Valuation of Latin-American stock prices with alternative versions of the Ohlson model: An investigation of cointegration relationships with time-series and panel-data

Duran-Vazquez, Rocio and Lorenzo-Valdes, Arturo and Ruiz-Porras, Antonio

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VALUATION OF LATIN-AMERICAN STOCK PRICES WITH ALTERNATIVE VERSIONS OF THE OHLSON MODEL: AN INVESTIGATION OF COINTEGRATION RELATIONSHIPS WITH TIME-SERIES AND PANEL-DATA

Rocío Durán-Vázquez [*]
Universidad de las Américas Puebla

Arturo Lorenzo-Valdés [**]
Tecnológico de Monterrey, Campus Ciudad de México

Antonio Ruíz-Porras [***]
Universidad de Guadalajara, CUCEA

Resumen

Desarrollamos una investigación sobre los determinantes de los precios de las acciones en seis mercados emergentes latinoamericanos (Argentina, Brasil, Chile, Colombia, México y Perú). Evaluamos el modelo tradicional de Ohlson y una versión internacional del mismo. El modelo internacional incluye al índice Dow Jones como variable explicativa adicional. Usamos metodologías de cointegración para series de tiempo y para datos en panel para evaluar las relaciones de largo plazo entre las variables postuladas por ambos modelos. Usamos datos trimestrales para el periodo 2000:01-2010:03. Los resultados sugieren que las técnicas para datos en panel pudieran ser mejores que las de series de tiempo para efectos de las estimaciones. Ellos apoyan el uso de los modelos de Ohlson y, especialmente, el modelo internacional. Las variables son significativas y tienen los signos postulados. Estos resultados prevalecen cuando las empresas son tomadas como un todo y para las empresas comerciales y de construcción. Además, los resultados sugieren que los precios de los activos latinoamericanos son complementarios a los de EEUU en el largo plazo.

Palabras clave: Modelo de Ohlson, Latinoamérica, Cointegración

Abstract

We develop an investigation regarding the determinants of the stock prices in six Latin American emerging markets (Argentina, Brazil, Chile, Colombia, Mexico and Peru). We test the traditional Ohlson model and an international version of it. The international model includes the Dow Jones index as an additional explanatory variable. We use time-series and panel-data cointegration methodologies to assess the long-run relationships among the variables postulated by both models. We use quarterly data for the period 2000:01-2010:03. The results suggest that panel-data techniques may be better than time-series ones for the assessments. They support the use of the Ohlson models and, specially, the international one. The variables are significant and have the postulated signs. These results hold when the firms are considered as a whole and for the commercial and construction firms. Furthermore, the results also suggest that the Latin American asset prices are complementary to the US ones in the long run.

Keywords: Ohlson Model, Latin America, Cointegration.

JEL: **G12, M40, C33, C32**

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[*] Email: iguazurocio@gmail.com Address for correspondence: Departamento de Finanzas y Contaduría, Universidad de las Américas Puebla. Sta. Catarina Mártir, 72820, Cholula, Puebla, México.

[**] Email: arvaldes@itesm.mx Address for correspondence: Departamento de Contabilidad y Finanzas. Tecnológico de Monterrey, Campus Ciudad de México. Calle del Puente 222, Ejidos de Huipulco, 14380, Tlalpan, México DF, México.

[***] Email: antoniop@cucea.udg.mx Address for correspondence: Departamento de Métodos Cuantitativos. Universidad de Guadalajara, CUCEA. Periferico Norte 799, Núcleo Universitario Los Belenes, 45100, Zapopan, Jalisco, México.

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1. Introduction

The analysis of the determinants of stock prices is an area of interest among policy-makers, researchers and practitioners alike. Financial, economic and profitability concerns have guided the development of empirical studies to analyze such determinants. These studies pursue to identify the factors that affect such prices on the basis of several theories and models. However, currently we are far from a generalized consensus on such determinants. Such situation occurs because the outcomes of such studies usually depend on the modeling assumptions, the types of markets and economies analyzed and the empirical techniques used. Moreover, many of these studies have been accused of reporting spurious regressions.[1]

Here we develop an econometric investigation regarding the determinants of the stock prices in six Latin American emerging markets (Argentina, Brazil, Chile, Colombia, Mexico and Peru). Particularly we test the traditional Ohlson model and an international version of it. The international model includes the Dow Jones index as an additional explanatory variable under the assumption that Latin American asset prices depend on US markets. We use time-series and panel-data cointegration methodologies to assess the long-run relationships among the variables postulated by both Ohlson models. We use quarterly data for twenty-three Latin American firms for the period 2000:01-2010:03.

[1] When spurious regressions are estimated, the relationships among the variables are not meaningful (real). Such situation occurs when the variables are not stationary. The estimated parameters are biased and they do not measure the relationships among the variables.

Theoretically our study uses the Ohlson (1995) framework to valuate financial assets. We use such framework because it has several features that have made it popular among researchers in developed economies. Specifically, it is a discounted cash-flow model that uses accounting data to valuate financial assets. Its main theoretical assumption is that investors price securities as the expected present value of future dividends. By applying an accounting relation, Ohlson (1995) shows that the value of the equity of a firm can be expressed as the present value of its book value and net income. Thus the Ohlson model provides a way to link the theoretical model to observable accounting variables.

This investigation is motivated by several questions that define the scope and limits of our research. Indeed we use them as research guidelines. These questions are the following: What is the importance of the Ohlson model for valuation purposes? What advantages, if any, does an international version have over the traditional model? Is it possible to use the Ohlson model to valuate financial assets of emerging economies? What type of statistical data and methodologies may be useful to assess the model in the Latin American context? Are the predictions of the Ohlson model supported by the statistical evidence? Are these predictions statistically meaningful and valid in the long run?

