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What drives stock market integration? An analysis using agribusiness stocks

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Abstract

This article explores the drivers of regional stock market integration with a focus on the agribusiness sector across relevant regional trade blocs around the world. We implement panel cointegration models to analyze the stock indices of agribusiness firms in the Southern Common Market (MERCOSUR), European Union (EU), Asia-Pacific Economic Cooperation (APEC), and North American Free Trade Agreement (NAFTA). Based on the literature on market integration and stock return pricing, we identify nine possible determinants of stock market integration, which we separate into three categories: individual market performance, macroeconomic conditions, and agricultural trade. In our analysis, we account for agriculture-specific factors to control for possible structural shifts in financial markets regimes by including the two main commodity price bubbles during last 20 years. Our results show that most of the variables included in our categories have been important factors in promoting regional stock market integration. Moreover, integration among regional stock markets was strengthened by the implementation of trade agreements. This effect is stronger in trade blocs with fewer members, such as NAFTA and MERCOSUR, compared with larger and more heterogeneous blocs, such as the EU and APEC.

JEL classifications: F36, G15

Keywords: Stock market integration; Agribusiness; Trade blocs; Cointegration

1. Introduction

The goal of this article is to explore the drivers of stock market integration with a focus on the agribusiness sector in regional blocs that account for major shares of global agricultural trade.

The definition of stock market integration employed in this work is based on two well-established theorems, the law of one price and the absence of arbitrage (Chen and Knez, 1995; Harrison and Kreps, 1979). The law of one price states that two assets with identical payoffs should not be priced differently. In other words, integrated stock markets should assign the same positive price to assets in different markets. Thus, the absence of arbitrage requires that the discount factor be strictly positive to rule out non-positive prices in practice. Consequently, on integrated financial markets, assets with the same risk characteristics will have identical expected returns (Alford, 1993; Campbell and Hamao, 1992). We study the factors that drive market integration in the case of agribusiness stocks, which we define as the stocks of companies that derive at least 50% of their revenues from agriculture (MSCI, 2014).

Why is the integration of agricultural stock markets important? First, many agribusiness stocks are considered defensive instruments (i.e., stocks with a risk level below that of the overall market) and tend to remain stable under difficult economic conditions (Ang et al., 2006; Zapata et al., 2012). As a result, publicly traded agribusiness stocks can contribute to diversified investment portfolios. Second, feeding a growing world population will require sustained improvements in the allocation of globally available resources for food production and processing. Markets for agribusiness stocks can contribute to this improved allocation of resources. According to Fama and French (2012), if stock markets are fully integrated investors face common risks (associated to the economic situation or policy actions on each market) and specific risks (generated from the risk diversification strategy of each investor), but price only common risk factors because specific risk is fully diversified internationally[1]. This increases the investment opportunity set

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[1] The works of Fama and French (2012) and Gounopoulos et al. (2013) present an extensive review of risk factors on financial markets.

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for local and foreign investors, and leads to higher savings and growth (Carrieri et al., 2007). If instead capital markets are segmented, asset pricing relationships vary from one country or region to another and domestic risk factors determine expected returns, thus increasing the cost of capital and reducing investments (Ehrmann et al., 2011). Hence, identifying and analyzing the factors that drive the integration of stock markets is not only important for investors' portfolio management strategies and financial stability, but also for increasing global investment in agriculture.

While numerous studies have studied the integration of stock markets in general, ours is the first to implement a two-stage method that involves an asset pricing approach and panel regression models to analyze agribusiness stocks. Several previous studies have focused on the effects of specific events or agricultural policies on agribusiness stock prices. For example, Tepe et al. (2011) investigate the effect of domestic biofuel policy on U.S. stock prices, while Pendell and Cho (2013) study reactions by investors in Korean agribusiness stocks following five outbreaks of foot-and-mouth disease. We consider a much larger set of variables to study the factors that drive stock market integration.

In particular, we also take into account the possible influence of regional trade bloc formation. Hooy and Goh (2008) report that emerging stock markets in Asia have become increasingly interdependent as a result of stronger regionalism and increased liberalization. In Latin America, Carneiro and Brenes (2014) suggest that stock markets have become more regionally integrated since the implementation of trade liberalization policies in the early 1990s. We attempt to confirm these findings for agribusiness stocks in four major regional trade blocs: Southern Common Market (MERCOSUR), European Union (EU), Asia-Pacific Economic Cooperation (APEC), and North American Free Trade Agreement (NAFTA).

