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Who Influences Latin American Stock Market Returns? China versus USA

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Abstract

This paper studies the influence of Chinese and American macroeconomic variables in the stock market indices of Brazil, Chile and Mexico by applying the present value model. The long-run relationships are tested applying Cointegration (Johansen), Granger causality tests, and a Vector Error Correction Model (VECM). The main findings suggest that (Chinese and US) macroeconomic variables are cointegrated with Latin American stock market indices; moreover, we uncover that US macroeconomic variables Granger cause Mexican and Brazilian stock market indices whilst Chinese macroeconomic variables Granger cause Mexican and Chilean stock market indices. Finally, we find evidence supporting the present value model since the domestic industrial production is a leading factor explaining stock market performance and domestic interest rates are inversely related to stock market performance. Meanwhile, the US leading industrial production index explains stock market indices in Mexico and Chile; whereas the Chinese leading industrial production index explains the Mexican stock market index. The results suggest that Chinese macroeconomic variables have increasingly become an important determinant of Latin American stock market performance.

Key words: stock market, present value model, cointegration, Granger-causality, VECM.

JEL Classification: G10, G15

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1. Introduction

During the last decade we have witnessed an increased economic interaction between China and Latin American countries, particularly in terms of trade. In fact, many Latin American countries are now some of the main trading partners with China. At the same time, trade between the US and many Latin American countries has decreased. These set of events has brought the attention of the influence of the US and China in Latin American economies. Thus, it is interesting to analyze if China has gained more influence in the region as opposed to the US. On the other hand, the degree of market capitalization in Latin America has increased, receiving increasingly large flows of capital from foreign countries, particularly after the recent low interest rate levels in developed economies. At the same time, emerging economies have experienced recent economic growth, even during the financial crisis, and are seen as the motor of the worldwide economic recovery.

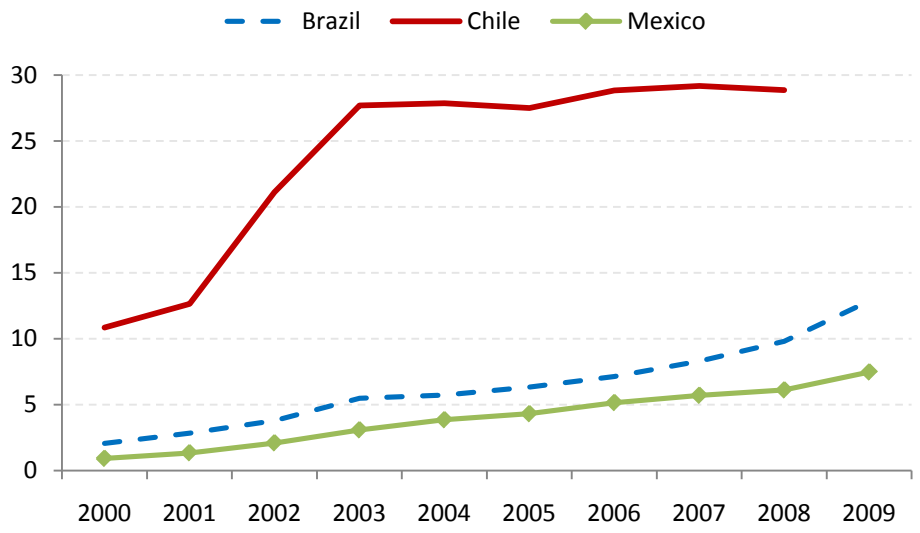
This paper tries to establish whether a set of macroeconomic variables in the US and China have a direct influence on stock market performance in three Latin American countries: Brazil, Chile and Mexico. We attempt to analyze whether foreign (US and Chinese) macroeconomic conditions are cointegrated with the stock markets of three Latin American countries, namely: Brazil, Chile and Mexico. The foreign macroeconomic variables are the Chinese and American industrial production and interest rates, in order to observe any long-run relationships and any causality with the stock markets for the countries studied. In doing so, we apply a Johansen Cointegration test, Granger causality test and a Vector Error Correction Model (VECM) to analyze the dynamics of the variables explaining stock market performance and any causality. This paper applies the present value model in order to observe the level of informational efficiency in each market studied. The present value model suggests that stock markets should be a leading indicator of economic activity. In particular the use of an aggregate value of interest rates (IR) and industrial production (IP) permits this relationship to be tested.

This paper is divided into six sections. Section 2 discusses the recent developments of the US and China as trading partners with Latin America; section 3 presents the literature review, section 4 shows the methodology and data used; section 5 presents the main results and finally section 6 concludes.

2. Background

China has increasingly become the most important trading partner with many Latin American countries, second to the US, mainly as an importer of commodities and goods. China´s main interests in the region are linked to access to natural resources and agricultural commodities, particularly oil, ores and soybeans. Latin American countries have increased their trade with China tenfold for the period 2000-2007, it reached 14.2 billion USD in 2008 (Lum, 2009). However, China´s total trade in the region is still one fifth of that of the US, 664 billion USD in 2008 (Lum, 2009). Currently, China´s largest trading partners in Latin America are Brazil, Mexico, Chile, Argentina and Peru. Figure 1 shows the trend in total trade between China, and Brazil, Mexico and Chile, the countries in study.

