RESEARCH ARTICLE

AESTIMATIO, THE IEB INTERNATIONAL JOURNAL OF FINANCE, 2016. 12: 110-127 DOI:10.5605/IEB.12.6

Impact of derivatives markets on economic growth in some of the major world economies: A difference-GMM panel data estimation (2002-2014)

Aali-Bujari, Alí
Venegas-Martínez, Francisco
Pérez-Lechuga, Gilberto

▸ RECEIVED: 27 OCTOBER 2015
▸ ACCEPTED: 22 DECEMBER 2015

Abstract

The aim of this paper is to assess the impact of the derivatives markets on economic growth in six of the major world economies (the European Union, the United States, Japan, China, India, and Brazil) during the period 2002-2014. To do so, a dynamic panel data model is estimated with the Generalized Method of Moments (GMM). The main empirical finding is that, in these countries, derivatives markets have a positive influence on economic growth. The paper concludes with several recommendations that may help promote the use of derivative markets in order to boost economic growth.

Keywords:
Derivatives market, Economic growth, Panel data.

JEL classification:
G13, F43, B23.

Aali-Bujari, A. ✉ *Universidad Autónoma del Estado de Hidalgo, México. Email: alibujari@yahoo.es*
Venegas-Martínez, F. Instituto Politécnico Nacional, México. Email: fvenegas1111@yahoo.com.mx
Pérez-Lechuga, G. Universidad Autónoma del Estado de Hidalgo, México. Email: glechuga2004@hotmail.com

AESTIMATIO, THE IEB INTERNATIONAL JOURNAL OF FINANCE, 2016. **12**: 110-127

Impacto de los mercados de derivados en el crecimiento económico de algunas de las principales economías del mundo: **estimación de datos panel con GMM en diferencias (2002-2014)**

Aali-Bujari, Alí
Venegas-Martínez, Francisco
Pérez-Lechuga, Gilberto

Resumen

Este trabajo tiene como objetivo evaluar el impacto de los mercados de derivados sobre el crecimiento económico en las seis principales economías del mundo (Unión Europea, Estados Unidos, Japón, China, India y Brasil) durante el período 2002-2014. Para ello, se estima un modelo de datos de panel con el Método Generalizado de Momentos). El principal resultado empírico es que los mercados de derivados de las economías estudiadas influyen positivamente en su crecimiento económico. Por último, se proporcionan varias recomendaciones útiles para promover el uso de los mercados de derivados con el fin de impulsar el crecimiento económico

Palabras clave:

Mercado de derivados, crecimiento económico, datos de panel.

1. Introduction

The relationship between the financial sector and economic growth is an important issue that has been examined in a wide range of research papers, both theoretical and empirical. Many of them have focused on the impact of the financial sector on economic growth. Pioneering studies that highlight the role of the financial sector in the dynamism of the economy include Wicksell (1934), Schumpeter (1954), and Goldsmith (1969), which found that the financial system serves as an engine driving the economic activity.

On the other hand, Levine (1991) points out that stock markets facilitate long-term investments, helping to reduce risk and simultaneously offering liquidity to savers and funding to companies. The author concludes that stock markets do contribute to economic growth. Moreover, Levine and Zervos (1998) highlight that a significant number of empirical studies support the existence of a relationship between capital markets and economic growth in the long term.

Derivatives markets have experienced robust growth in recent decades. In December 2008, the volume of derivatives worldwide was approximately USD 592 trillion, much higher than the gross domestic product (GDP) of the United States (the world's largest economy), which was just over 13.8 trillion in 2007. In 2003, 92% of the 500 largest firms in the world used derivatives to manage risk in several ways, especially interest rate risk, according to information provided by the BIS (Bank for International Settlements). The derivatives market is not only an enormous market, but also one that is growing dramatically. Derivative contracts increased more than sevenfold in the period 1998-2014 (see Table 1).

Table 1. **Derivatives market worldwide (USD trillions)**

	December 1998	December 2008	December 2014
Total contracts	80.3	592.0	630.6
Exchange rate contracts	18.0	49.8	75.8
Interest rate contracts	50.0	418.7	505.4
Contracts on shares	1.5	6.5	7.9
Commodity contracts	0.4	4.4	1.8

SOURCE: SUNDARAM AND DAS (2011), AND DATA FROM BIS.