Methodologically, we follow several steps to provide preliminary answers to the previous questions. First we justify and describe the specifications of the traditional and international Ohlson models. Then we describe the main features of the data. In the third step, we verify the order of integration of the time series for the individual firms. Then we assess the existence of cointegration relationships (v.g. we assess the existence of non spurious regressions), with traditional Johansen tests. The subsequent three steps involve the verification of the order of integration for the panel, the assessment of cointegration tests and the estimation of the cointegration relationships for panel data.

Statistically, we use the Johansen and Fischer/Johansen methodologies to assess the existence of cointegration relationships. We use them to avoid the estimation of spurious long run relationships. Particularly, we use the Johansen time-series methodology to assess cointegration among the variables of the individual Latin American firms. We use the Fischer/Johansen methodology to assess cointegration for panel data. We use these methodologies because they use similar procedures for the assessments. Moreover, they also use trace and maximum eigen-value tests for cointegration. Such features allow us to facilitate comparisons among the assessments.

The econometric results of the investigation show that the use of individual time-series may be somewhat limited to assess the Ohlson models. Particularly, regarding the traditional model, the results suggest that the statistical features of data allow the use of the traditional model only in nine out of twenty-three cases. The results regarding the international model increase such number to eleven out of twenty-three. These findings suggest that the international Ohlson model may be better than the traditional one to describe the Latin American asset prices. Moreover, the time-series evidence also provides some support to include the Dow Jones variable in the Ohlson model.

The results also suggest that panel-data techniques may be better than time-series ones for the assessment of cointegration. Indeed the tests for panel data support the use of the Ohlson models and, specially, of the international one. The estimated parameters are significant and have the postulated signs in the international specification of the model. Furthermore, the parameters of the Dow Jones variables are significant and positive. These results hold when the firms are considered as a whole; but also for the commercial and construction firms. Furthermore, the cointegration results also suggest that the Latin American asset prices are complementary to the US ones in the long run.

The chapter is organized in seven sections. Section 2 includes the literature review. Here we describe the theory underlying the Ohlson model and justify the main features of our study. Section 3 describes the institutional features of the six Latin American emerging markets. Section 4 focuses on the methodological issues. Specifically, the section describes the sources and variables, the specific models assessed and the econometric procedures used in our study. Section 5 shows the econometric results associated to the use of time-series and the Johansen methodology. Section 6 shows the results associated to the use of panel data and the Fischer/Johansen methodology. Section 7 concludes.

2. Literature review

Traditional economics explains financial prices in terms of the equilibrium of supply and demand under certain conditions. Such conditions include perfectly competitive and frictionless financial markets able to avoid arbitrage opportunities. When these conditions are satisfied, it can be shown that the current price of a financial asset must match its present value [Varian (2006)]. Discounted-cash-flow models are based on such equality for valuation purposes. In this type of models, the value of any asset is the net present value of some measure of future cash flow. Traditional valuations models (CAPM, APT) are discounted cash-flow models.

Ohlson (1995) develops a discounted cash-flow model that uses accounting data to valuate financial assets. It assumes that investors price securities as the expected present value of future dividends. By applying an accounting relation, the conditioning "clean surplus" one, the model shows that the value of the equity of a firm can be expressed as the present value of its book value and net income. Thus, equity values and stock prices are linear functions of the book value of equity and expected abnormal earnings. The empirical relevance of the Ohlson model is that it provides a way to link the discounted dividend model to observable accounting variables [Lo and Lys (2000)].

The Olson model has been used extensively to valuate equities mainly in developed economies. Studies for the US economy include the ones of Collins, Maydew and Weiss (1997), Frankel and Lee (1998), Dechow, Hutton and Sloan (1999) and Shi (2010). An application to Europe is the one of McCrae and Nilsson (2001). Studies refereed to the Japanese economy include the ones of Ota (2000) and Fukui (2002). However studies for emerging economies are scarce. Among these studies we include the ones of Lopes (2002), Durán-Vázquez, Lorenzo-Valdés and Valencia-Herrera (2007) and Khodadadi and Emami, (2009). These are studies for the Brazilian, Mexican and Iranian financial markets, respectively.

We should point out that emerging equity markets pose specific challenges for the Ohlson model. Since long, many authors have accepted that the risk exposure of emerging markets is different from developed ones [Harvey (1995)]. Even with not fully integrated capital markets, it is reasonable to suppose that international factors may influence equity markets. Such consideration explains why international versions and applications of some discounted-cash-flow models exist in the literature. However, this is not the case for the Ohlson model. Indeed there is not an international version of it. Such limitation might explain why the model has not been tested extensively in emerging markets.

Methodologically, it is also worthy to point out that the Ohlson model has been tested with different techniques. Most studies use OLS regressions. Some of them use time-series and panel data techniques. The diversity of techniques relies on the fact that they need to take into account all the assumptions of the model. Indeed, it is considered that many "empirical missaplications" exist due to this situation. Several authors have discussed and even have proposed solutions to this problem [see Lo and Lys (2000), Fukui (2002) and Medeiros-Cupertino and Barbosa-Lustosa (2004)]. However, currently there is no consensus about which may be the optimal technique.

We believe that further studies on the Ohlson model should verify cointegration for time-series and panel-data. As some authors have indicated "The general conclusion of (financial) theory is that an additional component of long-run return is required" [Chen, Roll and Ross (1986:383)]. This situation explains why some studies have tested other valuation models with cointegration techniques. However, this is not the case for the Ohlson model. Furthermore, for emerging markets, cointegration studies for panel-data may be necessary to combine the properties of time-series and cross-sectional data and to take advantage of the data available. However, few studies analyze these markets with panel-data techniques.

