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On the relationship between the real sector and the derivatives markets in major Latin American countries (2002-2016)

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Abstract

This paper is aimed at assessing the relationship between the real economy and the derivatives markets in three of the largest economies in Latin America (Brazil, Mexico and Argentina) during the period 2002-2016. To do this, Granger causality test among the variables are performed and, subsequently, a panel data model is specified and estimated. The main empirical findings, in the studied economies, are: 1) there is significant bidirectional Granger's causality between the real gross domestic product per capita and the derivatives markets and 2) the panel data model shows that the real economy is positively affected by the derivatives markets.

Keywords: Real economy, derivatives market, Granger causality, panel data.
JEL classification: O10, O31, O47.

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Sobre la relación entre el sector real y los mercados de derivados en los principales países de América Latina (2002-2016)

Resumen

Esta investigación tiene como objetivo evaluar la relación entre economía real y mercados de derivados en tres de las economías más grandes de América Latina (Brasil, México y Argentina) durante el período 2002-2016. Para ello, se realiza análisis de causalidad Granger entre las variables, posteriormente, se especifica y se estima un modelo de datos panel. Los principales hallazgos empíricos, en economías estudiadas, son: 1) existe causalidad Granger bidireccional significativa entre el producto interno bruto real per cápita y los mercados de derivados y 2) el modelo de datos panel muestra que la economía real se ve afectada positivamente por los mercados de derivados.

Palabras clave: economía real, mercado de derivados, causalidad de Granger, datos de panel.
Clasificación JEL: O10, O31, O47.

1. Introduction

The interrelation of the real economy with the financial sector has been an issue of interest for a long time; see, for instance, Goldsmith (1969), Mckinon (1973), Levine (1991), Levine and Zervos (1998), De Gregorio and Kim (2000), Greenwoood *et al*. (2010), Aali-Bujari *et al*. (2017), among others. Most of the above research highlights the existence of a positive relationship between financial markets and economic activity in the long run. Derivatives markets arise as a result of innovation and development in the financial sector and Black and Scholes' (1973) and Merton's (1974) papers emerged as pillars for subsequent research on the subject.

On the other hand, there are many theoretical and empirical investigations that suggest that companies that use derivatives for hedging increase their value. Moreover, banks that use derivatives have greater credit capacity as stated in Keely (1990), Hull and White (1995), Altman and Saunders (1997), Allayaninis and Weston (2001), Bratram *et al*. (2009), Sundaram and Das

(2011), Sipko (2011), Prabha *et al*. (2014), Purnanandam and Weagley (2016), and Aali-Bujari *et al*. (2016).

Derivatives markets have grown steeply in recent decades all over the world. In December 2016, the number of futures and option contracts exceeded 25 billion, grew 1.7% with respect to the previous year, which represents a historical maximum according to the information of the Future Industry Association (FIA). The derivatives market in Latin America grew 11.3%, much higher than the global growth rate, and the number of contracts exceeded 1.6 billion contracts, a record in the region. The use of derivatives markets among investors and firms for risk management has been increasing significantly, especially for hedging the risk of interest rates and exchange rates according to the information provided by FIA. The derivatives market is not only an immense market, but also a market that grows remarkably. The derivative contracts grew significantly in 2016, and most of the opened contracts correspond to contracts on exchange rates.

Table 1 shows the dynamics of the derivatives markets in the world by region. The proportion of contracts in the Asia-Pacific region was the largest, 36.40% of the total, followed by the North America region with 34.06%, and then by Europe with 20.54%. Notice that Latin America holds 6.40% of the total derivative contracts, and other regions 2.59%. Nevertheless, Asia-Pacific decreased the number of derivatives contracts by 5.3% in 2016 compared to 2015 and Latin America is the region that grew the most in 2016, followed by North America. On the other hand, about 55% of the total of the derivatives in 2016 are contracts on exchange rates, 11.56% of the total of the derivative contracts traded were made on commodities (raw materials), 11.68% of corresponded to interest rates and, finally, the lowest participation, of 10.68% was on stock.