The role played by derivatives markets in boosting economic growth has been analyzed by authors such as Sill (1997), Baluch and Ariff (2007), Sundaram and Das (2011), Sundaram (2013), Sipko (2011), Prabha *et al*. (2014), among many others. Most have found a positive relationship between the development of the derivatives market and economic growth; however, a worldwide analysis of such a relationship has yet to be carried out. This research paper examines the impact of derivatives markets on economic growth in six major world economies (the European Union, the United States, Japan, China, India, and Brazil). Specifically, we assess the impact of variables such as the volume of the derivatives market in US dollars and the volume of the derivatives market as a proportion of GDP on economic growth over the period 2002-2014. We use a dynamic panel data model with information from the World Bank and the Future Industry Association (FIA) to produce empirical evidence on the relationship between the derivatives markets and economic growth. Finally, based on the results of the proposed econometric model (a dynamic panel data model), we provide several recommendations on the use of derivatives markets for driving economic growth.

With respect to the current literature, the distinctive characteristics of this study are as follows: 1) it focuses on a set of major world economies (EU, USA, China, India, Japan, Brazil); 2) it draws on a greater volume of available data from the past, 3) it provides a static and dynamic panel data analysis that allows the use of a greater number of countries, periods and variables; and 4) it addresses possible problems of multicollinearity and autocorrelation.

The paper is organized as follows: section 2 provides a brief review of literature on the subject; section 3 presents the statistical description of relevant variables; section 4 details the econometric analysis based on a panel data analysis; section 5 presents and discusses the main empirical findings for the analyzed countries; and finally, section 6 outlines the final conclusions and policy recommendations derived from this research.

2. Derivatives market and economic growth

Derivative products (or contingent claims) have undergone impressive growth in regulated markets as well as in over-the-counter markets, *i.e.*, non-organized markets. They offer investment possibilities with potentially higher returns than those prevailing in the bond and stock markets, providing investors with a risk-sharing mechanism (Venegas-Martínez, 2011; Ángeles-Castro and Venegas-Martínez, 2010). Derivatives products are financial instruments whose price depends on other underlying variables, such as stock prices and indexes, interest rates, exchange rates, commodity prices, and so on. That is, derivatives are financial instruments linked to an underlying asset or benchmark, and are useful tools for protecting from or hedging against price fluctuations in hostile volatile environments. Generally speaking, they meet the following conditions: 1) their value is based on the time value of money, which is not stated in a specific part of the contract; 2) they require a low initial net investment (significantly less than the investment needed to buy the underlying asset) and sometimes even no investment at all; and 3) they are settled at a future date.

The effects and consequences of derivatives markets in an economy can vary widely. Some researchers focus on their beneficial contributions as risk-sharing mechanisms, providing firms with tools to hedge against contingencies and better information on financial markets. Other researchers, however, focus on the disadvantages associated with derivatives markets and the role they play in attracting speculators, increasing volatility in spot markets, and exacerbating financial crises. Either way, derivatives markets have shown tremendous growth in past decades although the gains from derivatives could be much bigger. Of course, derivatives may also contribute to achieving an efficient allocation of risk in the economy as whole. They are also useful in enabling markets to provide new opportunities for investors. Furthermore, derivatives provide information to the financial markets and so play a part in helping to reduce future volatility in the global financial markets. Finally, derivatives markets help participants to form expectations about underlying asset prices in order to manage the risks associated with price changes, thereby facilitating future decision-making processes.

A number of other authors focus on the losses related to the derivatives markets[1] despite the potentially exceptional benefits that derivatives can offer firms, investors and the economy as a whole. Derivatives such as options, forwards, futures, and swaps may provide firms as well as public and private investors with opportunities that might not otherwise be available. Derivatives help allocate risk between investors and firms, and can reduce the costs of portfolio diversification. Moreover, the prices of derivatives may reveal information to traders, which can help build more stable financial markets. Finally, Baluch and Ariff (2007) found a relationship between the derivatives markets and economic growth, suggesting that if there is sufficient liquidity in the underlying cash market, derivatives trading can be maintained and they make an important contribution to economic growth by means of transferring risk.

Sipko (2011) studies the relationship between the development of the derivatives market and the real economy. He highlights that the trading volume of the derivatives market has increased significantly in recent decades and that this increase contributed significantly to the global financial crisis. The author also compares the overall growth of nominal and real GDP with the global derivatives market, and in particular the over-the-counter market (OTC).

In summary, derivatives markets have grown dramatically in recent decades and have helped traders to hedge risk against unexpected events, spreading the risk between

[1] *See, for instance, Sill (1997).*

firms and investors. They provide more complete information on the market that enhances firms' decision-making. Their short-term negative effects are often outweighed by their positive effects over the long term. The expectations that derivatives markets help shape, along with appropriate risk management, may contribute to future stability and enable firms in all sectors to expand by taking early actions for future investment, thus contributing to long-term economic growth.

