Ohlson model by panel cointegration with Mexican data

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Abstract

In this study we use cointegration methods to investigate the relationship between the variables of the Ohlson model (stock price, earnings per share and book value) with panel data. The cointegration tests were applied at individual and group level (by all firms, and by sectors). The firms studied are from the Food & Beverage, Commercial and Construction economical sectors of the public companies listed on the Mexican Exchange Market. The data used was on a quarterly basis from 1997 to 2008. The empirical results, based on Johansen test, indicate that there are some individual cointegration relationships. The panel cointegration test show that the variables in the Ohlson model are not cointegrated for the Construction sector, although they are for the Commercial and Food&Beverage sectors.

Keywords: Ohlson model, value relevance, panel data cointegration.

El modelo Ohlson mediante cointegración de panel con datos mexicanos

Resumen

En este estudio utilizamos métodos de cointegración para investigar la relación entre las variables del modelo de Ohlson (precio de la acción, ganancia por acción y valor en libros) con datos de panel. Las pruebas de cointegración se realizaron de forma individual y a nivel de grupo total y por grupo de sectores. Las empresas estudiadas pertenecen a los sectores económicos de alimentos y bebidas, comercial y construcción, que cotizan en el Mercado Accionario Mexicano. Los datos utilizados fueron trimestrales de 1997 a 2008. Los resultados empíricos, basados en la prueba de Johansen, muestran que existen relaciones individuales de cointegración. Los resultados de las pruebas de cointegración en panel indican que las variables del modelo de Ohlson no están cointegradas para el sector de construcción, pero sí lo están para los sectores comercial y de alimentos y bebidas.

Palabras clave: modelo de Ohlson, valor de relevancia, cointegración en datos de panel.

Introduction

The main purpose of accounting information is to provide investors with relevant information in order to be useful for decision making. Following this purpose, different valuation models have been used in the accounting literature in order to contrast the value relevance of each. The first capital markets models used in empirical research placed a major emphasis on market efficiency. This informational perspective brought little attention to fundamental analysis of determinants of the companies' value. The usefulness of accounting numbers for firm valuation focus was emphasized in the works of Ou and Penman (1989) and Ohlson (1995).

We decided to follow the valuation perspective of the Ohlson model (by using book values and earnings as the two fundamental accounting variables that try to explain stock prices), in an attempt to analyze Mexican firms by assessing the cointegration relationship of the variables on the long term.

We focus the analysis on three economical sectors: Food & Beverage, Commercial and Construction activities. The period time of study is from 1997 to 2008 (a decade of stability and low inflation in Mexico).

The Food & Beverage and Commercial sectors were selected because their yearly average growth is above the country average, these activities usually continue because people need those supplies. In the other hand, the Construction sector depends on the extra resources of people for a new construction or improvements to their houses or office/commercial buildings. The Construction sector average growth rate is below the overall country average.

We expect to find a contrasting econometrical result in the cointegration relationship tests, because of the different economical behavior. The test was based on Maddala and Wu (1999) who used Fisher (1932) criteria, instead of the econometrical Pedroni test (2004) followed in Chang, Chen, Su and Chang (2008) where they found the cointegration relation between stock price and earnings.

The remainder of the paper is organized as follows: section 2 presents the Olhson model assumptions and results; section 3 lists the methodologies; section 4 presents the data and empirical results and section 5, the conclusions.

The Ohlson model

The Ohlson model (1995) made a hit in the market-based accounting research, because the financial information was considered as a value component. This model underlies the traditional belief that the company value consists of two main parts: the net investment value made in it (Book value) and the present value of the period benefits (Earnings) that put together bring the "clean surplus" concept of the Shareholders´Equity value. Ohlson (1995); specifically, motivates the adoption of the historical price model in value relevance studies, which expresses value as a function of earnings and book values (e.g., Collins et al. 1997; Francis and Schipper 1999).