Table 1
Evolution of the derivatives market in the world by region in 2016
(total number of contracts 25 219 926 317)

	Contracts	**Annual growth (%)**	**Participation in total (%)**
Asia-Pacific	9 180 674.887	-5.3	36.40
North America	8 589 865.508	4.8	34.06
Europe	5 180 068.421	8.0	20.54
Latin America	1 615 293.377	11.3	6.40
Others	654 024.124	-0.6	2.59

Source: data from FIA.

The purpose of this research is to examine the interrelation of the real economy and the derivatives markets in three of the largest economies in Latin America, Brazil, Mexico and Argentina. Specifically, it will be examined the volume of the derivatives market in US dollars during the period 2002-2016 and the real Gross Domestic Product per capita; the latter is a proxy for the performance of the real economy. To reach this goal, Granger causality test are performed, and panel data models are estimated. The data comes from the World Bank and the FIA. Subsequently, we establish several recommendations regarding the use of the derivatives markets to enhance the real sector.

This research is distinguished from the current state of the subject in the following: 1) it focuses on the largest economies in Latin America, emphasizing the three major ones, Brazil, Mexico and Argentina; 2) there is a greater availability of data with respect to the past; 3) a Granger's causality test is performed; 4) panel data models are estimated, which allows a large number of countries, variables and periods, and 5) problems of autocorrelation and multicollinearity are solved.

The present research is organized as follows: section 2 deals with a short review of the literature on the subject; section 3 presents the statistical description of the relevant variables; section 4 deals with the econometric analysis of panel data; section 5 provides the analysis and the discussion of the main empirical findings; finally, the conclusions and policy recommendations derived from this research are displayed in section 6.

2. Real economy and derivatives markets

Derivative products have experienced an extraordinary growth in both organized and over-the-counter markets. Interest rate derivatives are investment instruments with potentially higher yields than those prevailing in other financial markets. Moreover, derivatives offer a mean to isolate and distribute risks improving the information available on financial markets (Venegas-Martínez, 2011). There are other authors that center their attention on the disadvantages related to derivatives markets, such as their relationship with speculation, which increases volatility in spot markets associated sometimes with financial crises. Although the losses related to derivatives markets are kind of scandalous, the truth is that the benefits from derivatives for hedging are much more relevant. Finally, derivatives also provide information to participants in the financial markets serving to reduce volatility in the global financial market.

On the other hand, Allayannis and Weston (2001) study the use of currency derivatives and their potential impact on the value of the companies by analyzing a sample of 720 large non-financial corporations of the United States of America during the period 1990-1995. Their results indicate that the hedging causes an increase in the value of the firms and that the use of currency derivatives has a positive relationship with the value of the company. These authors estimate an increase of 4.87% in the value of the organizations. Moreover, the use of derivatives markets by non-financial corporations could reduce the rescue in financial crises (Bratram *et al*., 2009). Using derivatives also facilitates to determine the maturity level of the debt, the dividend policy, the trend of liquid assets, and international hedging operations.

Moreover, recently, the development of financial markets has accelerated due to the fact that financial markets have expanded, new markets have emerged, transaction costs have been reduced and better and cheaper information is available. The intermediaries have become more important and represent a large majority of the businesses in new markets in different types of derivatives. It is also important to point out that futures, options, forwards, and swaps can provide investors opportunities that could not otherwise be available. Derivatives are also useful for risk allocation between investors and companies and can diminish the costs of Diversification portfolios. Finally, derivatives prices reveal information to economic agents, making more stable the financial markets.

The theory of intermediation based on transaction costs (commissions and taxes) and asymmetric information are not easy to reconcile with the current changes in the global economy (Allen and Santomero, 1997). Derivatives are very useful in highly volatile environments, since they are used as means of protection from sudden and unexpected price changes, are settled at a future date and require very low initial investment for their acquisition (Sundaram and Das, 2011). The global derivatives market has expanded significantly and is still growing. Their interrelation with economic activity is analyzed by Purnanandam and Weagley (2016) by using an error correction model to study the interdependence between the global market of OTC derivatives and the economic activity of the countries of the Organization for Cooperation and Development Economic (OCDE). Their results indicate that there is too much heterogeneity of OTC derivatives contracts, which prevents them from reliably summarizing the impact on economic activity.