3. Statistical description of the variables

The data used in this research were sourced from the World Bank and the Future Industry Association (FIA). GDP and per capita GDP were obtained from World Bank statistics (in USD at constant 2005 prices), while the volume of the derivatives market was taken from the FIA statistics. The derivatives market as a proportion of GDP is obtained as a ratio of the volume of the derivatives market and the product GDP (% of GDP) for each country. The research is carried out using a balanced panel data analysis for the period under study, 2002-2014. The period is, of course, restricted according to the data available for the six major world economies. The notation and statistics for all the variables are shown in Table 2. If the name of a variable features the prefix "l", it indicates the logarithm of that variable.

Table 2. Statistics for the analyzed economies 2002-2014

Variable	Notation	Average	Standard Deviation	Minimum	Maximum
Gross domestic product	pib	7.05E+12	6.04E+12	5.00E+11	1.85E+13
Gross domestic product per capita	pibper	23724.66	17007.23	2256.89	54629.5
Volume of derivatives markets	der	1.06E+09	1.05E+09	612272	3.44E+09

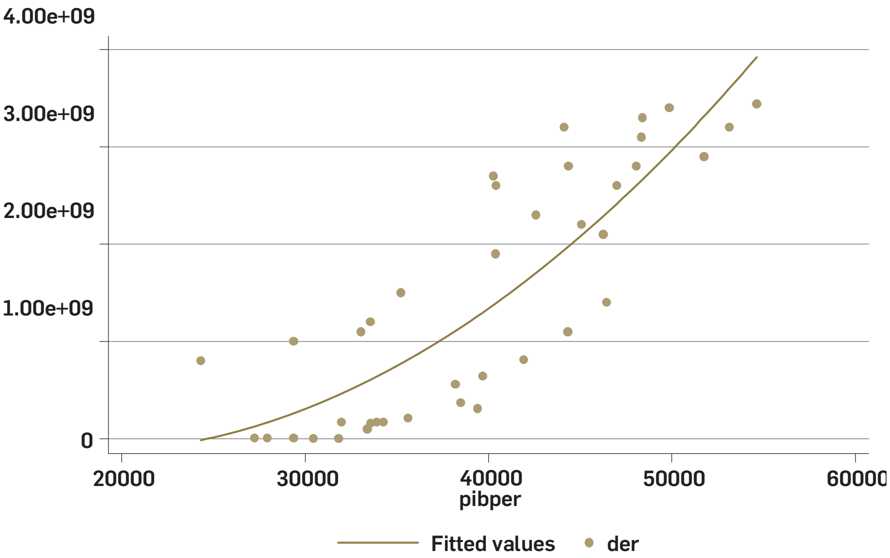
SOURCE: WORLD BANK AND FIA.

Table 2 shows the variables used in this research as well as their averages, standard deviations, and maximum and minimum levels. For the sample of the six economies under study, the average per capita GDP is USD 23,724.66, the standard deviation is USD , the minimum is USD 2,256.89, and the maximum USD The average volume of the derivatives market in the analyzed economies is USD 1.06E+09, with a standard deviation of USD 1.05E+09. The minimum is reached at USD 612,272 and the maximum at USD 3.44E+09.

Most studies of the relationship between the financial sector and economic growth predict a positive correlation. The following figures reinforce this argument, presenting a simple graphical analysis of derivatives markets that relates a dependent variable, per capita GDP, to the volume of derivatives markets.

Figure 1 shows the dynamics of the derivatives market compared with real per capita GDP in the United States, European Union and Japanese economies. A positive relationship between these variables is observed indicating a positive trend. This trend shows that the increase in the volume of the derivatives market may raise the real per capita GDP. That is, further expansion and development of the derivatives market tends to drive up real GDP per capita. In summary, the above chart supports the idea that the development of derivatives markets is positively associated with economic growth in the analyzed countries. The US economy has the greatest volume of derivatives, followed by the European Union and then Japan. Note that in the above statistical description, we are comparing two variables of a different nature: volumes of derivatives (stock variable) with per capita GDP (flow variable); the intention is simply to provide a quick graphic representation of the corresponding behavior of traded volumes in derivatives markets and per capita real GDP. This inconsistency will be eliminated in the econometric analysis and modelling that follows.