We believe that panel-data and cointegration studies are necessary for emerging economies. Studies that have used cointegration techniques to assess valuation models include the ones of Kwon and Shin (1999), Maysami, Howe and Hamzah (2004) and Asmy, et.al., (2009). However, none of these studies focuses on the Ohlson model. Studies that have tested the Ohlson model with panel data techniques are the ones of Khodadadi and Emami, (2009) and Lorenzo-Valdés and Durán-Vázquez (2010). In these studies it is assumed that the international capital markets do not have influence on the emerging markets. We must recognize that this is a very restrictive and unrealistic assumption for emerging markets.

We conclude this section by indicating that the review suggests certain research guidelines to test and assess the relevance of the Ohlson model. Specifically, the review suggests that further studies should focus on equity markets of emerging economies; but also, it suggest that they should include international determinants. From a methodological perspective, it supports the use of panel data techniques. Furthermore, it provides elements to support the analysis of potential long-run relationships between equity prices and other variables with cointegration techniques. These research guidelines are the ones that motivate and orientate this research.

3. Institutional features of the Latin American financial markets

In this section, we summarize some institutional features regarding the six Latin American emerging markets analyzed. The financial markets of Argentina, Brazil, Chile, Colombia, Mexico and Peru are described here because these markets are the most developed ones in the region. Moreover, we believe necessary this description due to the heterogeneous nature of the Latin American markets. Indeed the Latin American region includes twenty eight economies and a similar number of financial markets according to the CEPALSTAT database.

1. Argentinian Stock Exchange

The Bolsa de Comercio de Buenos Aires (BCBA) is the main financial center of Argentina. Its origins can be traced be traced back to 1854. The main instruments traded in such market include stocks, bonds, currencies and futures. Its´ main performance index is the Merval index. The Merval includes data of the fifteen most traded shares. The BCBA exchange market enlists around 134 firms.

2. Brazilian Stock Exchange

The Bolsa de Valores de São Paulo (BOVESPA) is the third largest stock exchange in the world. Moreover, it is the largest exchange market in Latin America. Its origins can be traced back to 1890. Its´ main performance index is the Ibovespa. The Ibovespa index includes data of the 80% of the traded shares. The BOVESPA exchange market enlists around 500 firms.

3. Chilean Stock Exchange

The Bolsa de Comercio de Santiago (BCS) is the main stock market of Chile. Its origins can be traced be traced back to 1893. The main instruments traded in such market include stocks, bonds, currencies and

futures. Its´ main performance indexes are the IGPA and IPSA indexes. The IGPA index includes data of the majority listed shares. The IPSA index includes data of the forty most traded shares.

4. Colombian Stock Exchange

The Bolsa de Valores de Colombia (BVC) is the main stock market of Colombia since 2001. However its origins can be traced back to 1928. The main instruments traded in such market include shares and other securities. Its´ main performance index is the IGBC index. The IGBC index includes data of the thirty most traded shares. The BVC exchange market enlists around 88 firms.

5. Mexican Stock Exchange

The Bolsa Mexicana de Valores, S.A.B. de CV (BMV) is the main stock market and financial center of Mexico. Its origins can be traced back to 1908. The main instruments traded in such market include shares and other securities.. Its´ main performance index is the IPC. The IPC index includes data of the thirty five most traded shares. The BMV exchange market enlists around 80 firms.

6. Peruvian Stock Exchange

The Bolsa de Valores de Lima (BVL) is the main stock market of Peru. Its origins can be traced back to 1971. The main instruments traded in such market include shares and other securities. Its´ main performance index is the IGBVL. The IGBVL index includes data of the largest and most traded shares. The BVL exchange market enlists around 250 firms.

We conclude by indicating that the previous review has shown us that the financial markets of the Latin American region are far from being homogeneous. The main market features (size, resources, experience and assets traded) are very different. These considerations suggest that the data available should be

adjusted in order to take into account the differences among the markets. These data adjustments, in addition to other methodological issues, are described in the following section.

4. Methodological issues

In this section we focus on the methodological design of our investigation. This section is integrated by three subsections. The first subsection focuses on the description of the sources and variables used to build the panel-data. The second describes the two specifications of the Ohlson framework used for the empirical assessments: the traditional model and the international one. Finally, the third subsection describes the cointegration techniques used to detect non spurious long-run relationships among the variables.

4.1 Database and variables

We use the Economatica database to obtain a sample of financial and accounting data. The sample includes firm-level accounting data of firms listed in the Latin American emerging markets. Furthermore it includes data on stock prices and the Dow Jones index. The sample includes quarterly data from the period 2000:01-2010:03. All data are in constant prices denominated in local currency (measured with reference to January, 2011). We should point out that we use certain conventions for econometric purposes. Specifically, the values of accounting variables of a period refer to the ones reported for the end the period. Stock prices of a specific period are the final ones of the following period.

We should recall that the financial data available in emerging economies are relatively limited. Indeed our sample includes data of twenty three Latin American firms. Such firms can be grouped on the basis of the type of economic activities that they develop (commercial, construction, foods & beverages). The heterogeneous nature of these economic activities suggests that firms´ performance and specific stock

prices may depend on the conditions prevailing in the local and global markets. Table 1 shows the specific Latin American firms analyzed grouped by economic sector.

