 4 = Colombia, 5 = Mexico, 6 = Peru

which can be expressed in vector and matrix algebra terms as:

$$r_t = c + Fr_{t-1} + e_t.$$

The specification continues defining the CCC multivariate GARCH model:

$$e_t = H_t^{\frac{1}{2}} n_t.$$

The conditional covariance matrix is defined as

$$H_t = D_t^{\frac{1}{2}} R D_t^{\frac{1}{2}},$$

Table 1
Unit root tests for Latin American CEMBIs in levels and in log-returns.
Source: Data retrieved from a Bloomberg terminal, and generated by Standard and Poor's.

Phillips Perron unit root tests. Null hypothesis: the variable is not stationary

		ARG	BRA	CHI	COL	MEX	PER
In levels							
W/constant	t-Statistic	−0.183	−0.808	−0.560	−1.356	−1.471	−0.535
	p-Value	0.938	0.816	0.877	0.605	0.548	0.882
W/cons & trend	t-Statistic	−2.474	−0.475	−1.796	−0.999	−1.747	−1.551
	p-Value	0.341	0.985	0.706	0.942	0.729	0.811
W/out cons & trend	t-Statistic	1.680	0.263	2.051	−0.147	0.670	1.592
	p-Value	0.978	0.762	0.991	0.633	0.860	0.973
Log-returns							
W/constant	t-Stat.	−25.814	−17.748	−23.700	−19.929	−23.868	−23.943
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
W/cons & trend	t-Stat.	−25.812	−17.9141	−23.685	−19.914	−23.854	−23.926
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
W/out cons & trend	t-Stat.	−25.743	−17.758	−23.738	−19.943	−23.919	−24.004
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Augmented Dickey Fuller unit root tests. Null hypothesis: the variable is not stationary

		ARG	BRA	CHI	COL	MEX	PER
In levels							
W/constant	t-Stat.	−0.115	−1.070	−0.284	−1.458	−1.303	−0.223
	p-Value	0.946	0.729	0.925	0.554	0.630	0.933
W/cons & trend	t-Stat.	−2.397	−0.786	−1.813	−1.100	−1.623	−1.225
	p-Value	0.381	0.965	0.698	0.927	0.783	0.904
W/out cons & trend	t-Stat.	1.757	0.123	1.893	−0.205	0.644	1.918
	p-Value	0.981	0.721	0.986	0.612	0.855	0.987
Log-returns							
W/constant	t-Stat.	−25.814	−13.045	−10.499	−13.814	−14.945	−23.074
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
W/cons & trend	t-Stat.	−25.812	−13.144	−10.498	−13.850	−14.938	−23.069
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
W/out cons & trend	t-Stat.	−25.732	−13.053	−10.305	−13.824	−14.935	−22.954
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

KPSS unit root tests. Null hypothesis: the variable is stationary

		ARG	BRA	CHI	COL	MEX	PER
In levels							
W/constant	t-Stat.	2.782	0.706	2.588	1.238	0.886	2.120
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
W/constant & trend	t-Stat.	0.443	0.595	0.349	0.457	0.342	0.445
	p-Value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Log-returns							
W/constant	t-Stat.	0.077	0.393	0.076	0.215	0.087	0.107
	p-Value	n.s.	*	n.s.	n.s.	n.s.	n.s.
W/constant & trend	t-Stat.	0.029	0.113	0.069	0.112	0.080	0.077
	p-Value	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Notes: (*) Significant at 10%; (**) Significant at 5%; (***) Significant at 1%.
n.s. = not significant.
*MacKinnon (1996) one-sided p-values.

$$D_t = \begin{pmatrix} h_{1,t} & 0 & 0 & 0 & 0 & 0 \\ 0 & h_{2,t} & 0 & 0 & 0 & 0 \\ 0 & 0 & h_{3,t} & 0 & 0 & 0 \\ 0 & 0 & 0 & h_{4,t} & 0 & 0 \\ 0 & 0 & 0 & 0 & h_{5,t} & 0 \\ 0 & 0 & 0 & 0 & 0 & h_{6,t} \end{pmatrix}$$

Table 2
VAR order selection according to information criteria.
Source: Data retrieved from a Bloomberg terminal, and generated by Standard and Poor's.