The relationship of the derivatives market with the real economy has been studied by Sipko (2011). This author points out that the trading

volume of the derivatives has increased in the last decades. This augment has also contributed considerably to several of the global financial crisis. Moreover, this author contrasts the growth of the nominal gross and real global gross domestic product with the growth rate of the global derivatives market mainly for the unorganized market (OTC). He concluded that it is essential to implement all the necessary measures to get rid of non-transparent transactions with products of certain contingent claims in order to put the world economy on a path of sustainable economic growth, solid and balanced. Also, Baluch and Ariff (2007) suggest that if there is sufficient liquidity in the underlying cash market, trade in derivative products can be sustained and the risk transfer function of the derivatives markets is a contribution to economic growth. These authors find a relationship between the derivatives market and growth. Recently, Aali-Bujari *et al*. (2016) analyze the impact of the derivatives market on economic growth in six of the major economies of the world (USA, European Union, Japan, China, India and Brazil) during 2002-2014. These authors estimate a panel data model by using the Generalized Method of Moments (GMM) and their central empirical finding is that economic growth is positively impacted by the derivatives market in all the studied economies.

3. Data and descriptive statistics

The data used in the present investigation was obtained from the World Bank and the FIA. The Gross Domestic Product and the real Gross Domestic Product per capita were obtained from the statistics provided by the World Bank (in USD at constant 2011 prices). While the other variable, the volume of the derivatives market, corresponding to each country, was obtained from the statistics of the FIA. All variables correspond to the period 2002-2016. The panel includes three economies of Latin America for the period 2002-2016. Below are the descriptive statistics of the variables and their notation:

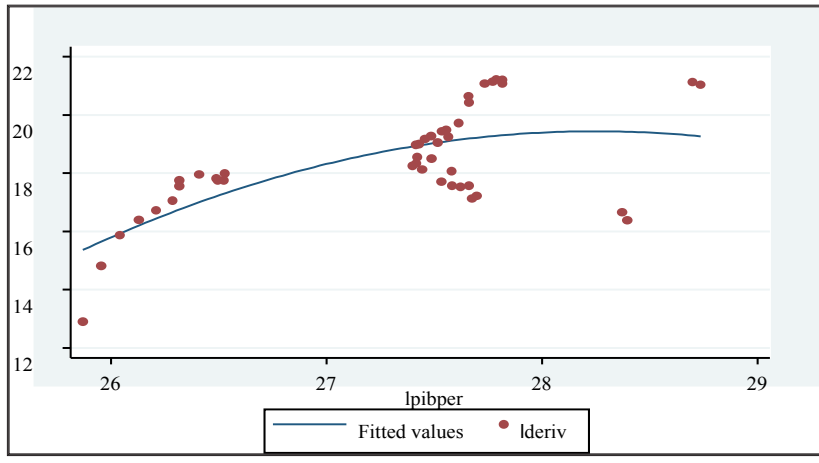
Table 2
Statistics of the variables

Variable	Notation	Average	Deviation	Minimum	Maximum
Derivatives Volume	*deriv*	3.44E+08	5.28E+08	399432	1.64E+09
Real GDP per capita	*pibper*	7147.64	1823.28	4503.58	11322.15

Source: authors' own elaboration with data from World Bank.

Table 2 shows the variables, their averages, standard deviations, maximum and minimum levels. For the three major economies in Latin America, the average volume of the derivatives market was 3.44E + 08 USD, with a standard deviation of 5.28E + 08, and a minimum of 399432 USD and a maximum of 3.02E + 09 USD. The average real GDP per capita is 7147.64 USD of the Purchasing Power Parity (PPP) of 2011, the standard deviation is 1823.28 USD, the minimum was 4503.58 USD, and the maximum 11322.15 USD. Most of the studies that deal with the link between the financial sector and the economic growth forecast that there is a direct relationship between them. The results of a graphical analysis are shown below, which relates the dependent variable Gross Domestic Product per capita and the volume of derivatives markets in Brazil, Mexico and Argentina.

Figure 1 confirms the dynamics of the derivatives market and its relation to real GDP per capita for Brazil, Mexico and Argentina. A positive relationship is observed between these variables indicating that the increase in volume of the derivatives market leads to an increase in the real gross domestic product per capita. That is, a greater expansion and development of the derivatives market, raises the real Gross Domestic Product per capita, which is used as a proxy for the real economy. Hence, the graph sustains the idea that the expansion of the derivatives market is positively related with the real economy.