We apply a Trading-Bloc Capital Asset Pricing Model (TB-CAPM; Hooy and Goh, 2008) to estimate stock market integration and pricing error among agribusiness stocks in these four trade blocs. Based on the literature, we identify nine possible drivers of stock market integration, which we divide into three categories: individual market performance, macroeconomic conditions, and agricultural trade. Using panel regression methods we confirm that these factors have significant effects on stock market integration. In particular, our results confirm that the implementation of trade agreements increases stock market integration. They also indicate that market stability indicators and intraregional trade levels have a stronger influence on stock market integration than performance variables. This suggests that stock market integration is more exposed to individual and regional market stability than world level conditions. To test the robustness of these results we control for factors that might affect agribusiness stock returns. For example, we account for the effects of the two main episodes of commodities price bubbles that have occurred during the last 20 years (January 1995 to December 1996, and January 2006 to December 2010) and find that stock market integration was strengthened during the 1995–1996 price bubble.

The rest of this article is organized as follows. Section 2 reviews the literature on the drivers of stock market integration. Sections 3 and 4 describe the methodology and the data that we use, respectively. Section 5 presents and discusses the empirical results, and Section 6 concludes.

2. Literature review

There is a large literature on stock market integration and the factors that affect it. For example, there is consensus in the literature that intraregional integration tends to be higher than interregional integration, mainly because intraregional time zones generally overlap more, leading to larger overlaps in trading hours within than between regions (Nagel and Singleton, 2011). Studies of time-varying correlation and covariance find that macroeconomic variables, such as inflation and volatility, have significant effects on bilateral lead-lag linkages between stock markets (Guvenen, 2009). Some studies demonstrate that regulatory aspects, trade levels, and economic signals can also influence stock market integration over time. For example, Jawadi et al. (2010) conclude that privatization and financial deregulation policies can lead to stronger integration of regional stock markets. Karim et al. (2011) find that direct trade with large economies is one of the most important factors that explain market integration.

Studies such as those cited above have been criticized for only considering *ex post* causalities and not capturing the process of market integration. Coval and Moskowitz (1999) point out that correlation between markets depend very much on their specialization of international trade of the individual economy. As a result, market comovement reflects only sectoral linkages instead of market integration. This argument implies that the study on stock market integration cannot be based on comovement of stock returns. A test for market integration needs to be built on asset pricing model, which is fundamentally an *ex ante* framework (Bekaert et al., 2002).

To the best of our knowledge, Carrieri et al. (2007) was the first to attempt in addressing the issue of determinants for market integration using an asset pricing approach. They estimated a pooled regression with four explanatory variables to study the equity markets of eight emerging countries: Argentina, Brazil, Chile, India, Korea, Mexico, Taiwan, and Thailand. They found that financial development and trade liberalization have a positive effect, while trade openness and global market volatility do not have a significant impact on market integration.

Under a Capital Asset Pricing Model (CAPM) equilibrium, perfect stock market integration exists when there are no pricing errors in benchmarking market indices with respect to a global portfolio or a list of common risk factors (Nagel and Singleton, 2011). These pricing errors could be due to limitations in common-border arbitrage, investment barriers, or market inefficiency (Tepe et al., 2011).

In this sense, when a conditional asset pricing test is applied, previous findings (see Caporale and Spagnolo, 2012; Carrieri et al., 2007) suggest that the integration of regional stock markets is mainly driven by the performance of individual markets, the macroeconomic situation, and the level of trade between markets.

According to Dufour et al. (2010) and Nagel and Singleton (2011) the most relevant market performance indicators are market development, the dividend yield differential, and stock index volatility. Market development and market integration are positively correlated because developed stock markets usually attract higher capital flows (Guangxi et al., 2014). The dividend yield differential refers to the relationship between the domestic and global market dividend yield, being previously been used for evaluating the rates of return of spatially separated portfolios (Bekaert et al., 2002). It is an adequate predictor of stock integration in emerging markets because it provides clues about the relative performance of an individual market relative to global stock markets (Dufour et al., 2010). Volatility is another important variable in explaining movements in stock returns (Guangxi et al., 2014). For example, Grullon et al. (2012) found a positive relationship between firm-level return volatility and firm-level stock returns.