Table 1. Latin-American firms grouped by economic sectors

Commercial	Construction	Food&Beverages
Lojas Americ	Rossi Resid	Molinos Rio
P.Acucar-Cbd	Ara Consorcio	Ambev
Exito	Geo Corporacion	BRF Foods
Comercial Mexicana	Ica Soc Controlad	Andina
Elektra Gpo	Grana y Montero S.A	Grupo Nac.Chocolate
Soriana Organizacio		Bimbo
Wal Mart de Mexico		Fomento Econ Mex
		GModelo
		Gruma
		Alicorp S.A.
		Corporación Lindley S.A.

The assessments of the two versions of the Ohlson model require several variables. Here we use "Stockholders' equity" for book value and "Net gain or loss" for earnings. Such variables are taken from the firms´ consolidated financial statements. In addition we express the variables in per share terms (the variable values are divided by the number of adjusted outstanding shares). We use the Dow Jones index as an additional variable for the international Ohlson model. The dependent variable for both models is the price per share (closing entry of the market stock data).

4.2 The Ohlson model and its international version

The assessments of the Ohlson model follow the methodological guidelines developed by Collins, Maydew and Weiss (1997) and Collins, Pincus and Xie (1999). The only difference with respect to these studies refers to the period length of the data available. Here we use quarterly data to expand the size of the

sample. Particularly, we assess two versions of the Ohlson model. We denominate these versions as the traditional and the international one. The first one includes the traditional book value and earning variables. The international version of the Ohlson model also includes the Dow Jones index as explanatory variable.

The two versions of the Ohlson model, the traditional and the international one, are respectively:

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

$$P_{it} = \alpha_{0t} + \alpha_{1t} BV_{it} + \alpha_{2t} E_{it} + \alpha_{3t} DJ_{it} + \varepsilon_{it} \quad (2)$$

Where:

P_{it} : Stock price of firm i, three months in advance each quarterly period t,

BV_{it} : Book value of firm i of each quarterly period t,

E_{it} : Earnings of firm i share of each quarterly period t,

DJ_{it} : Dow Jones index of each quarterly period t

ε_{it} : Error term.

We should point out that both Ohlson models aim at predicting prices in advance. The only difference between them is that the international model explicitly assumes that Latin American asset prices depend on US markets. However, we should point out that equation (2) a priori does not define the nature of such dependence. Asset prices between the US and Latin American markets may be complementary or substitute ones. In the first case, the coefficient α_{3t} will be significant and positive. Otherwise, it will be significant and negative. Theoretically, the coefficients of the other explanatory variables are postulated significant and positive.

4.3. Econometric methodology

The investigation relies on the use of time-series and panel-data cointegration methodologies to assess the relevance of the traditional and international specifications of the Ohlson model. Specifically, we use these methodologies in order to avoid the estimation of spurious long run relationships among the variables. We use the Johansen time-series methodology to assess cointegration among the variables of the individual Latin American firms. In addition we use the Fischer/Johansen methodology to assess cointegration for panel data. We use these methodologies because they use the same procedures. Moreover they rely on similar trace and maximum eigen-value tests for cointegration.

The Johansen time-series methodology is the traditional one for cointegration. Such methodology requires us to verify the existence of difference stationary variables I(1). Particularly, we use Augmented Dickey-Fuller (ADF) tests to assess the stationary of the individual time-series variables. Furthermore, the Johansen methodology requires us to estimate VAR models of the time-series variables associated to each Ohlson model per Latin American firm. We estimate these models in order to assess the maximum eigenvalue and trace tests. We assess the null hypothesis of no cointegration relationships under both tests for each VAR model. [2]

We use the Fischer/Johansen methodology to take advantage of the properties of time-series and cross-sectional data. This feature is particularly valuable given the limited availability of data in most Latin American economies. Furthermore, according to some econometricians the use of panel data significantly improves the quality and quantity of the analyses. Indeed such improvements would be impossible to

[2] We estimate both tests on the basis of the traditional Johansen methodology. However, Hjalmarsson and Österholm (2007), argue that the performance of the trace test appears worse than the one of the maximum eigenvalue test.

achieve by using only time-series or cross-sectional data [Gujarati (2003)]. The steps of the Fischer/Johansen methodology involve the estimation of the order of integration of the variables, cointegration tests and the estimation of the cointegration relationships.

The Fischer/Johansen methodology requires complementary tests for panel-data. We estimate the order of integration of the variables with three different unit root tests. We use the ones proposed by Im, Pesaran and Shin (IPS), Maddala and Wu (Fischer-ADF) and the Levin, Lin and Chu (LLC). We estimate the three tests for each Ohlson model specification because they assume different assumptions regarding the nature of the data. Furthermore, we test for cointegration with the combined test proposed by Maddala and Wu (1999). The test, known as the Fischer/Johansen one, involves the assessment of three null hypotheses regarding cointegration. Such test uses trace and maximum eigenvalue statistics.

The test of Maddala and Wu (1999) allows us to assess the hypothesis that the variables move together in time that and a long-run equilibrium exists. The test uses a chi-squared statistic to assess the existence of cointegration for the panel. The statistic uses the *p*-values associated to the cointegration tests of each of the *N* individual cross-section *i*. Thus the statistic combines results from all the individual cross-sections. The statistic, known as *CT*, is the following:

$$CT = -2\sum_{i=1}^{N} \log(\pi_i) . \qquad (3)$$

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

We summarize by indicating that the econometric methodology involves five steps to assess the relevance of the Ohlson framework for the Latin American firms. In the first one, we verify the order of integration of the time series for the individual firms. Then we assess the existence of cointegration relationships with

traditional Johansen tests. The subsequent three steps involve the verification of the order of integration for the panel, the assessment of cointegration tests and the estimation of the cointegration relationships for panel data. We use both methodologies for comparison purposes and to guarantee the existence of non spurious long-run relationships among the variables.