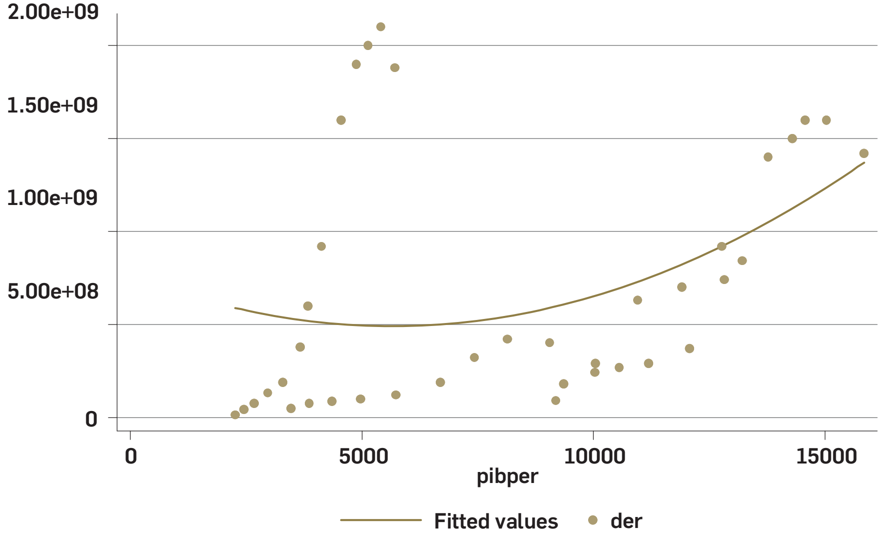
Figure 1. Relationship between derivatives markets with per capita GDP in the US, EU and Japan



SOURCE: AUTHORS' CALCULATIONS BASED ON DATA FROM WORLD BANK AND FIA.

Figure 2 shows the behavior of the derivatives market and its relationship with real per capita GDP for the emerging economies of China, India and Brazil. India has the greatest volume of derivatives followed by China and then Japan. The dots lying well above the trend function belong to India, indicating a significant difference in terms of the traded volume of derivatives. Notice, however, that after USD 5,000 per capita a positive relationship between these variables is observed.

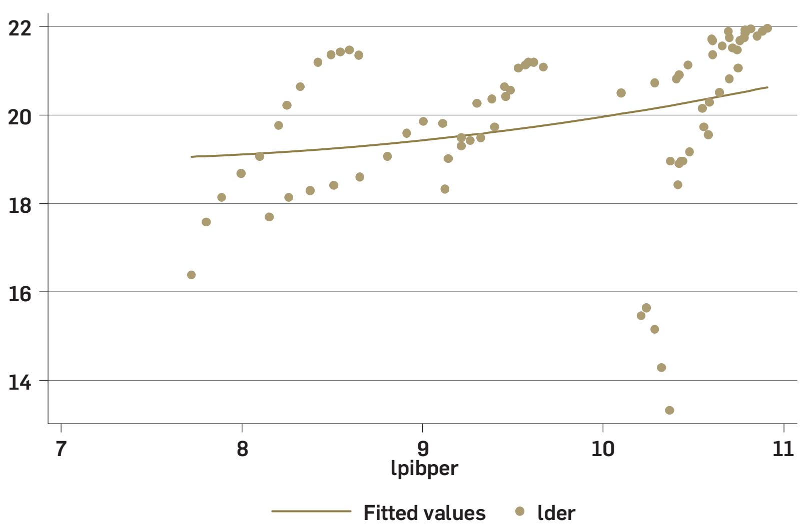
Figure 2. Relationship between the derivatives market and GDP per capita in China, India and Brazil



SOURCE: AUTHORS' CALCULATIONS BASED ON DATA FROM WORLD BANK AND FIA.

Figure 3 presents the activity of the derivatives markets with the per capita GDP for the six major world economies. With the exception of Japan, further expansion and development of the derivatives markets tends to raise domestic product per capita GDP; the dots far below the trend function represent Japan.

Figure 3. Relationship between derivatives markets and growth in the USA, EU, Japan, China, India and Brazil



SOURCE: AUTHORS' CALCULATIONS BASED ON DATA FROM WORLD BANK AND FIA.

4. Panel data analysis

The use of panel data analysis is becoming more common in applied research because it is an effective way of comparing different quantitative characteristics of countries over time. The panel data is a combination of time series and cross-sectional data. The general model is given by:

$$y_{it} = \alpha y_{it-1} + \sum_{k=1}^{K} \beta_k X_{kit} + u_{it} \tag{1}$$

where y_{it} is the dependent variable that changes as a function of both i (the number of countries) and t (the number of years), y_{it-1} is the lagged dependent variable, X_{itk}, $k = 1,2,...,K,$ denotes exogenous variables, and u_{it} are random disturbances. Estimation by ordinary least squares (OLS) will be biased, and so to avoid this alternative models are proposed for nested data regression with fixed effects (FE) and random effects (RE), which will be discussed in more detail below.