The effect of macroeconomic variables on stock market integration has been previously reported by Hilscher and Raviv (2011). Among them, macroeconomic stability and price indicators mostly affect stock market integration since they influence firms' abilities to expand their markets and, consequently, to promote investor confidence (Karim et al., 2011).

The most relevant macroeconomic stability variables used in studies of financial market integration using CAPMs are exchange rate volatility and currency reserve changes (Ehrmann et al., 2011). The first is important because it affects agribusiness firms via its effect on financial returns from international trade. The second have been used in international trade studies as an indicator of the economy's ability to finance international trade (Mohanty and Turner, 2006). We assume that larger currency reserves ease firms' financing conditions and, consequently, increase their stock prices.

The price indicators that most influence the stock market integration process are inflation and interest rates (Aghion et al., 2009). Both affect consumption and investment costs, and as such, a firm's expected cash flow (Ehrmann et al., 2011). The inflation level increases financial market friction and negatively affects the efficiency of the financial system (Boyd et al., 2001). Hence, interest rates affect stock market integration by influencing capital flows between stocks and other asset markets such as bonds (Faust et al., 2007).

International trade can influence stock market integration because agricultural goods are tradable and many large agribusiness enterprises whose stock is publicly traded are involved in trade. International trade affects the cash flow of such enterprises, and thus their stock valuations. For example, Kose et al. (2006) find a positive correlation between the trade volumes and stock valuations of publicly traded firms. In order to account for this link, we include agricultural market openness and agricultural trade intensity as explanatory variables in our model.

Overall, this article fills in the void in the literature of stock market integration through exploring the determinants of regional stock market integration in the agribusiness sector. In the following, we test whether different measures of market performance, macroeconomic conditions, and international trade drive stock market integration for agribusiness stocks specifically. We cover a large number of stock markets, use different measures of market integration, and explore a broad set of potential drivers that are drawn from literature on market integration and stock return pricing discussed above.

3. Methodology

According to Fratzscher (2002), perfect market integration can be achieved when there is no pricing error in benchmarking market indices to the world portfolio, or to a list of common risk factors under an CAPM equilibrium. In terms of market efficiency, this implies that the process of world market integration is merely a reflection of improvement in the information efficiency process to reduce pricing errors across borders (Casu and Girardone, 2010). Thus, in searching for possible determinants on how a market could differ with another in achieving the efficiency in pricing, we might construct a regional market integration index by looking at the information set that matters to the asset pricing process.

Based on the literature on market linkages and stock returns pricing, we innovate by implement a two-stage method to explore the drivers of stock market integration using agribusiness stock indices. First, we constructed a list of nine explanatory variables, which were divided into three groups of fundamental forces: Individual Market Performance, Macroeconomic Conditions and Agricultural Trade. We also control for several potential structural breaks and trading-bloc effects. In a second stage, our model is tested robustly using the approach of panel regression. The next paragraphs present the estimation strategy implemented to construct our regional integration index.

Considering the main categories of driving factors described in the previous section, a regional stock integration index $RSI_{i,t}$ is constructed for every market "i" and period "t" to capture the time-varying behavior of regional market integration. $RSI_{i,t}$ can be depicted as:

$$RSI_{it} = f\,(Z\,Market_{it}, Z\,Macroeconomic_{it}, Z\,Trade_{it})\,, \qquad (1)$$

where RSI_{it} denotes the level of regional stock integration and $ZMarket_{it}, ZMacroeconomic_{it}, and\ ZTrade_{it}$ are vectors of variables representing individual market performance, macroeconomic conditions, and agricultural trade, respectively.

Following the adjustment suggested by Levine and Zervos (1998), Eq. (1) is estimated with a fixed window of 10 years of monthly observations and the collected time-varying pricing errors are adjusted to construct the market integration index (RSI_{it}).

We estimate the time-varying pricing error from a TB-CAPM, which is an extension of the model proposed by Hooy and Goh (2008) for the pricing of trading-bloc integration. The main advantages of this model are: (a) it offers a theoretical framework for the pricing of risky assets in which the trade bloc portfolio is a weighted portfolio of stock return series based on market capitalization of other trade bloc member countries; (b) it accommodates the continuously evolving world market structure from completely segmented to fully integrated markets as well as the increasing availability of substitute assets; and (c) it captures the impact of differential cross-border risk preferences and costs/barriers on the free flow of capital.