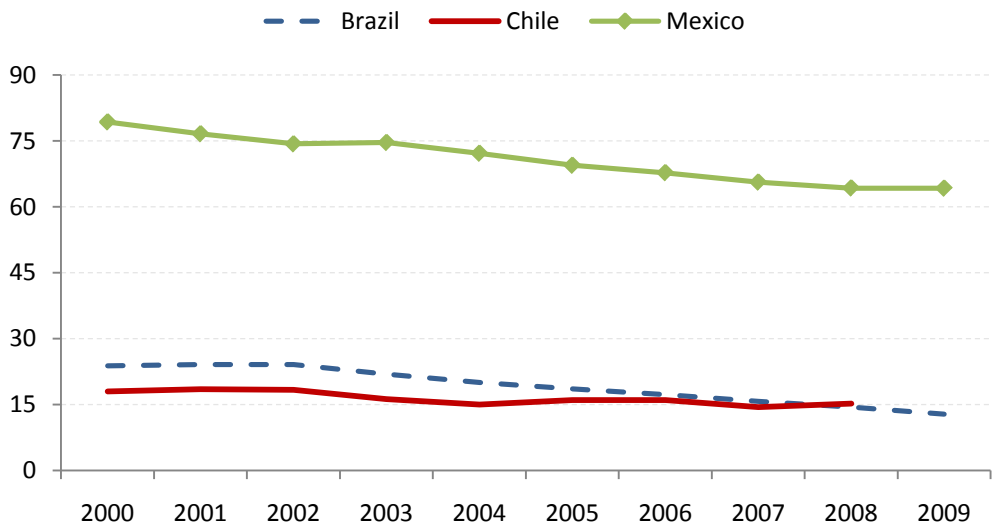
Figure 1
Total Trade to China
(% of total trade)



Source: Comtrade from the United Nations.
Trade is defined as the sum of imports and exports. Data for Chile for 2009 was not available.

As seen in Figure 1, total trade from Brazil, Mexico and Chile to China has increased, and the trend is positive. On the other hand, trade between these Latin American countries and the US has decreased, see Figure 2. The trend of trade towards the US shows a downward slope for the period of time studied. However, it is important to notice that Mexico´s trade with the US is still very large, representing 65% of all trade.

Figure 2
Total Trade to the US
(% of total trade)



Source: Comtrade from the United Nations.
Trade is defined as the sum of imports and exports. Data for Chile for the year 2009 was not available.

In terms of overall presence, China has positioned itself as one of the most important trade partners with Latin American countries. Table 1 shows the position of China as a trade partner for Brazil, Chile and Mexico.

Table 1
China´s position as a trade partner

	Exports		**Imports**	
	2000	*2008*	*2000*	*2008*
Brazil	12	1	11	2
Chile	5	1	4	2
Mexico	25	5	6	3

Source: CEPAL

As seen in Table 1, China has become the main recipient of exports from Brazil and Chile, and the second partner in terms of imports in these countries. On the other hand, China has increased its commercial ties with Mexico, although not a strongly as in South America. He (2008) argues that South American countries have benefited from China experiencing a trade surplus while Central American countries have suffered a growing trade deficit with regards to China. In the case of Mexico, by 2007, the trade deficit reached 12 billion USD (He, 2008). The growing difference in the relationship between South

American countries and Central American countries with regards to their trade with China and the US can be observed in their export levels. Table 2, shows the percentage of exports to China and the US for the countries studied for two periods in time: 2000 and 2009.

Table 2
Exports to US and China
(% of all exports)

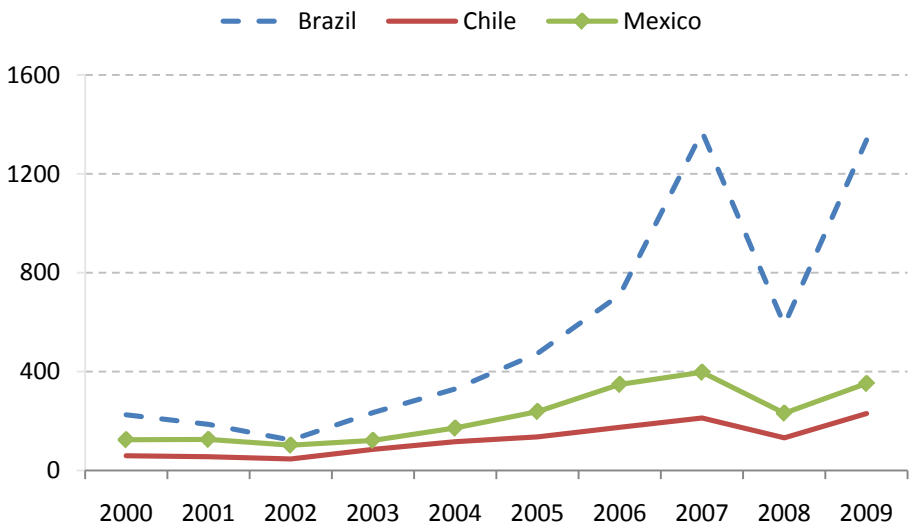
	USA		**CHINA**	
	2000	*2009*	*2000*	*2009*
Brazil	24.3	10.2	2.0	13.2
Chile	16.5	11.3	5.0	23.2
Mexico	88.2	87.6	0.2	0.6

Source: CEPAL

As observed in Table 2, exports from Chile and Brazil to China have surpassed those to the US, whilst the exports from Mexico to China are still very little, particularly compared to its exports to the US. It is therefore interesting to analyze how these developments are affecting the domestic stock markets in these Latin American countries.

At the same time, there has been a recent rise in the level of stock market capitalization in emerging markets, mainly pushed by the recent economic growth experienced in these countries alongside low interest rates in developed countries. Particularly in Latin America, there have been exponential increases in the degree of market capitalization. Figure 3 shows this trend for the countries in study for the period 2000-2009.

Figure 3
Stock market capitalization
(billions of USD)



Source: World Bank

As observed in Figure 3, the last decade has seen increases in the level of the capitalization of the stock market, particularly in Brazil. It is important to note, however, that during the aftermath of the recent financial crisis there was a decline in the capitalization level (2007-2008). Nevertheless, the prospects of future growth in EMEs alongside economic stability predict a rise in stock market levels in the near future.