The use of panel data may offer several advantages: it examines a greater number of observations with more information; it supports a greater number of variables and generates less multicollinearity between data from explanatory variables; it is very efficient in terms of the estimation procedure; and it is possible to keep track of each observation unit. The main advantage of the panel data framework is that individual effects or heterogeneity can be tackled by allowing the constant term to vary across individuals (Greene, 2012; Racicot, 2015). There are certainly and number of disadvantages and limitations associated with panel data analysis; because the data are more complex to analyze, they do not consider heterogeneity or individuality. If not all country characteristics are observable, then errors will be correlated with the observations and the OLS estimators will be inconsistent. The fixed effects (FE) model involves fewer assumptions. In this case, it is assumed that the model to be estimated is:

$$y_{it} = \alpha y_{it-1} + \sum_{k=1}^{K} \beta_k X_{kit} + \varepsilon_{it} . \tag{2}$$

Here, we assume that $\varepsilon_{it} = v_i + u_{it}$, therefore

$$y_{it} = \alpha y_{it-1} + \sum_{k=1}^{K} \beta_k X_{kit} + v_i + u_{it} . \tag{3}$$

The error ε_{it} can be decomposed into two parts, a fixed part for each country v_i, and a random part u_{it} that meets the OLS requirements ($\varepsilon_{it} = v_i + u_{it}$), which is equivalent to performing a general regression and giving each individual a different origin point (ordinate).

The random effects (RE) model has the same specification as the fixed effects except that instead of the terms v_i, being fixed values for each country, this is a random variable with a mean value $E(v_i)$ and variance $\text{Var}(v_i)\neq 0$. Thus, the model specification satisfies

$$y_{it} = \alpha y_{it-1} + \sum_{k=1}^{K} \beta_k X_{kit} + v_i + u_{it} \tag{4}$$

where v_i is now a random variable. The RE model is more efficient but less consistent than that of fixed effects. For the Generalized Method of Moments (GMM) estimation of dynamic panel data[2], we will be using Arellano and Bond's (1991) proposal, and the difference-GMM extension from Arellano and Bover (1995), which is based on regressions in differences in order to control for unobservable effects.

The model in differences has also limitations or disadvantages, as shown by Blundell and Bond (1998), especially when the explanatory variables are persistent over time. Lagged levels of these variables are weak instruments for the equation in differences. Moreover, this approach skews the parameter estimators if the lagged variables (in this case the instrument) are close to being persistent; Blundell and Bond (1998) also propose the introduction of new moments on the correlation of the lagged variable and the error term. To do so, the condition of covariance between the dependent and lagged variable and the difference of the errors, as well as the change in the lagged dependent variable are added; and the error level must be zero. The estimators in the "system" use a set of equations in differences that are instrumented with the lags of the equations in levels. These estimators are also related to a set of equations in levels instrumented with the lags of the difference equations (Bond, 2002).

The GMM estimator in the "system" provides sufficient orthogonality conditions to ensure consistent estimators of the parameters, even with endogeneity problems and when unobserved individual country effects are present. This approach, which will be used to estimate the parameters, was developed by Arellano and Bover (1995) with a number of subsequent improvements made by Blundell and Bond (1998). The obtained estimator has advantages over other estimators, including FE and others. The GMM optimal estimator takes the following form:

$$\hat{\theta}_{GMM} = \begin{pmatrix} \hat{\alpha}_{GMM} \\ \hat{\beta}_{GMM} \end{pmatrix} = \left((y^*_{-1}; x^*)' z^* V_N^{-1} z^{*\prime} \begin{pmatrix} y^*_{-1} \\ x^* \end{pmatrix} \right)^{-1} \left((y^*_{-1}; x^*)' z^* V_N^{-1} z^{*\prime} y^* \right) \tag{5}$$

where the asterisk stands for consistent and efficient estimated coefficients. The above equation is a system consisting of a regression that contains information on levels and differences in terms of time. The condition

[2] *Racicot (2015) also proposes robust instruments for GMM estimation of panel data models.*

$$E\left(X_{i,t=s}(v_{it}-v_{i,t=1})\right)=0,\ \text{for } s\geq 2;\ t=3,\ldots,T, \tag{6}$$

is applied to the first part of the system and the regression in differences, which is written as follows:

$$E\left((X_{i,t=s}-X_{i,t-s-1})(v_{it}-v_{i,t=1})\right)=0,\ \text{for } s=1;\ t=3,\ldots,T \tag{7}$$

is applied to the second part in the regression in levels.