This model can be formulated as follows:

$$R_{i,t} - R_{F,t} = \alpha_i + \beta_i(R_{\text{TradeBloc},t} - R_{F,t}) + \varepsilon_{i,t};\ \forall\, t, \tag{2}$$

where $R_{i,t}$ and $R_{\text{TradeBloc},t}$ are the returns for the market portfolio and the trade bloc portfolio, respectively, and $R_{F,t}$ is the international risk-free rate at market "*i*" and period "*t*." The trading-bloc portfolio is a weighted portfolio of stock return series based on market capitalization of other trading-bloc member countries. In other word, the index of the market of interest is not included in the trading-bloc portfolio.

The pricing error α_i shows deviation from the state of perfect market integration. To obtain a time-series estimates for the market integration index, a 10-year rolling regression is implemented.

Levine and Zervos (1998) suggest that if stock markets are perfectly integrated, then the absolute value of the intercept term from the multivariate regression (2) of any asset's excess return on the appropriate benchmark portfolio (in this case $R_{\text{TradeBloc},t} - R_{F,t}$) should be zero:

$$RSI_{i,t} = -\left|\hat{\alpha}_{i,t}\right|, \tag{3}$$

where $RSI_{i,t}$ is positively correlated with the degree of market integration and can take any negative value with an upper limit of zero, where 0 indicates perfect integration. Furthermore, the rejection of the restrictions in (3) may be interpreted as rejection of the underlying asset-pricing model or rejection of market integration. The information set at each level of $RSI_{i,t}$captures the influence of each unique environment in driving the aggregate behavior of firms listed in the stock market, which in turn determines the degree of regional stock integration with the world market over time. With the above setting, the distinct roles of each individual market, their macroeconomic situation, and the trade level between them can then be envisaged and accurately assessed.

Following this estimation of $RSI_{i,t}$, we employ a panel approach with fixed cross-section and period effects to estimate the stock market integration model in Eq. (1), that we call model A:

$$\begin{aligned} RSI_{i,t} &= \mu + Z'_{i,t}\varphi + \eta_i + \phi_t \\ &\quad + v_{i,t} \qquad i = 1, \ldots, M;\quad t = 1, \ldots, T, \end{aligned} \tag{4}$$

where μ is the intercept term, φ is a vector of $k \times 1$ coefficients, and $Z_{i,t}$ is a vector of $k \times 1$ covariates for stock market "*i*" and time period "*t*," η_i represents the cross-section fixed effects, ϕ_t captures the period fixed effects, and $v_{i,t}$ is a random disturbance effects.

Since the inclusion of additional time-invariant variables into a panel model with similar characteristics to the model A is subject to perfect multicollinearity problems (Hsiao, 2003). Thus, using panel specification, we estimated an additional version of the panel data model (called model B) to test the effect of trade blocs and price bubbles. In this case, we replaced the cross-section terms and time period terms in (4) by trade agreement and price bubble binary variables, respectively:

$$\begin{aligned} RSI_{i,t} = \mu_t &+ \varphi_1 AMD_{i,t} + \varphi_2 DYD_{i,t} + \varphi_3 VOL_{i,t} + \varphi_4 EXV_{i,t} \\ &+ \varphi_5 CRC_{i,t} + \varphi_6 IFL_{i,t} + \varphi_7 INT_{i,t} + \varphi_8 AMO_{i,t} \\ &+ \varphi_9 ATI_t + \varphi_{10} D95_t + \varphi_{11} D06_t + \varphi_{12} DEUNI_i \\ &+ \varphi_{13} DNAFT_i + \varphi_{14} DMERC_i \\ &+ \varphi_{15} DAPEC_i + v_{it};\forall i \forall t. \end{aligned} \tag{5}$$