3. Literature Review

The relationship between macroeconomic fundamentals and stock market returns has been extensively explored in industrialized countries (see Fama, 1990; Schwert, 1990; Nasseh and Strauss, 2000; Chen, Roll and Ross, 1986; Cheung and Ng, 1998, Choi, Hauser and Kopecky, 1999; Chen, 1991; among others). There are other studies that have focused on the macroeconomic influences on stock market indices across a variety of markets and time horizons (Been et al., 1990; Bulmash and Trivoli, 1991; Cochrane, 1991; Golsten et al., (1993); Ibrahim, 1999; Maysami and Koh, 2000; Mukherjee and Naka, 1995; Poon and Taylor, 1991; among others). However few studies have analyzed this relationship in emerging economies and in particular there are scant studies for Latin America. Among studies which focus on emerging markets are: Allen et al. (2004) who study the domestic

and international macroeconomic influences on stock market performance in Pacific-Basin countries; Chukwuogor-Ndu and Kasibhatla (2007) who study the integration and correlation between stock markets for NAFTA countries; Kwon and Shin (1999) who study the macroeconomic determinants of stock market performance in Korea; among others. However, the role of the domestic economy and influence of foreign economies in Latin American stock market performance has not been well documented. It is particularly interesting to analyze the relationship between domestic and international macroeconomic variables on stock market returns in Latin America given its open economic nature.[1]

There are several recent studies that focus on the relationship between macroeconomic variables and stock market indices. Pilinkus (2009) analyzes the relationship between several macroeconomic variables and the Lithuanian stock market index. Moreover, he applies a Granger causality test to observe any causality relationships. His main findings suggests that some macroeconomic variables such as GDP, net exports and FDI lead stock market returns and at the same time, the stock market index leads GDP, material investment and the construction volume index. Gay (2008) studies the effects of some macroeconomic variables, namely the exchange rate and oil prices on stock market returns for four emerging economies: Brazil, Russia, India and China using the Box Jenking ARIMA model. They find no significant relationships between these macroeconomic variables and the stock market index in either country. They argue that other macroeconomic factors could be related to stock market performance. Agrawalla and Tuteja (2007) examine the long-run causality between stock market development and economic growth in India. The methodology includes a cointegration analysis followed by a Granger causality test. Their findings provide evidence of a stable long-run equilibrium between stock market development and economic growth in India. Chancharat et al. (2007) analyze the influence of international stock markets and macroeconomic variables on the Thai stock market. They apply a GARCH-M model using data for 1988-2004. They conclude that changes in the stock markets of Singapore, Malaysia and Indonesia affected the Thai stock market prior to the 1997 financial crisis, whereas changes in the stock markets of Singapore, Philippines and Korea affected the Thai stock market after the 1997

[1] Mexico has currently 13 free trade agreements, Brazil has 5 free trade agreements, Chile has 17 free trade agreements and Argentina has 4 free trade agreements (WTO, 2010).

financial crisis. Finally, they find that changes in oil prices affected negatively the Thai stock index prior to 1997 and that markets outside the region had no immediate impact on the stock market index. Rivas et al. (2006) study the response of Latin American stock market movements in European stock market movements applying a VAR for the period 1990-1998. The results vary depending on the degree of openness of the country in Latin America; however there is evidence that Latin American stock markets are responsive to changes in the stock market from Spain particularly. Gan et al. (2006) study the relationship between the New Zealand stock index and some macroeconomic variables for the period 1990-2003 using cointegration. They employ the Johansen Maximum Likelihood and Granger causality tests. Their results state that the New Zealand stock is determined by interest rates, money supply and real GDP, and there is no evidence of the stock market index as a leading indicator for macroeconomic variables. Maysami et al. (2004) study the long-term equilibrium relationships between a number of macroeconomic variables and the Singapore stock market index. Using a cointegration approach they find that the Singapore stock market index is cointegrated with short and long-term interest rates, industrial production, price levels, the exchange rate and money supply. Islam and Watanapalachaikul (2003) study the relationship between macroeconomic factors and stock market performance in Thailand for 1999-2001. Their results suggest that interest rates, bond prices, foreign exchange rate, price-to-earnings ratio, market capitalization and the consumer price index have a long-run relationship with stock market performance in Thailand. Mukherjee and Naka (1995) employ the Johansen cointegration test and the VECM to study the relationship between a selection of macroeconomic variables and the stock market index in Japan. They find that six macroeconomic variables (exchange rate, money supply, inflation rate, industrial production, long term government bonds and short term call money rates) are cointegrated with the Japanese stock market index.

There are few studies related to Latin America, and in particular, on the influence of foreign macroeconomic variables in stock market performance. The next section presents the methodology and data used in this study.

4. Methodology and data

We follow the methodology by Allen et al. (2004) and test the validity of the present value model, which tests the relationship between economic variables and stock markets. The present value model suggests that current share prices should be caused by future industrial production:

$$SP_t = IP_{t+1} - IR_t \quad (1)$$

where SP_t is the stock market index, IP_{t+1} denotes domestic industrial production leading one month which proxies the economic conditions, IR_t denotes the domestic money market interest rate and the subscript t which represents the time. By including the leading industrial production and interest rates of two foreign countries, USA and China, we can observe these foreign macroeconomic variables and their relationship with domestic stock price changes:

$$SP_t = IP_{t+1} - IR_t + IPUSA_{t+1} - IRUSA_t \quad (2)$$

and

$$SP_t = IP_{t+1} - IR_t + IPCHINA_{t+1} - IRCHINA_t \quad (3)$$

where $IPUSA_{t+1}$ and $IRUSA_t$ are the future industrial production and interest rate of the USA; and $IPCHINA_{t+1}$ and $IRCHINA_t$ are the future industrial production and interest rate of China respectively. We can then establish whether there is any cointegration and/or causality between these macroeconomic variables and the domestic stock market indices.