The lags of the variables in levels are used as instruments in the regression in differences. Only the most recent differences are used as instruments in the regression in levels. The model generates consistent and efficient estimated coefficients in such a way that:

$$y_i^{*}=\alpha y_{i-1}^{*}+\beta x_i^{*}+v_i^{*} \tag{8}$$

The error component v_i^{*} proceeds from both models, levels and differences, and can be defined as:

$$v_i^{*}=\binom{\Delta v_i}{u_i}\rightarrow\begin{cases}\Delta v_i=(\Delta v_{i3},\Delta v_{i4},\ldots,\Delta v_{iT})\\ u_i=(\Delta u_{i2},\Delta u_{i3},\ldots,\Delta u_{iT})\end{cases} \tag{9}$$

The matrix of instruments, which for the model in differences includes information about the explanatory variables and the lagged dependent variable, is given by:

$$Z_i=\begin{bmatrix} y_{i0} & x_i^2 & 0 & 0 & 0 & \ldots & 0 & 0 & 0 & \ldots & 0 & 0\\ 0 & 0 & y_{i0} & y_{i1} & x_i^3 & \ldots & 0 & 0 & 0 & \ldots & 0 & 0\\ 0 & 0 & 0 & 0 & 0 & \ldots & 0 & 0 & 0 & \ldots & 0 & 0\\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots & \ldots\\ 0 & 0 & 0 & 0 & 0 & \ldots & y_{i0} & y_{i1} & y_{i2} & \ldots & y_{T-2} & x_i^T \end{bmatrix} \tag{10}$$

Only the explanatory variables, with the exception of the lagged dependent variable, are entered as instruments for levels.

$$Z_j=\begin{bmatrix} x_j^2 & 0 & 0 & \ldots & 0\\ 0 & x_j^3 & 0 & \ldots & 0\\ 0 & 0 & x_j^4 & \ldots & 0\\ \ldots & \ldots & \ldots & \ldots & \ldots\\ 0 & 0 & 0 & \ldots & x_j^T \end{bmatrix}. \tag{11}$$

The instruments matrix takes the following form and is included in the GMM estimator:

$$Z = \begin{bmatrix} Z_1 \\ Z_2 \\ Z_3 \\ \vdots \\ Z_N \end{bmatrix} \qquad (12)$$

Finally, the covariance matrix of constraints of the moments, V_N, for the optimal satisfies:

$$V_N = E\left(Z'\Delta v \Delta v' Z\right). \qquad (13)$$

An additional test to ensure the proper functioning of GMM suggested by Arellano and Bond is the first and second-order autocorrelation tests and the Sargan test of over-identification that considers the statistics

$$s = \hat{v}' Z\left(\sum_{i=1}^{N} Z_i' \hat{v}\hat{v}' Z_i\right)^{-1} Z'\hat{v} \;\; \sim \chi^2(p-k-1). \qquad (14)$$

This test has a distribution χ^2, where $\hat{v}$ is the vector of residuals, Z the number of conditions imposed, k the number of parameters included in the vector β, and p is the number of columns of the matrix Z. The Sargan test examines the overall validity of the instruments analyzed. Subsequently, the existence of second-order serial autocorrelation of the differentiated error is examined, and the test is performed under the null hypothesis of no second-order autocorrelation.

5. Analysis of empirical results

The aim of this section is to develop a panel data model that allows us to study the relationship between the derivatives markets and per capita GDP growth in a sample of six major world economies. The variables are expressed in logarithms: "lpibper" is the logarithm of the per capita GDP, "lder" is the logarithm of the volume of the derivatives market in USD, and "lderpib" is the logarithm of the volume of derivatives as a proportion of GDP. The 2002-2014 period is analyzed, which provides a total of 78 observations, 6 groups and 13 years. We use the econometric software *Stata.*11to estimate a balanced panel model. The main results are shown in Table 3.

Table 3 shows the results of four estimations of the static panel data. The first column indicates that the dependent variable is the logarithm of real per capita gross output. The explanatory variable is the logarithm of the volume of the derivatives market. For all models the coefficient of determination is estimated and the Lagrange multiplier and Hausman tests are performed. The second column shows the OLS estimation indicating a significant coefficient estimator with positive sign of the log of the volume of the derivatives markets, and a significant intercept with positive sign. Finally, it should be noted that R^2=0.50, indicating a low coefficient of determination. The third column of Table 3 shows the results of the estimators BE[3]; the positive coefficient estimator and the intercept are not significant and the estimated R^2 is 0.5, which is low. The fourth column shows that the results of the estimation with FE have appropriate signs for all variables; all of them have positive significant coefficient estimators. We also obtain a significant positive intercept; however, a low coefficient of determination (R^2=0.5) is found. The last column shows the results of the estimation with RE indicating appropriate signs and significant coefficient estimators, but once again with a low coefficient of determination (R^2=0.5). Subsequently, we carried out the Lagrange multiplier test[4] yielding a prob> chi2 =0.0000, which indicates that the random effects estimation is preferable to OLS. Finally, the Hausman test provides[5] prob> chi2 =0.9853 demonstrating that the RE estimation is preferable to FE estimation.