5. Econometric results I: Johansen methodology for time-series

Methodologically, we need to verify that each time-series variable associated to each Latin American firm are difference stationary, i.e. they should be I(1). Here we use the Augmented Dickey-Fuller (ADF) test to assess the stationary of the individual time-series variables. We use the ADF test because it allows us to control for the serial correlation that may exist in the time series. The null hypothesis associated to such test is that there is a unit root (i.e. the time series is non-stationary). The statistical results associated to the estimation of such ADF tests for the Ohlson model variables and their associated first differences are summarized in Table 2.

Table 2. ADF unit root tests for the firms´ variables

(p-values)

Firm	*P*	*ΔP*	*E*	*ΔE*	*BV*	*ΔBV*	
Molinos Rio	0.6151	0.0000	0.3051	0.0000	0.7875	0.0000	
Ambev	0.9953	0.0001	0.3422	0.0000	0.1662	0.0000	
BRF Foods	0.9080	0.0000	0.9846	0.0000	0.0259	0.0079	
Lojas Americ	0.6434	0.0037	0.0267	0.0000	0.1627	0.0000	
P.Acucar-Cbd	0.1317	0.0000	0.5024	0.0000	0.0477	0.0131	
Rossi Resid	0.2326	0.0013	0.2067	0.0000	0.0318	0.0076	
Andina	0.9952	0.0004	0.8597	0.0065	0.9435	0.0008	
Exito	0.9542	0.0000	0.0000	0.0000	0.2004	0.0923	
Grupo Nac.Chocolate	0.9745	0.0000	0.9253	0.0000	0.0842	0.0000	
Ara Consorcio	0.3456	0.0034	0.6035	0.0000	0.2504	0.0010	
Bimbo	0.9213	0.0000	1.0000	0.0273	0.9490	0.0252	
Comercial Mexicana	0.4697	0.0002	0.6466	0.0000	0.0448	0.2010	
Elektra Gpo	0.0010	0.1410	0.9708	0.0000	0.7421	0.4267	*
Fomento Econ Mex	0.9796	0.0000	0.9967	0.0000	0.9960	0.9711	
Geo Corporacion	0.3837	0.0042	0.6611	0.2164	0.8610	0.0022	*
GModelo	0.8726	0.0054	0.6786	0.0000	0.8018	0.0036	
Gruma	0.5565	0.0000	0.8231	0.0002	0.8519	0.0000	
Ica Soc Controlad	0.4211	0.0000	0.0100	0.1576	0.0669	0.0002	*
Soriana Organizacio	0.8315	0.0001	0.9497	0.0002	0.0334	0.0000	
Wal Mart de Mexico	0.9624	0.0003	0.9999	0.0000	0.9850	0.0144	
Alicorp S.A.	0.9809	0.0582	0.9958	0.0003	0.8672	0.0024	
Corporación Lindley S.A.	0.7890	0.0006	0.0377	0.0000	0.2729	0.0034	
Grana y Montero S.A	0.8194	0.0016	0.9802	0.0003	0.9284	0.0053	

Notes. P-values for the ADF unit root tests for the Price (P), Earnings (E) and Book value (BV) variables and their differences. An asterisk (*) denotes that the firm is non-eligible for the cointegration test.

Table 2 shows that most of the time-series variables of the Ohlson models are difference stationary on the basis of the ADF tests. Only four out of sixty-nine individual variables are not integrated of order one. The firms associated to such not integrated variables are Grupo Electra, Corporacion GEO and Sociedad Controladora ICA. In addition, we should point out that further ADF tests show that the Dow Jones index is integrated of order one, I(1).[3] Thus the results suggest that only twenty out of twenty three Latin American firms are eligible for the cointegration assessments.

[3] The ADF test p-values for the Dow Jones and its first-difference are 0.2314 and 0.0001.

The Johansen methodology requires us to estimate regressions and statistical tests in order to assure the existence of non spurious relationships. Here we assess the existence of cointegration with the individual time-series variables used by the traditional Ohlson model given by equation (1). Specifically we estimate a VAR model for each Latin American firm. Particularly we assess the maximum eigenvalue and trace tests associated to each VAR. Under both tests, we assess the null hypothesis of no cointegration relationships under certain statistical assumptions. [4] The results associated to such tests are summarized in Table 3.

[4] The Johansen cointegration tests assume that the data and the cointegration equations have linear trends (intercept and trend). Particularly, the cointegration tests are run with one lag in the first differenced terms of the series.

Table 3. Trace and maximum eigenvalue tests for the variables of the traditional Ohlson model (p-values)