4.1 Cointegration

Cointegration examines long-run relationships between a set of variables, in this case the long-run relationship between industrial production, interest rates and the stock market. We apply the Johansen Maximum Likelihood cointegration test in order to find any long-term stochastic relationships.

We first examine the stationarity of all the variables using the augmented Dickey-Fuller unit root test to insure that the regression results obtained are robust.[2] If all the variables are

[2] The optimal lag length determined by the Akaike Information Criterion (AIC).

not stationary in the form of a unit root, the first order difference should be used in the modeling procedure. We then check for cointegration in terms of stock prices and macroeconomic variables. If cointegration exists among all variables, an error correction term should be added to the estimation procedure (Engle and Granger, 1987).

The Johansen cointegration procedure firstly specifies the unrestricted n-variable VAR:

$$x_t = \mu + \sum_{i=1}^{k} \prod_i x_{t-1} + u_t \quad (4)$$

where x_t, is an n x 1 vector of I (1) or stochastic variables integrated in the same order, μ is a vector of intercepts and u_t is a vector of error terms. This equation, however, can be reparameterized in order to obtain long-term response matrix (Johansen, 1988; Johansen and Juselius, 1990):

$$\Delta x_t = \mu + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-1} + \prod x_{t-k} + u_t \quad (5)$$

Equation 5 is now a VAR reparameterized in error correction form, where $\Pi = -(\Pi - \Pi_1 - ... - \Pi_k)$ and represents the long run response matrix. Rewriting this matrix as $\Pi = \alpha\beta$ then the linear combinations of $\Pi = \alpha\beta_{t-k}$ will be I(0) in the existing cointegration, where α is the adjustment of coefficients and the matrix Π is of reduced rank. The Johansen cointegration approach is useful to determine the rank (r) of the matrix, if r = 0 then all the variables are I(1) and there are no cointegrating vectors, if 0<r<n then there are r cointegrating vectors, and finally if r=n then all the variables are I(0) there are n cointegrating vectors given that any linear combinations are stationary.

Some special features in determining a long-run equilibrium are the dynamics that influence the long run patterns. These dynamics are tested by applying the Vector Error Correction Model (ECM) which searches the temporal direction and causality of the short run dynamics. The VECM is of the form:

$$\Delta z_t = \Gamma_1 \sum \Delta z_{t-1} + ... + \Gamma_{k-1} + \Delta z_{t-k+1} + \Pi z_{t-k} + \mu_t \quad (6)$$

where Δ denotes first differences, $\Gamma_i = -(I - A_1 - ... A_i), (I = 1,..., k-1),$ and $\Pi = -(I - A1 - ... - A_k).$ The long and short-run adjustments are specified by Γ_i and Π. If we denote $\Pi = \alpha\beta'$ then α is the speed of adjustment to disequilibrium and β is a matrix of

long-run coefficients that represents up to n-1 cointegration relationships and provides that $z_t s$ converges to its long-run steady state.

4.2 Granger causality test

Granger (1969) proposes a method of describing the relationship between two (or more) variables in order to observe the direction of causality. Consider the variables: X_t and Y_t, the Granger-causality test can be applied as follows:

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-1} + \sum_{j=1}^{q} \beta_j X_{t-j} + \mu_t \quad (6)$$

Where the restricted model is:

$$Y_t = \sum_{i=1}^{p} \alpha_i Y_{t-1} + \nu_t \quad (7)$$

where μ_t and ν_t are white noise, p is the order of lag Y, and q is the order of lag X. The null hypothesis for equation (8) is:

$$H_0 = \sum_{j=1}^{q} \beta_j = 0 \quad (8)$$

suggesting that the lag terms X_{t-j} does not Granger cause Y_t in the regression. The hypotheses is tested using an F-test.

4.3 Data

The data was obtained from Bloomberg and the International Financial Statistics (IFS) from the IMF. From Bloomberg we obtained the values for the stock market indices and the values for industrial production indices. On the other hand, the values for the interest rate were obtained from the IFS. The frequency of the data is monthly for the period of January 2000 to December 2009, accounting for 120 observations. Table 3 presents the descriptive statistics of the variables used.

Table 3
Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
SPMEX	15,364.18	9,219.182	5,575.158	32,098.15
IPMEX	115.9	12.955	95.002	142.877
IRMEX	8.337	3.186	4.45	17.89
SPBRA	30,547.22	17,855.25	9,207.876	71,077.77
IPBRA	108.911	13.059	82.059	137.751
IRBRA	16.616	4.407	8.674	28.78
SPCHI	9,052.077	3,673.466	4,669.346	16,112.42
IPCHI	113.682	13.29	88.935	140.817
IRCHI	4.822	2.879	.481	14.707
IPCHINA	103.677	6.199	87.713	114.94
IRCHINA	3.15	.404	2.7	4.14
IPUSA	104.432	4.568	95.835	112.397
IRUSA	2.719	1.855	.04	6.18

Where SP denotes the stock market index, IP denotes the industrial production index and IR denotes the money market interest rate.

5. Results

In order to apply the methodology, we first test the variables for unit roots by performing the Augmented Dickey Fuller (ADF) and Philip-Perron (PP) tests. Table 4 presents the main results of the ADF and PP tests.