The Ohlson model equation used in this study complies with the empirical methodology followed by Collins, Maydew and Weiss (1997) and Collins, Pincus and Xie (1999), and we decided to expand the study by using the four quarterly periods of each year, being as follows:

$$P_{it} = \alpha_{0t} + \alpha_{1t} BV_{it} + \alpha_{2t} E_{it} + \varepsilon_{it} \tag{1}$$

Where:

P_{it} the price of a firm *i* share three months after each quarterly period of year *t*,
BV_{it} the book value per firm *i* share at each quarterly period of year *t*, and
E_{it} the earnings per firm *i* share of each quarterly period of year *t*,
ε_{it} other value-relevant information of firm *i* of each quarterly period of year *t* orthogonal to earnings and book value.

Since 1995, the Ohlson model has been tested extensively with United States and Foreign Developing Countries' stock market data under different methodologies of analytical or empirical points of study. Few of the studies are analytical, such Ota's research (2000), who worked with the autoregression assumption, or Fukui (2001), who developed new considerations that brought about a modification of residual dynamics to the Ohlson model assumptions. However, most studies are conducted under regression analysis, few of them use the panel data analysis and none have tested the cointegration assumption.

The concept of cointegration is used to provide the long-run relation between the variables involved, in this case, between Stock Price (*P*), Book Value (*BV*) and Earnings (*E*). If cointegration exists, the variables move together in timeliness, this means that the accounting information co-varies with market values, making the Ohlson model relevant as an equilibrium relation in the Stock Market.

In accounting literature, there are few applications that employ Latin American data and even fewer that use information from the Mexican stock market. One example of research studies with Mexican data is Davis-Friday and Rivera (2000); though they do not follow the Ohlson model per se, the study analyzes features of the Mexican accounting model and describes the effect of the accounting differences between Mexico and the United States on the relation between equity prices and accounting information reported in the two countries and emphasize the inflation effect in the restatement of financial information. Durán, Lorenzo and Valencia (2007) found value relevance of the Ohlson model by panel data analysis for all the Mexican stock market from 1991 to 2003, but that study did not test the cointegration relationship between the variables.

Methodology

Data Base Characteristics

Financial accounting information and stock prices per share were taken from the first quarter of 1997 to the first quarter of 2008 Mexican stock market information, available in the Economatica data base[1] in December 2008, with the monetary denomination of constant Mexican pesos on November 30th. 2008.

The financial accounting variables are at the end of each quarter period (using 45 quarterly data) and the market stock price information is from the following quarter period of each data of the financial accounting variables.

Due to inflation in Mexico, the sample data is analyzed under a constant base rather than current pesos for each year. The first step was to carry out a whole restatement of the financial information. The variables were restated with the same purchase power as on November 30th., 2008. For this purpose, the Mexican General Price Index published by the Bank of Mexico was used, and the restatement process employed was in accordance with that detailed in Mexican Reporting Statement NIF-B10.[2] The restatement data was used to control the heteroscedasticity effect of using nominal data instead of constant pesos.

Variables Definitions

The independent variables from the consolidated financial statements are as follows:

- "Stockholders' equity" for book value. This is listed on the 65th row of the financial statements of each company (of Economatica Report). This variable is valuated in accordance with Mexican Reporting Bulletin C-11.[3]
- "Net gain or loss" for earnings. This is listed on the 127th row of the financial statements of each company (of Economatica Report). This variable is valuated in accordance with Mexican Reporting Statement B-3.[4]

[1] Economatica: Tools for Investment Analysis". General information available at http://manual.economatica.com

[2] Mexican Reporting Statement B-10 describes the Effects of Restatement in Financial Statements by the use of the General Index Price.

[3] Mexican Reporting Bulletin C-11 describes the characteristics of valuation of Stockholders´Equity as the Net Asset of the Balance Sheet.

[4] Mexican Reporting Statement B-3 describes the characteristics of valuation of the Income Statement in order to obtain the Net Income or Loss of each accounting period.

It was necessary that both concepts were under per-share calculation, so each was divided by the number of outstanding shares (row 193 of Economatica Report). These shares were adjusted by corporate actions. The corporate actions include the following record types: Stock Dividend, Stock Split, Capital Adjustment, Capital Reduction, Reversed Split, Rights Issue, Cash Dividend, Spin-off, Change in Lot Size, Retirement, Increase in shares of a different class, Increase of shares for merger/acquisition, Change in number of shares (unspecified), Conversion of securities into shares, Placement, No-exercise-of-Rights Issue, and Issuance of shares related to exercise of previous-rights issue.