	Trace		M.Eigen	
Firm	**Statistic**	**Prob.**	**Statistic**	**Prob.**
Molinos Rio	15.0070	0.7796	9.8397	0.7595
Ambev	20.1177	0.4149	16.7745	0.1829
BRF Foods	28.9384	0.0625 ***	23.2241	0.0250 **
Lojas Americ	20.5917	0.3836	10.2945	0.7166
P.Acucar-Cbd	22.2339	0.2857	11.3890	0.6085
Rossi Resid	32.3584	0.0248 **	18.7379	0.1047
Andina	17.1809	0.6267	8.8702	0.8428
Exito	24.0996	0.1963	18.4168	0.1150
Grupo Nac.Chocolate	35.8322	0.0089 *	19.4383	0.0848 ***
Ara Consorcio	20.3014	0.4026	16.3900	0.2029
Bimbo	21.8219	0.3085	13.4103	0.4152
Comercial Mexicana	29.9648	0.0478 **	17.2965	0.1585
Elektra Gpo	27.3863	0.0925	13.5244	0.4052
Fomento Econ Mex	22.8892	0.2516	19.7156	0.0779 ***
Geo Corporacion	32.8180	0.0218 **	19.5357	0.0823 ***
GModelo	21.8563	0.3065	12.1353	0.5344
Gruma	24.4492	0.1821	17.4350	0.1524
Ica Soc Controlad	37.0551	0.0061 *	20.8043	0.0555 ***
Soriana Organizacio	34.8813	0.0119 **	22.6869	0.0300 **
Wal Mart de Mexico	38.5492	0.0038 *	26.1895	0.0089 *
Alicorp S.A.	24.8820	0.1657	15.6065	0.2487
Corporación Lindley S.A.	32.5258	0.0237 **	23.6637	0.0215 **
Grana y Montero S.A	27.8902	0.0817 ***	16.3087	0.2073

Notes: Trace and maximum eigenvalue statistics for cointegration. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent, respectively.

Table 3 suggests that eleven firms are characterized by cointegration relationships on the basis of the rejection of the null hypothesis associated to the Johansen test. This finding implies that for these firms there may not be spurious long run relationships among the analyzed variables. However, this number is over-estimated because not all the firms are eligible for the cointegration assessments according to our previous results.[5] We need to adjust it. Such adjustment reduces the number to nine firms. From a financial

[5] Notice that Corporacion GEO and Sociedad Controladora ICA, that seem to be characterized by cointegration relationships, are non eligible for the assessments. See Table 2.

point of view these findings imply that the traditional Ohlson model may be useful to describe the asset prices of nine firms in the best of the cases.

We use again the Johansen methodology to assess the existence of non spurious relationships among the time-series variables used in the international Ohlson model. Such model, given by (2), includes the Dow Jones index as additional explanatory variable. Like before we estimate a VAR model for each Latin American firm and the associated maximum eigenvalue and trace tests. For comparison purposes, we maintain the same statistical assumptions in the new cointegration assessments. The results associated to the Johansen cointegration tests are summarized in Table 4.

Table 4. Trace and maximum eigenvalue tests for the variables of the international Ohlson model (p-values)

	Trace		M.Eigen	
Firm	**Statistic**	**Prob.**	**Statistic**	**Prob.**
Molinos Rio	32.2163	0.6002	14.8973	0.7563
Ambev	42.6440	0.1415	24.1792	0.1286
BRF Foods	57.0932	0.0054 *	44.4247	0.0002 *
Lojas Americ	26.4980	0.8725	10.7316	0.9718
P.Acucar-Cbd	38.6067	0.2762	19.7976	0.3553
Rossi Resid	48.6449	0.0421 **	27.9771	0.0445 **
Andina	40.8669	0.1930	18.3229	0.4685
Exito	45.5788	0.0806 ***	25.0251	0.1027
Grupo Nac.Chocolate	55.3145	0.0085 *	27.8829	0.0458 **
Ara Consorcio	55.4336	0.0083 *	32.2887	0.0115 **
Bimbo	38.9341	0.2629	21.2198	0.2631
Comercial Mexicana	56.9804	0.0055 *	24.3498	0.1230
Elektra Gpo	44.8002	0.0942 ***	19.6479	0.3660
Fomento Econ Mex	49.1865	0.0373 **	20.7103	0.2941
Geo Corporacion	53.1761	0.0146 **	27.6711	0.0487 **
GModelo	41.3641	0.1773	25.0732	0.1014
Gruma	39.5916	0.2374	23.5629	0.1507
Ica Soc Controlad	52.9523	0.0154 **	25.7841	0.0835 ***
Soriana Organizacio	55.0149	0.0092 *	26.8038	0.0627 ***
Wal Mart de Mexico	57.0740	0.0054 *	26.3079	0.0721 ***
Alicorp S.A.	51.1589	0.0237 **	24.2483	0.1263
Corporación Lindley S.A.	49.3807	0.0357 **	29.7588	0.0259 **
Grana y Montero S.A	43.7954	0.1143	18.4452	0.4585

Notes: Trace and maximum eigenvalue statistics for cointegration. One, two and three asterisks indicate significance levels of 10, 5 and 1 percent, respectively.

Table 4 suggests that fourteen firms are characterized by cointegration relationships on the basis of the Johansen tests. However, again we should point out that this number is over-estimated because it includes the three non eligible firms found previously. Like before, we need to adjust such number in order to include only eligible firms. Such adjustment reduces it to eleven firms. These findings imply that the international Ohlson model may be useful to describe the asset prices of eleven firms. Indeed the inclusion of the Dow Jones variable, as a proxy for US financial assets, seems relevant to explain the asset prices of the Latin American firms.

We summarize our findings by indicating that the use of individual time-series may be limited to assess the adequacy of the Ohlson models. Particularly, regarding the traditional model, the results suggest that the statistical features of data allow the use of such model in nine out of twenty-three assessments. The results regarding the international model increase such number to eleven out of twenty-three. These findings may suggest that the international Ohlson model may be better than the traditional one to describe the Latin American asset prices. Moreover, they provide support to include the Dow Jones variable in the assessments.

6. Econometric results II: Fischer/Johansen methodology for panel-data

Methodologically, we verify the stationary properties of the panel data. Here we use three different unit root tests for panel data. Specifically we use the ones proposed by Im, Pesaran and Shin (IPS), Maddala and Wu (Fischer-ADF) and the Levin, Lin and Chu (LLC). The null hypothesis associated to the three tests is that there is an unit root. For estimation purposes we develop the unit root tests under certain assumptions. These assumptions include the use of individual fixed effects as regressors and the selection of automatic lag difference terms (using the Schwarz criterion for the lag differences). The statistical results are summarized in Table 5.