Table 4
Unit root Test

	ADF Unit Root Test		PP Unit Root Test	
Variables	Level	First difference	Level	First difference
SPMEX	0.077 (0.963)	-8.589 (0)	-0.158 (0.939)	-8.965 (0)
IPMEX	-1.677 (0.44)	-16.499 (0)	-2.185 (0.213)	-16.166 (0)
IRMEX	-2.256 (0.188)	-9.507 (0)	-2.357 (0)	-9.518 (0)
SPBRA	-0.159 (0.939)	-7.498 (0)	-0.13 (0.943)	-7.557 (0)
IPBRA	-1.142 (0.697)	-2.8 (0.006)	-2.766 (0.066)	-16.142 (0)
IRBRA	-0.983 (0.758)	-10.081 (0)	-1.339 (0.61)	-10.187 (0)
SPCHI	0.53 (0.987)	-9.291 (0)	0.195 (0.971)	-9.415 (0)
IPCHI	-1.519 (0.52)	-8.64 (0)	-2.215 (0.202)	-32.207 (0)
IRCHI	-2.451 (0.13)	-13.763 (0)	-2.671 (0.082)	-29.495 (0)
IPCHINA	-2.571 (0.102)	-6.497 (0)	-2.21 (0.204)	-6.536 (0)
IRCHINA	-1.913 (0.325)	-9.622 (0)	-2.153 (0.225)	-9.622 (0)
IPUSA	-2.286 (0.178)	-3.676 (0)	-1.378 (0.591)	-9.304 (0)
IRUSA	-1.539 (0.51)	-5.598 (0)	-1.233 (0.658)	-5.548 (0)

The adjusted t statistic is presented alongside the McKinnon (1996) probability values (in brackets).

Table 4 shows that all the variables have unit roots in levels but are stationary in first differences, thus they follow a I(1) process. We then proceed to apply the Johansen Cointegration tests to observe any stationary linear relationships present in the group of variables including industrial production, interest rates and share prices. However, in order to do this we first select the appropriate number of lags to be used in the cointegration test. Tables A1-A6 in the appendix show the results of the lag length selection for the models used. A finding of cointegration would satisfy the conditions of the present value model where share prices are defined by long-run relationships between cash flows (aggregate industrial production) and interest rates (Allen et al., 2004). Table 5 presents the results of the Johansen Cointegration rank test.

Table 5
Johansen Cointegration rank Test

	US macroeconomic factors		Chinese macroeconomic factors	
	ME	Trace	ME	Trace
Mexico	r=1	r=1	r=1	r=2
Brazil	r=1	r=1	r=2	r=2
Chile	r=1	r=1	r=1	r=1

The US and Chinese macroeconomic factors include the money market interest rate and the leading industrial production index for each country respectively. r indicates the number of cointegrating relationships found in the Johansen ML cointegration tests, significant at the 5% level. For robustness pruposes, both the maximal eigenvalue (ME) statistic and the trace statistic were considered and are reported in the table.

From Table 5, the linear cointegration relationships can be observed. In the case of Mexico, Brazil and Chile with respect to the US, we find 1 cointegration relationship in all cases. However, when compared to Chinese macroeconomic variables, we find up to 2 cointegration relationships, particularly in Brazil and Mexico. Since there are at least 1 cointegrating relationship we proceed to analyze the causality of the cointegration effects. Table 6 shows the Granger Causality tests.

Table 6
Granger Causality Test

Null hypothesis	Obs.	Chi-square	Probability
US Macro variables do not Granger cause SPMEX	115	42.9	0.002
Chinese Macro variables do not Granger cause SPMEX	118	18.21	0.02
US Macro variables do not Granger cause SPBRA	113	49.11	0.01
Chinese Macro variables do not Granger cause SPBRA	118	9.005	0.34
US Macro variables do not Granger cause SPCHI	116	22.67	0.12
Chinese Macro variables do not Granger cause SPCHI	118	17.16	0.03

Where the null hypothesis suggests no causality, Ho = 0.

From Table 6 we find that US macroeconomic variables Granger cause the stock markets in Mexico and Brazil, but not in Chile. On the other hand, we find that Chinese macroeconomic variables Granger cause the stock markets in Mexico and Chile, but not in Brazil. The next step is to estimate a VECM, the results are shown in Table 7.

Table 7
Vector Error Correction Model

Variable	Mexico		Brazil		Chile	
IR	-0.126	0.122	0.7***	0.855***	2.165***	1.142***
IP	-2.85***	-6.674***	-10.1***	-3.726***	3.185	-14.463***
IRUSA	0.452***		-0.149*		-0.998***	
IPUSA	-14.634***		6.952***		-14.735*	
IRCHINA		2.297***		-1.018***		-4.309***
IPCHINA		-9.23***		-0.516		2.427
TREND	-0.003***	-0.013***	0.004***	0.0003	-0.003	
C	31.497	27.772	1.09	3.672	18.437	

(*,**,***) denote significance at 10%, 5% and 1% confidence intervals. Where IR is the logarithm of the domestic money market interest rate, IP is the logarithm of the domestic industrial production index, IRUSA is the logarithm of the US money market interest rate, IPUSA is the logarithm of the US industrial production index, IRCHINA is the logarithm of the Chinese money market interest rates, IPCHINA is the logarithm of the Chinese industrial production index., TREND is a time trend and C is a constant term. All variables are in differences.

The values observed in Table 7 represent the coefficients of the independent variables when the dependent variable is normalized. The interpretation of the dynamic relationships will be given by the opposite signs of the coefficients obtained (Al-Sharkas, 2004). As such, we can see that the domestic leading industrial production, for Mexico, Brazil and Chile, is positively related to the stock market index, as expected from the literature (Chen, Roll and Ross, 1986; and Cheung and Ng, 1998; Fama, 1990). As explained before, current stock prices should be influenced by future economic conditions. With regards to domestic interest rates, we find a negative relationship with the stock market index in Chile and Brazil, but no significance for the case of Mexico. Most companies finance their capital and inventories with borrowed money, and a reduction in the interest rate would contribute to further borrowing and an expansion of the company, having positive expected prices for these companies. On the other hand, a substantial amount of stocks are purchased with borrowed money, and an increase in the interest rate would increase the cost of purchasing stocks which would lead to lower demand and price depreciation (Mayasami et al., 2004).