Lag	AIC	SC	HQ
0	2.884244	2.925227	2.900132
1	2.624537	2.911421[a]	2.735757[a]
2	2.580375[a]	3.113159	2.786928
3	2.600054	3.378739	2.901939
4	2.63061	3.655195	3.027827
5	2.678923	3.949409	3.171472
6	2.69592	4.212307	3.283802
7	2.742534	4.504821	3.425748
8	2.784903	4.793091	3.563449

AIC: Akaike information criterion.
SC: Schwarz Bayesian criterion.
Hannan-Quinn criterion.
[a] Denotes VAR order chosen.

Table 3
ARCH effects & dynamic conditional correlation tests.
Source: Data retrieved from a Bloomberg terminal, and generated by Standard and Poor's.

ARCH-LM	p-Value	Multivariate J-B test	p-Value	Engle & Sheppard test	p-Value
2183.2936	< 0.01	3534.635	< 0.01	1.5137	0.4691

$$R = \begin{pmatrix} 1 & r_{1,2} & r_{1,3} & r_{1,4} & r_{1,5} & r_{1,6} \\ r_{2,1} & 1 & r_{2,3} & r_{2,4} & r_{2,5} & r_{2,6} \\ r_{3,1} & r_{3,2} & 1 & r_{3,4} & r_{3,5} & r_{3,6} \\ r_{4,1} & r_{4,2} & r_{4,3} & 1 & r_{4,5} & r_{4,6} \\ r_{5,1} & r_{5,2} & r_{5,3} & r_{5,4} & 1 & r_{5,6} \\ r_{6,1} & r_{6,2} & r_{6,3} & r_{6,4} & r_{6,5} & 1 \end{pmatrix}$$

The individual variances are given by the GARCH process $h_{i,\ t} = \omega_i + \alpha_i e_{i,\ t-1}{}^2 + \beta_i h_{i,\ t-1}{}^2$; and the covariances by $h_{i,t} = r_{ij}\sqrt{h_{i,t}h_{j,t}}$, $i, j = 1, 2, \ldots, 6$.

Table 4 shows the estimated parameters for the mean and variance equations. The results of the estimated VAR-CCC multivariate GARCH model suggest that Brazilian CEMBI returns are the most influential on the dynamics of the returns of the other indices, with highly significant coefficients and with positive signs in all cases. An increase in Brazil's CEMBI returns would be followed by increases in the other regional CEMBI returns the next day. That influence is particularly high for Argentina and Colombia and relatively small for Chile. For example, the day after a 1% increase in the Brazilian CEMBI, one can expect an average increase of 0.1305% in Argentina's CEMBI, 0.1143% in Colombia's CEMBI, and only 0.0263% in Chile's CEMBI. Excluding Brazil's CEMBI, the past return of Mexico's CEMBI also seem helpful to anticipate upward movements in the other Latin American markets. However, an upward movement in the Mexican CEMBI return will produce a downward adjustment in its own next-day returns. In a similar vein,

Table 4
The estimated VAR-CCC model.
Source: Data retrieved from a Bloomberg terminal, and generated by Standard and Poor's.

	$r_{\text{argentina,t}}$		$r_{\text{brazil,t}}$		$r_{\text{chile,t}}$		$r_{\text{colombia,t}}$		$r_{\text{rmexico,t}}$		$r_{\text{peru,t}}$	
c	0.0539	***	0.0309	***	0.0252	***	0.0193	**	0.0194	**	0.0299	***
$r_{\text{argentina,t}-1}$	−0.0690	*	−0.0178		0.0183	**	−0.0025		−0.0089		−0.0153	
$r_{\text{brazil,t}-1}$	0.1305	**	0.2876	***	0.0263	*	0.1143	***	0.0751	***	0.0421	*
$r_{\text{chile,t}-1}$	−0.1340		−0.0615		−0.0879	**	0.1753	**	0.1128	*	0.1384	***
$r_{\text{colombia,t}-1}$	0.0691		0.0586		0.0446	**	0.1134	**	0.0511		0.1029	***
$r_{\text{mexico,t}-1}$	0.2336	***	0.0160		0.0822	***	0.0303		−0.0896	**	0.0704	**
$r_{\text{peru,t}-1}$	0.0379		0.0400		0.0936	***	−0.0052		0.1312	***	−0.0883	**
ω_i	0.0031		0.0060	***	0.0033	**	0.0249	***	0.0388	***	0.0003	
α_i	0.0438	***	0.1181	***	0.0898	**	0.3206	***	0.1521	***	0.2184	***
β_i	0.9443	***	0.8493	***	0.7820	***	0.5048	***	0.3129	*	0.8192	***

Log-likelihood = −2473.5, Akaike information criterion = 646.7001, Schwarz Bayesian criterion = 988.5695, g.l. 5.659691.
*** Denotes the 1% significance level.
** Denotes the 5% significance level.
* Denotes the 10% significance level.