Table 5. Panel unit root tests for the firms´ variables

(p-values)

	All firms		Commercial		Construction		Food&Beverages	
Method	**Statistics**	**Prob.**	**Statistics**	**Prob.**	**Statistics**	**Prob.**	**Statistics**	**Prob.**
P								
IPS	3.3976	0.9997	0.0518	0.5207	-0.3222	0.3737	5.1328	1.0000
Fisher	33.3672	0.9178	20.8838	0.1046	9.0855	0.5240	3.3979	1.0000
LLC	2.5004	0.9938	-0.4026	0.3436	-0.2850	0.3878	3.8994	1.0000
ΔP								
IPS	-18.8221	0.0000	-9.8922	0.0000	-7.4129	0.0000	-14.3139	0.0000
Fisher	397.1624	0.0000	116.0027	0.0000	69.0868	0.0000	212.0729	0.0000
LLC	-19.2507	0.0000	-10.7847	0.0000	-7.4157	0.0000	-14.5037	0.0000
E								
IPS	2.9518	0.9984	0.5475	0.7080	-0.3538	0.3618	4.1089	1.0000
Fisher	58.3802	0.1041	31.3980	0.0049	14.2401	0.1623	12.7421	0.9401
LLC	2.0688	0.9807	0.7877	0.7846	-0.2818	0.3891	3.1328	0.9991
ΔE								
IPS	-23.1272	0.0000	-15.0722	0.0000	-8.4262	0.0000	-15.8713	0.0000
Fisher	508.5870	0.0000	182.4274	0.0000	88.8450	0.0000	237.3146	0.0000
LLC	-21.1777	0.0000	-15.2778	0.0000	-5.3615	0.0000	-15.4487	0.0000
BV								
IPS	-0.3396	0.3671	-1.6009	0.0547	-0.7136	0.2377	1.2960	0.9025
Fisher	62.2823	0.0550	26.5657	0.0219	15.5225	0.1141	20.1942	0.5709
LLC	1.5202	0.9358	1.0380	0.8504	-0.4481	0.3271	1.8322	0.9665
ΔBV								
IPS	-13.6622	0.0000	-6.1287	0.0000	-6.8344	0.0000	-10.2983	0.0000
Fisher	291.6680	0.0000	71.1772	0.0000	63.5547	0.0000	156.9361	0.0000
LLC	-4.2206	0.0000	0.8041	0.7893	-5.0004	0.0000	-3.4641	0.0003

Notes. P-values for the panel unit root tests for the Price (P), Earnings (E) and Book value (BV) variables and their differences.

Table 5 shows that all the panel-data variables are difference stationary on the basis of at least two out of three tests. This finding suggests that all the panels are integrated of order one and that all the Latin American firms are eligible for the cointegration assessments. This result holds when the firms are considered as a whole or when they are grouped into economic sectors. However, the results also suggest that commercial firms might be the exception. According to the Fischer-ADF and LLC statistics, respectively, the earning and book values variables may not be I(1). Despite of these exceptions, we should

point out that the results confirm that the use of cointegration techniques for panel data may be adequate for econometric purposes.

We test for cointegration in panel-data with the combined test proposed by Maddala and Wu (1999). Under such test, we assess three null hypotheses regarding cointegration under the same assumptions used for the individual Johansen cointegration assessments. The first null hypothesis states no cointegration. The second states at most one cointegration relationship. The third one states at most two cointegration relationships. Such tests are assessed with trace and maximum eigenvalue statistics. The results associated to the variables included in the traditional and international Ohlson models are summarized in tables 6 and 7, respectively.

Table 6. Trace and maximum eigenvalue tests for the variables of the traditional Ohlson model

(Fischer/Johansen combined tests for cointegration in panel data)

	All firms		Commercial		Construction		Food&Beverages	
	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
Trace Statistic								
None	110.7161	0.0000	38.5082	0.0004	32.0694	0.0004	40.1385	0.0104
At most 1	61.3959	0.0640	23.0998	0.0587	19.3965	0.0355	18.8995	0.6515
At most 2	60.5603	0.0735	20.7600	0.1079	18.0605	0.0540	21.7398	0.4755
Max Eigen Statistic								
None	88.5000	0.0002	27.9354	0.0145	21.6275	0.0171	38.9371	0.0143
At most 1	54.0132	0.1949	20.2974	0.1210	15.8065	0.1053	17.9092	0.7114
At most 2	60.5603	0.0735	20.7600	0.1079	18.0605	0.0540	21.7398	0.4755

Notes: Trace and maximum eigenvalue statistics for cointegration in panel data.

Table 7. Trace and maximum eigenvalue tests for the variables of the international Ohlson model

(Fischer/Johansen combined tests for cointegration in panel data)

	All firms		Commercial		Construction		Food&Beverages	
	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.	Statistics	Prob.
Trace Statistic								
None	137.8585	0.0000	42.8351	0.0001	37.0724	0.0001	57.9509	0.0000
At most 1	67.7367	0.0201	26.8414	0.0202	17.1357	0.0714	23.7596	0.3600
At most 2	42.7795	0.6079	16.5803	0.2792	11.1542	0.3456	15.0451	0.8603
Max Eigen Statistic								
None	106.2560	0.0000	23.6789	0.0501	27.7223	0.0020	54.8548	0.0001
At most 1	57.3378	0.1220	21.1169	0.0987	14.1379	0.1668	22.0831	0.4549
At most 2	34.3668	0.8966	14.7033	0.3987	7.4111	0.6862	12.2525	0.9519

Notes: Trace and maximum eigenvalue statistics for cointegration in panel data.