Considering the macroeconomic US variables we find contrasting results. The US industrial production is positive with a large coefficient for the case of Mexico and Chile. On the other hand, there is no significance between the US industrial production and the stock market index in Brazil. These results show the importance of the US economic activity in both Chile and Mexico, whereas there are no long-run dynamic effects for the case of Brazil. With regards to US interest rates, the results show a positive relationship with stock market indices for Brazil and Chile, but a negative relationship for Mexico. For the particular case of Mexico, since its economy is highly linked to the US economy, any changes in US interest rates will affect the Mexican economic activity. As such, increases in US interest rates will produce the same effects as a rise in domestic interest rates with relationship to stock market prices. Hsing (2004) has analyzed the potential responses of Mexican interest rates when US monetary policy changes, and finds that there is a stable long-run relationship between Mexican interest rates and US interest rates.

Turning into the Chinese macroeconomic variables and their relationship with Latin American stock prices we find mixed results. The leading industrial production index is positive and significant only with regards to Mexico and is not significant in any other case.

Thus, increases in the Chinese economy affect the Mexican stock market index positively. On the other hand, the Chinese money market interest rates show a positive relationship with Brazil and Chile, but negative for Mexico. This is not surprising, since for the last years the Yuan has been pegged to the US dollar and fluctuates accordingly. Thus, we obtain the same results as when analyzing the US interest rates and Latin American stock market indices.

6. Conclusion

This paper applies the present value model in order to determine whether a set of foreign (Chinese and American) macroeconomic variables, are cointegrated or have any causality with the stock market indices in three Latin American countries, namely Brazil, Mexico and Chile. In doing so, the Johansen Maximum Likelihood, Granger causality tests and a Vector Error Correction Model (VECM) are applied to test for cointegration, causality and long-run dynamics.

The first set of results with regards to the Johansen cointegration test suggests that there is at least one cointegration relationship between the USA with Brazil, Mexico and Chile. On the other hand, we find evidence of at least two cointegration relationships between China with Mexico and Brazil, and one cointegration relationship with Chile. Thus, the Chinese macroeconomic variables seem to be more cointegrated with Latin American stock market indices than the US macroeconomic variables. The next set of results analyzed the Granger causality between these macroeconomic variables and the stock market indices. The results show that the US macroeconomic variables Granger cause stock market performance in Mexico and Brazil; whereas, the Chinese macroeconomic variables Granger cause stock market performance in Mexico and Chile. It seems interesting that Mexico is the only country which presents causality with both China and the US. This result implies that China has gained importance in the region and its macroeconomic variables are influential to some Latin American stock markets. Finally, we employ a VECM to analyze any long-run dynamics between domestic and international macroeconomic variables and stock market indices. The results confirm that the present value model holds since leading domestic industrial production is positively related to stock market performance. On the other hand, domestic money market interest rates are negative

and significant, also expected by the literature. With regards to the US and Chinese macroeconomic variables, we find that the US leading industrial production index is positively related to increases in stock market indices in Mexico and Chile but negative for the case of Brazil. Moreover, the Chinese leading industrial production index is positive with regards to the Mexican stock market index but not significant in any other case. In terms of US and Chinese interest rates, we find evidence of a positive relationship with regards to the Mexican stock market index and a negative relationship with regards to Brazil and Chile. Not surprisingly, both the US and Chinese interest rates reflect the same relationship since these currencies are pegged. The main results of this paper suggest that Chinese macroeconomic variables have increasingly become an important determinant of Latin American stock market performance.

References

Agrawalla, R. K. and Tuteja, S. K. (2007) "Causality between Stock Market Development and Economic Growth: A Case Study of India." *Journal of Management Research*, Vol. 7, pp. 158-168.

Allen, D., Lim, L. and Winduss, T. (2004) "The Present Value of Pacific Basin Stock Markets: A Domestic and External Factor Model." *Accounting Finance and Economics Working Paper*, No.1, Edith Cowan University.

Al-Sharkas, A. (2004) "The Dynamic Relationship between Macroeconomic Factors and the Jordanian Stock Market." *International Journal of Applied Econometrics and Quantitative Studies*, Vol. 1 (1), pp. 97-114.

Been, W., Glosten, L. R. and Jagannathan, R. (1990) "Predictable Variations in Stock Index Returns." *Journal of Finance*, Vol. 22, pp. 1177-1189.

Bilson, C., Brailsford, T. J., and Hooper, V. (1999) "Selecting Macroeconomic Variables as Explanatory Factors of Emerging Stock Market Returns." *Working paper series* available at http://ssrn.com/abstract=201908.

Bulmash, S. B. and Trivoli, G.W. (1991) "Time-Lagged Interactions between Stock Prices and Selected Economic Variables." *Journal of Portfolio Management*, pp. 61-67.

Chancharat, S. and Valadkhani, A. (2007) "Testing for the Random Walk Hypothesis and Structural Breaks in International Stock Prices." *Economics Working Papers* No. 07-15, School of Economics, University of Wollongong.

Chen, N.F. (1991) "Financial Investment Opportunities and the Macroeconomy." *Journal of Finance*, Vol. 46(2), pp. 529-54.

Chen, N. F., Roll, R. and Ross, S.A. (1986) "Economic Forces and the Stock Market." *Journal of Business*, Vol. 59, pp. 383-403.

Cheung, Y. and Ng, L. (1998) "International Evidence on the Stock Market and Aggregate Economic Activity." *Journal of Empirical Finance*, Vol. 5, pp. 281-296.

Choi, J., Hauser, S. and Kopecky, K. (1999) "Does the Stock Market Predict Real Activity? Time Series Evidence from the G-7 Countries." *Journal of Banking & Finance*, Vol. 23(12), pp. 1771-1792.

Chukwuogor-Ndu, C. and Kasibhatla, K. (2007) "Post NAFTA Integration of North American Stock Markets: Implications for Financial Decision Making." *North American Journal of Finance and Banking Research*, Vol 1(1).