Table 5
Estimated cross-correlations.
Source: Data retrieved from a Bloomberg terminal, and generated by Standard and Poor's.

	Brazil		Chile		Colombia		Mexico		Peru	
Argentina	0.3346	***	0.1917	***	0.2656	***	0.1570	***	0.0903	***
Brazil			0.3947	***	0.5475	***	0.4159	***	0.3332	***
Chile					0.3513	***	0.3644	***	0.3217	***
Colombia							0.4299	***	0.3126	***
Mexico									0.3350	***

*** Denotes the 1% significance level.

an increase of the Chilean CEMBI returns anticipates next-day increments in Colombia, Peru and Mexico. Colombian CEMBI return could be useful to forecast future increases in Chile and Peru CEMBI returns. A rise in Peruvian CEMBI returns anticipates increases in Chilean and Mexican CEMBI returns. Lastly, the least influential CEMBI seems to be Argentina's, anticipating only Chilean CEMBI returns. Besides, interpreting the results in an alternative but complementary way, Chilean and Peruvian CEMBI returns are the most influenced by the returns of the other indices, while the Brazilian CEMBI is not influenced at all.

Regarding the estimated variance equations, almost all the estimated parameters of the GARCH processes are significant. Our estimates suggest that Peru's volatility process could be explosive, maybe requiring an alternative specification (e.g., a long memory process). However, this line of inquiry is not pursued here. Argentinean and Brazilian CEMBIs exhibit the highest levels of volatility persistence; at the opposite extreme, Mexico's CEMBI volatility is the lowest.

All the estimated CEMBI correlations (see Table 5) are highly statistically significant, but only small or medium in magnitude. The highest correlation (0.5475) corresponds to the Brazil-Colombia pair, followed by Colombia-Mexico (0.4299) and Brazil-Mexico (0.4159). At the other extreme we have the three lowest correlations: Argentina-Peru (0.0930), Chile-Mexico (0.1570) and Argentina-Chile (0.1917). The remaining correlations rank from 0.2656, for Argentina-Colombia, to 0.3947 for Brazil-Chile.

4. Conclusion

Financial globalization has opened favorable funding opportunities for corporations based in emerging countries, although not many firms have the size and managerial capacities to issue international bonds. Notwithstanding, the growing importance of international bond issues as a source of funds for new investments works as a complement to other mechanisms, such as foreign direct investment, international government bonds, and mergers and acquisitions, to attract capital towards emerging economies. A better knowledge of the nature and characteristics of corporate emerging market bonds contributes to make them attractive to portfolio and institutional investors.

In this paper, we review the statistical relationship that exists among international corporate bonds issued by Latin American corporations. The utilization of CEMBI time-series data is, to our knowledge, a first in the academic literature.

The VAR-CCC model, estimated to carry out our analysis, confirms the relative importance of the two largest Latin American economies corporate bond indices (Brazil and Mexico) with respect to the rest of the sample (Argentina, Chile, Colombia and Peru), and provides insights into the possible response of the latter to changing returns of the former.

The estimated correlations show that there is enough room for portfolio diversification, which is good news for international portfolio investors, as well as for Latin American corporate debt issuers. Looking at the advantages of diversification, investors' demand for Latin American bonds may provide significant resources to firms in Latin America.

There are still several areas in Latin American bond markets that require further research. First of all, a natural avenue is related to the concerns about capital flow reversals. A second avenue of interest includes the effects of economic policies, both foreign and local, on bonds' medium- and long-term performance. A third area of relevance is the analysis of the consequences of crises and their transmission to bond markets. Lastly, the long-run relationships among these markets require a detailed exploration. However, since CEMBI data has only been recorded for a relatively short period of time, testing for the presence of long-run relations (cointegration) is not yet feasible. This analysis will have to wait some time, until the observation period is long enough to provide the necessary inputs.

Conflict of interest

The authors declare that there is not conflict of interest of any kind in regards the paper entitled “Latin American Corporate Emerging Markets Bond Indices (CEMBIs): their recent evolution”.

References

Ayala, D., Nedeljkovic, M., & Saborowski, C. (2015). What slice of the pie? The corporate bond market boom in emerging economies (IMF working paper series no. WP/15/148). Retrieved from https://www.imf.org/external/pubs/ft/wp/2015/wp15148.pdf.