Source: authors' own elaboration with data from World Bank

Figure1
Relation between real GDP per capita and the volume of derivatives in Latin America

4. Panel data analysis

In our context, panel data is a sample of characteristics that countries have over time, that is, it is a simultaneous combination of time series and cross-section data. The general model that is intended to be estimated in this research is given by:

$$y_{it} = \alpha y_{it-1} + \beta X_{it} + u_{it} \quad (1)$$

here y_{it} is the dependent variable that depends on i (the number of countries) and t (the year), $y_{it\text{-}1}$ is the lagged dependent variable, X_{it} are exogenous variables, and u_{it} are random perturbations. A problem that arises here is that the estimates for Ordinary Least Squares (OLS) are biased and to keep away from this, alternative models are used as fixed effects models (FE) and random effects models (RE).[1] The fixed-effect model is defined as:

$$y_{it} = \alpha y_{it-1} + \beta X_{it} + \varepsilon_{it} \quad (2)$$

[1] For a more detailed analysis of panel data see Baltagi (1995).

where $\varepsilon_{it} = v_i + u_{it}$. In this case, the error ε_{it} can be broken into two parts, a fixed part, constant for each country v_i, and other part that is random, u_{it}, that meets the OLS requirements ($\varepsilon_{it} = v_i + u_{it}$). The random effects model (RE) has the same specification as the fixed effects model with the exception that the term v_i, instead of being a fixed value for each country and constant over time it is a random variable with a variance $Var(v_i) \neq 0$ a constant mean value $E[v_i]$. Now, the specification of the model is.

$$y_{it} = \alpha\, y_{it-1} + \beta X_{it} + v_i + u_{it} \tag{3}$$

where v_i it is a random variable.[2]

5. Empirical results

5.1 Granger causality

Granger's causality analysis[3] is a fundamental analysis to detect correlation of past values of one variable with current values of another variable. The test states the null hypothesis that there is no causality between the two variables. The rejection criterion is based on detecting the value of *F*, and its level of probability. The associated p-value statistics is rejected at levels greater than or equal to 0.05.[4] The causality tests are presented below.

Table 3 shows the results from Granger's causality between the logarithm of the real Gross Domestic Product per capita and the logarithm of the volume of the derivatives markets in Brazil, Mexico and Argentina. The estimations point toward that, in general, there is causality in both directions between the real GDP per capita and the volume of derivatives from 2002 to 2016 until the fourth lag, except for Mexico and Argentina. In the former, the first lag of volume of derivatives does not cause real GDP per capita, and in the latter, the first lag of real GDP per capita does not cause the volume of derivatives. From the fifth lag there is no causality in any direction among variables. In summary, Granger's causality reveals that there is bidirectional causality between the real economy and the volume of derivatives markets in the region during the period 2002 to 2016 in the first four lags.

[2] The RE model is more efficient, but less consistent than fixed effects.
[3] For a more detailed analysis, review Granger (1969.
[4] See, for instance, Gujarati and Porter (2009), Wooldrige (2011), and Greene (2012).

Table 3
Granger causality between real GDP per capita and volume of derivatives

Pairwise Granger causality tests					
Country	Null Hypothesis	lag 1 Prob.	lag 2 Prob.	lag 3 Prob.	lag 4 Prob.
Brazil	lder does not Granger cause lpibper	0.348	0.3570	0.5260	0.7461
	lpibper does not Granger cause lder	0.8446	0.8577	0.6296	0.7069
Mexico	lder does not Granger cause lpibper	0.0266	0.1407	0.1168	0.3575
	lpibper does not Granger cause lder	0.4573	0.1217	0.4007	0.6987
Argentina	lder does not Granger cause lpibper	0.5747	0.6377	0.8889	0.7237
	lpibper does not Granger cause lder	0.0047	0.1147	0.3166	0.2191

PIB per: Real Gross Domestic Product per capita.