Cochrane, J. (1991) “Production-Based Asset Pricing and the Link between Stock Returns and Economic Fluctuations." *Journal of Finance*, Vol. 46(1), pp. 209-37.

Engle, R.F. and Granger, C.W.J. (1987) “Cointegration and Error Correction: Representation, Estimation and Testing.” *Econometrica*, Vol. 55, pp. 251- 76.

Fama, E. (1990) “Stock Returns, Expected Returns, and Real Activity.” *Journal of Finance*, Vol. 45(4), pp. 1089-1108.

Gan, C., Lee, M., Yong, H. and Zhang, J. (2006) “Macroeconomic Variables and Stock Market Interactions: New Zealand Evidence.” *Investment Management and Financial Innovations,* Vol. 3(4), pp. 89-101.

Gay, R. (2008) “Effect of Macroeconomic Variables on Stock Market Returns for Four Emerging Economies: Brazil, Russia, India and China.” *International Research and Business Journal,* Vol. 7(3), pp. 1-8.

Golsten, L. R., Jagannathan, R., and Runkel, D. E. (1993) “On the Relation between the Expected Value and the Volatility of the Nominal Excess Return on Stocks.” *Journal of Finance*, Vol. 48, pp. 1779-1801.

Granger, C.W.J. (1969) “Investigating Causal Relations by Econometric Models and Cross-Spectral Methods.” *Econometrica*, Vol. 37(3), pp. 424-38.

He, L. (2008) “China´s Growing Influence in Latin America: Challenges and Opportunities.” *EAI Background Brief,* No. 411.

Hsing, Y. (2003) “ Responses Of Interest Rates In Mexico To U.S. Monetary Policy.” *The Journal of Applied Business Research,* Vol. 19 (2), pp. 15-20.

Ibrahim, M.H. (1999) “Macroeconomic Variables and Stock Prices in Malaysia: An Empirical Analysis.” *Asian Economic Journal*, Vol. 13, pp. 219-231.

Islam, S. M. N. and Watanapalachaikul, S. (2005) *Empirical Finance: Modelling and Analysis of Emerging Financial and Stock Markets.* New York: Physica-Verlag.

Kwon, C.S. and Shin, T.S. (1999) “Co-Integration and Causality between Macroeconomic Indicators and Stock Exchange Prices.” *Global Finance Journal*, Vol. 10(1), pp. 71-81.

Lum, T. (2009) “China´s Assistance and Government-Sponsored Investment Activities in Africa, Latin America, and Southeast Asia.” *US Congressional Research Service*, No. 7-5700.

Maysami, R. C., and Koh, T. S. (2000) “A Vector Error Correction Model of the Singapore Stock Market.” *International Review of Economics and Finance*, Vol. 9, pp. 79-96.

Maysami, R., Howe, L. and Hamzah, M. (2004) “Relationship between Macroeconomic Variables and Stock Market Indices: Cointegration Evidence from Stock Exchange of Singapore´s All-S Sector Indices.” *Jurnal Pengurusan*, Vol. 24, pp. 47-77.

MacKinnon, J.G. (1996) “Numerical Distribution Functions for Unit Root and Cointegration Tests.” *Journal of Applied Econometrics*, Vol. 11(6), pp.601-18.

Mukherjee, T. K., and Naka A. (1995) “Dynamic Relations between Macroeconomic Variables and the Japanese Stock Market: An Application of a Vector Error Correction Model.” *Journal of Financial Research*, Vol. 18, pp. 223-237.

Nasseh, A. and Strauss, J. (2000) “Stock Prices and Domestic and International Macroeconomic Activity: A Cointegration Approach.” *The Quarterly Review of Economics and Finance*, Vol. 40, pp. 229–245.

Pilinkus, D. (2009) “Stock Market and Macroeconomic Variables: Evidence from Lithuania.” *Economics and Management*, Vol. 14, pp. 884-891.

Poon, S. H. and Taylor, S. J. (1991) “Macroeconomic Factors and the UK Stock Market.”*Journal of Business and Accounting*, Vol. 18, pp. 619-636.

Rivas, R. and Albuquerque, P.H. (2006) “Are European Stock Markets influencing Latin American Stock Markets? *Analisis Economico*, Vol. 21(47), pp. 51-67.

Samitas, A. and Kenourgios, D. (2007) "Macroeconomic Factors' Influence on 'New' European Countries' Stock Returns: The Case of Four Transition Economies." *International Journal of Financial Services Management*, Vol. 2(1), pp. 34-49.

Schwert, G.W. (1990) “Stock Returns and Real Activity: A Century of Evidence.” *Journal of Finance*, vol. 45(4), pp. 1237-57.

Appendix

Table A1
Lag-length selection
SPMEX IRMEX IPMEXT IRUSA IPUSAT

Lag	Logl	LR	FPE	AIC	SC	HQ
0	610.8685	NA	1.38E-11	-10.81908	-10.69772	-10.76984
1	1352.755	1404.286	3.80E-17	-23.62063	-22.89246*	-23.32519
2	1393.367	73.24534	2.88E-17	-23.8994	-22.56443	-23.35776*
3	1426.216	56.31335	2.52E-17	-24.03957	-22.09779	-23.25173
4	1456.603	49.37798	2.32E-17	-24.13576	-21.58717	-23.10171
5	**1486.971**	**46.63700***	**2.15e-17***	**-24.23162***	**-21.07622**	**-22.95138**
6	1504.657	25.5819	2.53E-17	-24.10102	-20.33881	-22.57457
7	1531.4	36.29402	2.56E-17	-24.13214	-19.76313	-22.3595
8	1549.862	23.40768	3.06E-17	-24.0154	-19.03958	-21.99655

* indicates lag order selected by the criterion.

SPMEX refers to the stock market index in Mexico, IRMEX is the interest rate in Mexico, IPMEXT is the leading production index in Mexico, IRUSA is the interest rate in the USA and IPUSAT is the leading production index in the USA. LR is the sequential modified likelihood ratio test statistic, FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.