The dependent variable is the price per share. For this concept, the closing entry of the market stock data was used. The Mexican securities market is relatively confined, focused around one national exchange, the Bolsa Mexicana de Valores (BMV), which has only one trading floor.[5] This is the only exchange in the country that lists equities. This stock market is relatively centralized and basic in its structure and operation. Like other countries in Latin America, Mexico's securities market is dominated by debt instruments. Investment in the securities market through the BMV has been driven by investment in mutual funds managed by local stock brokerage houses or banks.

Variables Econometrical Characteristics

Stock pricing, earnings and book value data are usually non-stationary, if we use the classical model regression it is possible to present the spurious regression problem and the standards assumptions for asymptotic analysis will not be valid.

The spurious problem means that the relation between the variables showed in the regression between them is not real, the estimated parameters are unbiased and they will not measure the relations between the variables only provide the independent growth behaviour of each one. Many time series are non-stationary but move together over time, so we identify that the variables are cointegrated. If a cointegration relationship exists, then the relation is not spurious. That means that the variables move together in time and a long-run equilibrium exists.

[5] For more information, please refer to http://www.cnbv.org.mx

We have to test the existence of a cointegration relation and we follow the Johansen test. The first step is to examine if the data are integrated of order one. If the series are integrated of first order then we use the Johansen cointegration test.

First, we test cointegration for the individual firms. Then we test for panel cointegration. Fisher (1932) derives a combined test that uses the results of the individual independent tests and Maddala and Wu (1999) propose an alternative approach to testing for cointegration in panel data by combining tests from individual cross-sections to obtain a test statistic for the full panel.

The idea is to include the *p*-value (π_i) cointegration test from each of the N individual cross-section i and calculate the statistic CT as:

$$CT = -2\sum_{i=1}^{N}\log(\pi_i)\,. \tag{2}$$

Under the null hypothesis of non-cointegration, $CT \sim \chi^2_{2N}$.

Empirical results

Financial accounting information and stock prices per share were taken quarterly from the 1997-2008 periods of public 22 Mexican companies (listed on the stock market).

Results from individual analysis

Table 1 indicates the percentage of variables I(1). We use the Augmented Dickey Fuller test. Only in 14 of the 22 firms the three variables are I(1) and qualify for to the cointegration test.

Table 1
Percentage of I(1) variables

Variables	1%	5%
P	86.36%	77.27%
BV	77.27%	72.73%
E	86.36%	77.27%

Table 2 shows whether the cointegration relationships exist between individual stock prices, book values and earnings. We use Johansen cointegration test by individual firms and the results indicate only seven firms have a cointegration relation between the three variables.

Table 2
Trace and Max. Eigen value statistics

Firm	Trace Statistic	Prob.	M.Eigen Statistic	Prob.	
BAFAR	13.1190	0.8861	7.5220	0.9305	
BIMBO					
COCA COLA	17.0901	0.6334	12.5779	0.4918	
CONTINENTAL					
FOMENTO					
GEMB					
GRUMA					
HERDEZ	47.4533	0.0002	31.1041	0.0014	*
MASECA	16.8362	0.6521	9.3125	0.8065	
GMODELO	30.2854	0.0439	18.4139	0.1151	*
ARA	34.1420	0.0148	21.3311	0.0469	*
GEOCORP	26.2236	0.1221	16.7166	0.1858	
HOGAR	25.1955	0.1546	17.0556	0.1694	
ICA					
COMERCI	25.5912	0.1414	14.8787	0.2975	
ELEKTRA					
FARBEN	33.5942	0.0174	17.5950	0.1457	*
GIGANTE	31.2882	0.0334	24.9146	0.0140	*
LIVERPOOL					
SABA	39.4514	0.0029	24.7761	0.0146	*
SORIANA	20.9074	0.3634	12.1142	0.5364	
WALMART	47.6714	0.0002	40.2810	0.0000	*

A analyzing panel data is relevant to test the relation, as a whole (by all the firms) and by sectors (by common economical activities). The idea of the group analysis is that the variables should be moving in the same way with their related firms. We choose only three economical sectors: Commercial, Construction and Food&Beverage.