5.2 Fixed and random effects models

In this section, we specified a panel data model that allows assessing the impact of derivatives markets on the growth of the real Gross Domestic Product per capita focusing on a sample of three of the major economies in Latin America, Brazil, Mexico and Argentina. The variables are expressed in levels and in logarithms: (lpibper) is logarithm of the real Gross Domestic Product per capita, (lder) is logarithm of the volume of the derivatives market in USD. The period analyzed is 2002-2016, which allows for 3 groups and 15 years. The empirical results are stated in table 4, which shows the outcomes of four panel data estimates. The first column indicates that the dependent variable is the logarithm of the real Gross Domestic Product per capita, the explanatory variable is the logarithm of the volume of the derivatives market; a constant is considered. The coefficient of determination is estimated for the models and the Lagrange Multiplier and Hausman tests are carried out. The second column shows the estimate by OLS that indicates positive and significant coefficient of the logarithm of the volume market of derivatives, which also indicates adequate and proper signs. Finally, it is worth noticing that R^2 is 0.4635. The third column provides the results of the cross-sectional estimation where an inadequate sign is observed (negative) for the logarithm of the volume of derivatives, but it is not significant; the value of R^2 is 0.4635. The fourth column shows the estimate by RE, it indicates positive and significant coefficients for both the variable of the logarithm of the volume of derivatives and for the constant; the value of R^2 is 0.4635. The last column shows the results of the estimation by FE, it indicates ad-

equate, positive and significant signs for the logarithm of the volume of derivatives and the constant; the coefficient of determination R^2 is 0.4635. Next, the Lagrange Multiplier test is presented,[5] which has prob> chi2 =0.0000, which indicates that the estimate by RE is preferable to the estimate by OLS. Next, the Hausman test is presented with prob> chi2 = 0.000 indicating that the estimate by FE is preferable to the estimate by RE. Finally, the prob> F =0.0000 which indicates that the estimate by FE is preferable to the estimate by OLS. In short, the best model is the Fixed Effects model and indicates that a 1% increase in the volume of the derivatives market causes an increase of 0.1048503% in the real Gross Domestic Product per capita in the studied countries during 2002-2016. Hence, we find evidence, from the panel data model, that the real economy is positively affected by the derivatives markets in all the studied economies.

Table 4
Estimations of panel data models

Dependent variable dep: lpibper	OLS	BE	RE	FE
Lder	0.0896681 (0.000)	0.0717906 (0.523)	0.0896681 (0.000)	0.1048503 (0.000)
Constant	7.192432 (0.000)	10.16353 (0.089)	7.192432 (0.000)	6.913056 (0.000)
R^2	0.4635	0.44635	0.4635	0.4635
ML BP				Prob>Chi2=0.0000
Hausman				Prob>Chi2=0.0000 Prob > F =0.0000
Number of contries	3	3	3	3
Number of observations	45	45	45	45

Dependent variable: Log of real gross domestic product per capita. Parentheses the corresponding standard error.

Source: authors' own elaboration with data from World Bank. Stata package.

[5] If the test is not rejected, there are no differences between OLS and EA, and it is preferable to use the Ordinary Least Squares method.

6. Conclusions

The empirical evidence presented in this research shows that the derivatives market are relevant and have important effects on the real economy. Therefore, a greater effort in the development of derivatives markets will contribute to boost economic activity in Latin America. This research also shows, through a graphical analysis, that the increase in the volume of the derivatives market has a positive relationship with real GDP per capita in the three largest economies in Latin America (Brazil, Mexico and Argentina). Subsequently, Granger's causality analysis reveals that there is a bi-directional causal relationship between derivatives markets and real GDP per capita, which indicates a two-way positive impact. Regarding the panel data model, it was shown that the real economy is positively affected by the derivatives markets

Derived from the present research, the following recommendations are suggested for decision makers to find the appropriate instruments and incentives to promote derivatives markets to boost real economy: 1) Latin America must face the challenge of exploring more derivatives markets to increase the nominal value of its businesses, encouraging the potential of its organizations for boosting economic growth; 2) promoting the use of derivatives markets in Latin America allows a better risk distribution, increases investment volumes, mitigates volatility, deepens markets, contributes to the growth of companies and affects economic growth in the region; 3) encouraging the use of derivative markets allows a better allocation of resources and an efficient risk management in the productive sector; 4) using technology to regulate markets facilitates the use of derivatives promoting growth in the region; and 5) strengthen the derivative markets in Latin America diversifies the offer of financial instruments to cover the increase in the demand of investors, contributing to a greater depth of the market, which may enhance economic activity.

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