Table A2
Lag-length selection
SPMEX IRMEX IPMEXT IRCHINA IPCHINAT

Lag	Logl	LR	FPE	AIC	SC	HQ
0	772.5599	NA	7.67E-13	-13.70643	-13.58506	-13.65719
1	1476.372	1332.217	4.18E-18	-25.82808	-25.09991*	-25.53264
2	**1515.502**	**70.57356***	**3.25e-18***	**-26.08040***	**-24.74542**	**-25.53876***
3	1530.7	26.05391	3.90E-18	-25.90537	-23.96358	-25.11752
4	1548.579	29.05337	4.49E-18	-25.7782	-23.22961	-24.74416
5	1571.168	34.68993	4.78E-18	-25.73515	-22.57975	-24.4549
6	1584.471	19.24205	6.08E-18	-25.52628	-21.76407	-23.99983
7	1604.741	27.50855	6.91E-18	-25.4418	-21.07279	-23.66915
8	1628.476	30.09289	7.51E-18	-25.41922	-20.44339	-23.40037

* indicates lag order selected by the criterion.

SPMEX refers to the stock market index in Mexico, IRMEX is the interest rate in Mexico, IPMEXT is the leading production index in Mexico, IRCHINA is the interest rate in China and IPCHINAT is the leading production index in China. LR is the sequential modified likelihood ratio test statistic, FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.

Table A3
Lag-length selection
SPBRA IRBRA IPBRAT IRUSA IPUSAT

Lag	Logl	LR	FPE	AIC	SC	HQ
0	312.5377	NA	5.49E-08	-5.365873	-5.270397	-5.32712
1	849.5295	1027.289	6.38E-12	-14.4266	-13.94922*	-14.23283*
2	865.2883	29.05102	6.41E-12	-14.42241	-13.56312	-14.07363
3	889.2953	42.58626	5.59E-12	-14.56166	-13.32047	-14.05787
4	**906.0805**	**28.60787***	**5.55e-12***	**-14.57531***	**-12.95222**	**-13.91651**

* indicates lag order selected by the criterion.

SPBRA refers to the stock market index in Brazil, IRBRA is the interest rate in Brazil, IPBRAT is the leading production index in Brazil, IRUSA is the interest rate in the USA and IPUSAT is the leading production index in the USA. LR is the sequential modified likelihood ratio test statistic, FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.

Table A4
Lag-length selection
SPBRA IRBRA IPBRAT IRCHINA IPCHINAT

Lag	Logl	LR	FPE	AIC	SC	HQ
0	312.5377	NA	5.49E-08	-5.365873	-5.270397	-5.32712
1	849.5295	1027.289	6.38E-12	-14.4266	-13.94922*	-14.23283*
2	865.2883	29.05102	6.41E-12	-14.42241	-13.56312	-14.07363
3	889.2953	42.58626	5.59E-12	-14.56166	-13.32047	-14.05787
4	**906.0805**	**28.60787***	**5.55e-12***	**-14.57531***	**-12.95222**	**-13.91651**

* indicates lag order selected by the criterion.

SPBRA refers to the stock market index in Brazil, IRBRA is the interest rate in Brazil, IPBRAT is the leading production index in Brazil, IRCHINA is the interest rate in CHINA and IPCHINAT is the leading production index in CHINA. LR is the sequential modified likelihood ratio test statistic, FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.

Table A5
Lag-length selection
SPCHI IRCHI IPCHIT IRUSA IPUSAT

Lag	Logl	LR	FPE	AIC	SC	HQ
0	645.7645	NA	9.95E-12	-11.14373	-11.02439	-11.09529
1	1329.041	1295.255	1.06E-16	-22.59202	-21.87595*	-22.30137*
2	1347.787	33.90534	1.19E-16	-22.48325	-21.17046	-21.95039
3	1381.102	57.35983	1.03E-16	-22.62786	-20.71834	-21.8528
4	**1420.11**	**63.77000***	**8.20e-17***	**-22.87148***	**-20.36524**	**-21.85421**

* indicates lag order selected by the criterion.

SPCHI refers to the stock market index in Chile, IRCHI is the interest rate in Chile, IPCHIT is the leading production index in Chile, IRUSA is the interest rate in the USA and IPUSAT is the leading production index in the USA. LR is the sequential modified likelihood ratio test statistic, FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.

Table A6
Lag-length selection
SPCHI IRCHI IPCHIT IRCHINA IPCHINAT

Lag	Logl	LR	FPE	AIC	SC	HQ
0	770.0179	NA	8.03E-13	-13.66103	-13.53967	-13.61179
1	1397.282	1187.321	1.71E-17	-24.41575	-23.68758*	-24.12031*
2	**1431.037**	**60.8799**	**1.47e-17***	**-24.57209***	**-23.23712**	**-24.03045**
3	1445.675	25.09302	1.78E-17	-24.38705	-22.44527	-23.59921
4	1459.525	22.50667	2.20E-17	-24.18795	-21.63935	-23.1539
5	1475.298	24.22274	2.65E-17	-24.02318	-20.86778	-22.74293
6	1497.031	31.43594	2.90E-17	-23.96485	-20.20264	-22.4384
7	1517.951	28.39033	3.26E-17	-23.89198	-19.52296	-22.11933

* indicates lag order selected by the criterion.

SPCHI refers to the stock market index in Chile, IRCHI is the interest rate in Chile, IPCHIT is the leading production index in Chile, IRCHINA is the interest rate in China and IPCHINAT is the leading production index in China. LR is the sequential modified likelihood ratio test statistic, FPE is the final prediction error, AIC is the Akaike information criterion, SC is the Schwarz information criterion, and HQ is the Hannan-Quinn information criterion.