Results from panel analysis

Table 3 shows the panel unit root test to examine the stationary properties of the data. The null hypothesis for the Im, Pesaran and Shin statistic (IPS) and the Fisher statistic (Maddala and Wu, 1999) are unit root. The null hypothesis for the Hadri statistic is not unit root. With Hadri test, all the variables have unit root test, they are not stationary. In the Construction sector we found that the variables are stationary (under the Fisher Test) and this is a difference from the other two sectors studied. The consequence of this is that the variables of the Construction sector are not cointegrated.

The Ohlson model then, is not relevant for this sector. It might be because the economical activities of the Construction sector are by many years cycles, so the accounting variables and the price are not related in the short run, so they cannot move together in time.

Table 3
Panel unit root test

	All firms		Comercial		Construction		Food	
Method	**Statistics**	**Prob.**	**Statistics**	**Prob.**	**Statistics**	**Prob.**	**Statistics**	**Prob.**
P								
IPS	5.9054	1.0000	4.3017	1.0000	-3.4830	0.0002	7.1844	1.0000
Fisher	47.5303	0.3309	7.6475	0.9587	30.9490	0.0001	8.9337	0.9837
Hadri	14.7191	0.0000	10.2422	0.0000	2.3887	0.0085	7.4115	0.0000
BV								
IPS	-5.5237	0.0000	4.9002	1.0000	-8.1213	0.0000	-7.4638	0.0000
Fisher	153.2311	0.0000	6.9009	0.9751	34.4772	0.0000	111.8530	0.0000
Hadri	11.9470	0.0000	9.8482	0.0000	4.2696	0.0000	2.9993	0.0014
E								
IPS	-2.9897	0.0014	2.1766	0.9852	-2.1645	0.0152	-5.0258	0.0000
Fisher	102.8877	0.0000	9.8003	0.8768	17.2733	0.0274	75.8141	0.0000
Hadri	13.2733	0.0000	9.4239	0.0000	1.6301	0.0515	2.5834	0.0049

Table 4 shows Fisher-based Johansen panel cointegration test. All the cases indicate that there is at least one cointegration relation between the three variables.

Table 4
Cointegration test

	All firms		Comercial		Construction		Food	
	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
Trace Statistic								
None	158.7454	0.0000	67.9323	0.0000	29.1987	0.0003	61.6143	0.0000
At most 1	63.9577	0.0262	28.8521	0.0250	13.9239	0.0838	21.1817	0.3865
At most 2	63.0762	0.0310	20.8299	0.1851	16.5498	0.0352	25.6966	0.1761
Max Eigen Statistic								
None	134.1705	0.0000	56.5536	0.0000	22.2687	0.0044	55.3482	0.0000
At most 1	54.7601	0.1282	27.5917	0.0354	10.3304	0.2426	16.8380	0.6635
At most 2	63.0762	0.0310	20.8299	0.1851	16.5498	0.0352	25.6966	0.1761

Conclusions

This study investigates the Ohlson model relation between stock prices (one period after), book values and earnings in the long run, for 22 firms from 1997 to 2008 (under quarterly basis). The long-run relationship was tested by the cointegration analysis for all the firms and by groups of economical activities. According with the data, the analysis were tested on the following sectors: Commercial, Construction and Food&Beverage.

The individual cointegration test suggests that the Ohlson model cannot be generalized for all firms. This paper provides results of common cointegration analysis, because it allows to test the information as a whole (by all the firms or by sectors).

The main results of this paper are by common panel cointegration tests that show:

- The Ohlson model is relevant for all the firms in a long-run equilibrium.
- The Ohlson model is relevant for the Commercial and Food&Beverage sectors in a long-run equilibrium.
- The Ohlson model seems to be non-relevant for the Construction sector, in a long-run equilibrium. This result is an important contrast beside the other sectors and the explanation of this behavior is underlies the characteristics of their operations.

A general conclusion of this paper is that the Ohlson model seems to provide explanation power only for the economical sectors whose accounting operation is reflected in the short-run more related to its business cycle time.

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