Table 3. **Estimators of static panel data**

Variable dep: lpibper	OLS	BE	FE	RE
Lder	0.1359752 (0.000)	0.1524688 (0.678)	0.1359389 (0.000)	0.1359752 (0.000)
Constant	6.995704 (0.000)	6.667866 (0.382)	6.996427 (0.000)	6.995704 (0.000)
R^2	0.5040	0.5134	0.5000	0.4904
ML BP				Prob>Chi2=0.000
Hausman				Prob>Chi2=0.9853
Number of countries	6	6	6	6
Number of observations	78	78	78	78

Dependent variable: logarithm of per capita product (Standard error in parentheses).
SOURCE: WORLD BANK AND FIA.

Table 3 summarizes the estimates of the four static data panel methods, that is, OLS, "between", fixed effects and random effects, as well as the Lagrange Multiplier and Hausman tests. The results indicate that the estimated RE model is preferable, however the fit of the model is quite weak, which does not allow us to appropriately explain the impact of derivatives markets on economic growth with these kinds of

[3] *Between is a cross-sectional estimate using the means of the variables.*

[4] *The null hypothesis of this test is that $\sigma_u^2 = 0$. If the test is rejected, there is a difference between OLS and RE, and it is preferable to use the RE method.*

[5] *The null hypothesis for the Hausman test is that the estimates of random effects and fixed effects do not differ substantially; however, when it is not rejected (as in this case) RE is preferable.*

static models. In addition to the abovementioned testing problems, autocorrelation is detected as Durbin = 0.635, meaning that we reject the null hypothesis of no autocorrelation. Therefore, autocorrelation problems are corroborated. To address such problems, we use dynamic panel data models, estimated with GMM. The main results of the estimates of the dynamic panel data are shown in Table 4.

Table 4. **Estimates of dynamic panel data with GMM system**

Variable dep: lpibper		Difference GMM (One-sted)	Difference GMM (Two-step)	System GMM (One-sted)	System GMM (Two-step)
lpibper.L1		0.9165913	0.9440255	0.9552014	0.9713473
		(0.000)	(0.000)	(0.000)	(0.000)
Lder		0.0017609	0.0282294	-0.0065822	-0.007083
		(0.075)	(0.142)	(0.291)	(0.633)
Constant		0.8296	0.0253809	0.623216	0.4800041
		(0.000)	(0.971)	(0.000)	(0.699)
AR (1)	Prob>Z=		0.1643		0.0760
AR (2)	Prob>Z=		0.2714		0.1988
Sargan test	Prob>Chi2=	0.3944	1.000	0.3147	1.000
Number of countries		6	6	6	6
Number of observations		74	74	74	74

Dependent variable: logarithm of per capita product. Corresponding standard error in parentheses.
SOURCE: WORLD BANK AND FIA.

Table 4 shows the results of the estimates of the dynamic panel data. The first column indicates that the dependent variable is the logarithm of real per capita GDP, while the explanatory variables are the lag of the logarithm of per capita GDP, and the logarithm of the volume of the derivatives market in USD. First and second-order serial correlation tests were performed, as well as the Sargan test.[6] The second column shows the results of the estimation using one-step difference-GMM: the ratio of lagged per capita GDP, the logarithm of the volume of the derivative markets, and the intercept have significant coefficient estimators with appropriate positive signs. According to the Sargan test, there is no over-identification, thus supporting the model specification and the overall validity of the instruments.

The third column shows the results of the two-step difference GMM estimation. The coefficient of the lagged per capita GDP has a significant positive sign, which is expected. The coefficient of the logarithm of the volume of derivatives market also has the expected positive sign, but it is not significant. The first-order serial correlation is not rejected, whereas second-order autocorrelation is rejected. The Sargan test does not reject the null hypothesis of over-identification. Therefore, the model specification

[6] *It was instrumented with a maximum of two lags.*

and the overall validity of the instruments are not supported. The fourth column presents estimates for one-step system GMM, the lagged per capita GDP has the right sign (positive and significant), but the coefficient of the logarithm of the volume of derivatives market shows a non-significant negative sign, which is not the expected sign. The Sargan test rejects the null hypothesis; therefore, the model specification and the overall validity of the instruments are supported. The fifth column presents two-step system GMM estimates in which the coefficient of the lagged dependent variable (lpibper.L1) has the right sign and is significant. The coefficient of the logarithm of the derivatives market has the wrong sign and is not significant. On the other hand, first-order and second-order autocorrelation are rejected, while the Sargan test indicates an incorrect model specification.

Therefore, estimation through difference-GMM in one stage is preferable and more appropriate in relation to other estimations. Hence, this is the model that is to be chosen to explain the impact of derivatives markets on economic growth. Estimates indicate that the model of best fit is the estimated difference-GMM in one stage, indicating that derivatives markets are positively related to GDP. The estimates GMM in differences model shows that an increase of 1% of the volume of the derivatives market will have an impact of 0.17% in per capita GDP in economies that were the objects of this study during the period of 2002- 2014. As it can be observed, the impact is really important. This could be because derivatives markets may help form expectations of future asset prices. These expectations with an appropriate risk management may contribute to future stability and expansion to firms by taking anticipated actions for future investment that positively impacts economic activity in the long run.