Baek, I.-M., Bandopadhyaya, A., & Du, C. (2005). Determinants of market-assessed sovereign risk: Economic fundamentals or market appetite? *Journal of International Money and Finance, 24*, 533–548.

Balakrishnan, R., Danninger, S., Elekdag, S., & Tytell, I. (2009). *The transmission of financial stress from advanced to emerging economies. IMF working paper 09/133.*

Washington, DC: International Monetary Fund.
Baldacci, E., Gupta, S., & Mati, A. (2008). Is it (still) mostly fiscal? Determinants of sovereign spreads in emerging markets (IMF working paper no. WP/08/259).
Bellas, D., Papaioannou, M. G., & Petrova, I. (2011). Determinants of emerging market sovereign bond spreads. In C. A. Primo Braga, & G. A. Vincelette (Eds.). *Sovereign debt and the financial crisis. Will this time be different?* (pp. 77–100). Washington, DC: The International Bank for Reconstruction and Development/The World Bank.
Cavallo, E. A., & Valenzuela, P. (2009). The determinants of corporate risk in emerging markets: An option-adjusted spread analysis. *International Journal of Finance and Economics, 15*(1), 59–74. https://doi.org/10.1002/ijfe.
Chen, L., Lesmond, D. A., & Wei, J. (2007). Corporate yield spreads and bond liquidity. *Journal of Finance, 62*(1), 119–149. https://doi.org/10.1111/j.1540-6261.2007.01203.x.
Christiansen, C. (2007). Volatility-spillover effects in European bond markets. *European Financial Management, 13*(5), 923–948. https://doi.org/10.1111/j.1468-036X.2007.00403.x.
Engle, R. F., & Sheppard, K. (2001). *Theoretical and empirical properties of dynamic conditional correlation multivariate GARCH.* (NBER working paper).
González-Rozada, M., & Levy-Yeyati, E. (2008). Global factors and emerging markets spreads. *The Economic Journal, 118*(54 11), 1917–1936.
IMF (2014). *Global financial stability report: risk taking, liquidity, and shadow banking. Curbing excess while promoting growth October 2014*.
Jiang, G. J., Konstantinidi, E., & Skiadopoulos, G. (2012). Volatility spillovers and the effect of news announcements. *Journal of Banking & Finance, 36*(8), 2260–2273. https://doi.org/10.1016/j.jbankfin.2012.04.006.
Kim, G. H., Li, H., & Zhang, W. (2016). CDS-bond basis and bond return predictability. *Journal of Empirical Finance, 38*, 307–337. https://doi.org/10.1016/j.jempfin.2016.07.006.
Lim, J. J., & Mohapatra, S. (2016). Quantitative easing and the post-crisis surge in financial flows to developing countries. *Journal of International Money and Finance, 68*, 331–357. https://doi.org/10.1016/j.jimonfin.2016.02.009.
MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics, 11*(6), 601–618.
Min, H. G. (1998). *Determinants of emerging market bond spread: Do economic fundamentals matter? World Bank policy research working paper*.
Min, H. G., Lee, D. H., Nam, C., Park, M. C., & Nam, S. H. (2003). Determinants of emerging-market bond spreads: Cross-country evidence. *Global Finance Journal, 14*(3), 271–286. https://doi.org/10.1016/j.gfj.2003.10.001.
Núñez Reyes, G., Perrotini Hernández, I., & López-Herrera, F. (2018). Gobierno corporativo y deuda internacional de empresas latinoamericanas. *Revista de la CEPAL, N° 126, diciembre* (pp. 31–45). .
Schneider, T. E. (2011). Is environmental performance a determinant of bond pricing? Evidence from the U.S. pulp and paper and chemical industries. *Contemporary Accounting Research, 28*(5), 1537–1561. https://doi.org/10.1111/j.1911-3846.2010.01064.x.
Skintzi, V. D., & Refenes, A. N. (2006). Volatility spillovers and dynamic correlation in European bond markets. *Journal of International Financial Markets, Institutions & Money, 16*(1), 23–40. https://doi.org/10.1016/j.intfin.2004.12.003.
Sy, A. N. R. (2002). Emerging market bond spreads and sovereign credit ratings: Reconciling market views with economic fundamentals. *Emerging Markets Review, 3*(4), 380–408. https://doi.org/10.1016/S1566-0141(02)00043-2.
Yang, J. (2005). International bond market linkages: A structural VAR analysis. *Journal of International Financial Markets, Institutions & Money, 15*(1), 39–54. https://doi.org/10.1016/j.intfin.2004.02.001.