The Fischer/Johansen tests suggest that that there is at least one cointegration relationship among the variables analyzed [See Tables 6 and 7]. This result holds when the firms are considered as a whole or when they are grouped into economic sectors. This finding implies that the variables have common stochastic trends and long run equilibrium values. Thus estimated relationships may not be spurious. Particularly, Table 6 shows that the variables of the traditional Ohlson model are cointegrated. Table 7 confirms this result but also shows that the same occurs with the Dow Jones variable. Thus the results support the statistical relevance of the international model.

The previous statistical tests suggest that the traditional Ohlson model may have equation specification errors. Specifically, the results of Table 7 suggest that estimations of equation (1) may have omitted-variable biases. The omission of variables (like the Dow Jones one), has serious consequences for estimation purposes [Gujarati (2003)]. Estimations of the variables retained may be biased and inconsistent. Additionally, the variances and standard errors may be incorrectly estimated (invalidating the usual hypothesis-testing procedures). These considerations make us to focus on the international Ohlson model given by equation (2). Table 8 summarizes the estimations associated to such model.

Table 8. Cointegration relationships on the basis of the international Ohlson model

(Estimations with fixed-effects regressions for panel data)

	α_0			α_1			α_2			α_3		
	Coefficient	Std. Error		Coefficient	Std. Error		Coefficient	Std. Error		Coefficient	Std. Error	
All firms	-954.4956	381.1804	**	12.8349	0.9514	*	0.4880	0.0493	*	0.0882	0.0363	**
Commercial	-1786.7162	929.1024	***	7.9481	2.0539	*	0.5042	0.0894	*	0.1729	0.0884	***
Construction	-22.0802	4.7360	*	0.4820	0.1404	*	0.3057	0.0571	*	0.0029	0.0005	*
Food&Beverages	-467.6200	332.8339		-2.5984	0.9983		1.8236	0.0653		0.0355	0.0316	

Notes: Estimations based the international Ohlson model (equation 2). One, two and three asterisks indicate significance levels of 10, 5 and 1 percent, respectively.

Table 8 shows the estimations of the cointegration relationships for panel data associated to the international Ohlson model. In most of the regressions, the estimated parameters of the traditional Ohlson model are significant and have the postulated signs. Furthermore, the coefficients of the Dow Jones variables are significant and positive. We should point out that these results hold when the firms are considered as a whole. However, when the firms are grouped into economic sectors these results also hold for the commercial and construction ones. Indeed the assessments suggest that none of the Ohlson models may be useful for explain the stock prices of the food-and-beverage firms.

We summarize our findings by indicating that the results estimated with panel data techniques generally support the relevance of the Ohlson models. Particularly they support the adequacy of the international one. Indeed the estimation of the cointegration relationship suggests that, in the long run, the Latin American asset prices are complementary to the US ones. When the Dow Jones increases the same occurs to the Latin American asset prices. From a financial view, these findings suggest that some difficulties may exist to diversify financial portfolios using US and Latin American assets. Furthermore they confirm that panel data may be necessary for the econometric assessments.

7. Conclusions

Here we have shown an econometric investigation regarding the determinants of the stock prices in six Latin American emerging markets (Argentina, Brazil, Chile, Colombia, Mexico and Peru). We have tested the traditional Ohlson model and an international version of it. The international model includes the Dow Jones index as an additional explanatory variable under the assumption that Latin American asset prices depend on US markets. We have used time-series and panel-data cointegration methodologies to assess the long-run relationships between the variables for both models. We have used quarterly data for the period 2000:01-2010:03.

The econometric evidence shows that the use of individual time-series may be limited to assess the adequacy of the Ohlson models. Particularly, regarding the traditional model, the results suggest that the statistical features of data allow the use of such model in nine out of twenty-three assessments. The results regarding the international model increase such number to eleven out of twenty-three. These findings may suggest that the international Ohlson model may be better than the traditional one to describe the Latin American asset prices. Moreover, the time-series evidence provides some support to include the Dow Jones variable in the assessments.

The results confirm that the use of panel-data may be necessary for the assessment of the cointegration relationships. Indeed the statistical tests support the adequacy of the Ohlson models and, specially, of the international one. The estimated parameters of associated to the traditional Ohlson variables are significant and have the postulated signs in the international specification of the model. Furthermore, the ones of the Dow Jones variables are significant and positive. These results hold when the firms are considered as a whole and for the commercial and construction firms. Furthermore, the cointegration results also suggest that, in the long run, the Latin American asset prices are complementary to the US ones.

The previous results imply that we cannot dismiss the importance of international financial markets in the emerging ones. International financial relationships exist among the financial markets of the global economy. Particularly the evidence exposed quantifies such relationships in the context of the determination of the Latin American asset prices. Furthermore, the results support the necessity to extend valuation models, like the Ohlson one, in order to capture the trends in the international financial markets. Financial markets are not autarkic ones and valuation models should take into account such international relationships. We believe that further research may be developed along these ideas.

We conclude by indicating that the importance of the financial relationships between the US financial markets and the Latin American emerging ones should not be dismissed. Indeed our findings not only quantify some of these relationships, but also show that some difficulties may exist to diversify assets among these markets. Such findings suggest that further research on the international determinants of asset prices in the emerging markets may be necessary. Particularly we believe that the further developments in the Ohlson model should emphasize the interrelations among the international markets. We hope that our study may be considered a first step in such direction.

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