6. Conclusions

Empirical evidence presented in this research shows that derivatives markets may have major effects on economic growth. Greater efforts made to develop derivatives markets will help boost economic activity, and thus improve the welfare of society. This research paper uses graphical and statistical analysis to demonstrate a positive relationship between the increasing volume of the derivatives market and real per capita GDP in six major world economies. Static and dynamic estimates from the panel data analysis reveal the importance of the volume of the derivatives market for economic growth.

The impact of the derivatives market volume was analyzed in connection with GDP growth in some of the major world economies. The empirical evidence presented here supports our hypothesis: an increased volume of the derivatives market has a positive impact on economic growth for the period 2002-2014. In light of this research, it is recommended that economic policy decision-makers should seek instruments and incentives to encourage derivative markets and boost economic growth, thus contributing to economic development and improved welfare. The development of the derivatives market should be a key objective for policy- and decision-makers to promote economic growth and welfare. It will therefore require the implementation all necessary regulatory measures to eliminate non-transparent transactions with products from certain derivatives in order to put the global economy on a sustainable path of strong and balanced economic growth.

Finally, the developed model does not reject the initial hypothesis of the paper: derivatives markets have a strong impact on GDP in six major economies. However, another interesting question arises in the same field: do derivatives markets predict economic growth? This question is already on the future research agenda.

References

- Ángeles-Castro, G. and Venegas-Martínez, F. (2010). Valuación de opciones sobre índices bursátiles y determinación de la estructura de plazos de la tasa de interés en un modelo de equilibrio general, *Investigación Económica*, **69**(271), pp. 43-80.
- Arellano, M. and Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-components Models, *Journal of Econometrics*, **68**(1), pp. 29-51.
- Arellano, M. and Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and Application to Employment Equations, *The Review of Economic Studies*, **58(**2), pp. 277-297.
- Baltagi, B. (1995). Editor's Introduction: Panel Data, *Journal of Econometrics*, **68**(1), pp. 1-4.
- Baluch, A. and Ariff, M. (2007). *Derivative Markets and Economic Growth: Is There a Relationship?*, Bond University-Globalisation and Development Centre, Working Paper Series No. 13, Gold Coast, Australia.
- Blundell, R. and Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models, *Journal of Econometrics*, **87(**1), pp. 115-143.
- Bond, S. (2002). Dynamic Panel Data Models: A Guide to Micro data Methods and Practice, *Portuguese Economic Journal*, **1**(2), pp 141-162.
- Goldsmith, R.W. (1969). *Financial Structure and Development*, Yale University Press, New Haven, USA.
- Greene, W. H. (2012). *Econometric Analysis*, Seventh Edition, Pearson, Boston.
- Levine, R. (1991). Stock Market, Growth, and Tax Policy, *Journal of Finance*, **46**(4), pp. 1445-1465.
- Levine, R. and Zervos, S. (1998). Stock Markets, Banks and Economic Growth, *The American Economic Review*, **88**(3), pp. 537-558.

■ Prabha, A., Savard, K. and Wickramarachi, H. (2014). *Deriving the Economic Impact of Derivatives, Growth Trough Risk Management*, Working paper, Milken Institute, Los Angeles, USA.

■ Racicot, F.E. (2015). Engineering Robust Instruments for GMM Estimation of Panel Data Regression Models with Errors in Variables: A Note, *Applied Economics*, **47**(10), pp. 981-989.

■ Sill, K. (1997). The Economic Benefits and Risks of Derivative Securities, *Business Review*, January-February, Federal Reserve Bank of Philadelphia.

■ Sipko, J. (2011). Derivatives and the Real Economy, *International Scientific Journal*, **1**(1), pp. 33-43.

■ Sundaram, K.R. and Das, S.R. (2011). *Derivatives Principles and Practice*, Mc Graw Hill, New York.

■ Venegas-Martínez, F. (2011). *Riesgos financieros y económicos. Productos derivados y decisiones económicas bajo incertidumbre* (Segunda Edición), Cengage Learning, México.

■ Wicksell, K. (1934). *Lectures on Political Economy*, Routledge, London.

Impact of derivatives markets on economic growth in some of the major world economies: A difference-GMM panel data estimation (2002-2014). *Aali-Bujari, A., Venegas-Martínez, F. and Pérez-Lechuga, G.*
AESTIMATIO, THE IEB INTERNATIONAL JOURNAL OF FINANCE, 2016. **12**: 110-127