In this model, as measures of market performance we first include agricultural market development ($AMD_{i,t}$), dividend yield differential ($DYD_{i,t}$), and agricultural index volatility ($VOL_{i,t}$). In the category macroeconomic conditions, we consider the exchange rate volatility ($EXV_{i,t}$), currency reserve changes ($CRC_{i,t}$), inflation rate ($IFL_{i,t}$), and interest reference rate ($INT_{i,t}$). In the category trade, we include the agricultural market openness ($AMO_{i,t}$) and the agricultural trade intensity ($ATI_{i,t}$) for each market "*i*" and time period "*t*." Four trade bloc dummies variables are added to capture whether market integration are related to economic cooperation in trading bloc. The dummies are $DEUNI_i$, $DNAFT_i$, $DMERC_i$, and $DAPEC_i$, to represent EU, NAFTA, MERCOSUR, and APEC, respectively. These variables equal one if the stock market in question is located in the respective bloc, and zero otherwise. In order to avoid a binary variable trap, European Union (EU) is chosen as the reference group. Due to the condition of monetary union, members of EU are expected to have the highest degree of world integration.

We include a second set of binary variables to represent episodes of recent agricultural price bubbles. The objective is to account for possible structural shifts in financial markets that could affect the behavior of agribusiness stocks. To define these variables, we follow Esposti and Listorti (2013) who identified the two main price bubbles that have occurred during the last 20 years; the first from January 1995 to December 1996 (D95), and the second from January 2006 to December 2010 (D06). Finally, all volatility series are conditional volatilities generated from an AR(1) process by a Generalized Autoregressive Conditional Heteroscedastic Model (GARCH model) (1,1) (Bollerslev, 1986). According to Ferenstein and Gaşowski (2004), a GARCH (1,1) model can be depicted as follows:

$$\sigma_t^2 = (1 - \alpha_1 - \beta_1)E\left[\sigma^2\right] + \alpha_1\alpha_{t-1}^2 + \beta_1\sigma_{t-1}^2, \tag{7}$$

Table 1
List of trade blocs, member countries, and their respective stock markets

EU	Stock market	NAFTA	Stock market	MERCOSUR	Stock market	APEC	Stock market
Germany	Deutsche Börse	United States	New York, Chicago and American Stock Exchange	Argentina	Bolsa de Comercio de Buenos Aires	Chile	Bolsa de Santiago
Spain	Bolsa de Madrid	Canada	Montreal, Toronto and Vancouver Stock Exchange	Brazil	BOVESPA	Australia	Australia Stock Exchange
Italy	Borsa Italiana	Mexico	Bolsa Mexicana de Valores	Uruguay	Bolsa de Montevideo	New Zealand	NZX Limited
France	Bourse de Paris			Paraguay	BVPASA	Vietnam	HOSE
Portugal	Lisbon Stock Exchange					Russia	Moscow Exchange

Table 2
Description of covariates in the stock market integration model

Category	Explanatory variable	Measurement	Reference
Individual Market Performance	Agricultural Market Development	AMD = Agricultural market value/Nominal GDP	–
	Dividend Yield Differential	DYD = DY country i − DY world; DY = dividend/price	Ang and Liu (2007)
	Agriculture Stock Index Volatility	VOL = conditional volatility generated from an AR(1) process with GARCH(1,1) errors on log (P_t/P_{t-1})	–
Macroeconomic Conditions	Exchange Rate Volatility	EXV = conditional volatility generated from an AR(1) process with GARCH(1,1) errors on log(ExRate). Exchange rate is expressed in terms of each domestic currency per unit of USD	Aghion et al. (2009)
	Currency Reserve Changes	CRC = changes of log (international currency reserve)	Mohanty and Turner (2006)
	Inflation Rate	IFL = $(\mathrm{CPI}_t - \mathrm{CPI}_{t-1})/\mathrm{CPI}_{t-1}$	Boyd et al. (2001)
	Interest Reference Rate	INT = log (Short term interest rate, TB rate or interbank rate)	Faust et al. (2007)
Agricultural Trade	Agricultural Market Openness	AMO = total agricultural trade with the world/Nominal GDP	–
	Agricultural Trade Intensity	ATI = total agricultural trade with bloc members/Total agricultural trade with the world	–

where the next period's conditional variance is a weighted combination of the unconditional variance of returns, $E[\sigma^2]$, last period's squared residuals, α_{t-1}^2, and last period's conditional variance, σ_{t-1}^2, with weights $(1 - \alpha_1 - \beta_1)$, α_1, β_1 which sum to one.

4. Data description

We considered 18 stock markets in the four regional blocs with the highest volumes of agricultural trade measured in tons: the EU, MERCOSUR, NAFTA, and APEC (Table 1). Movements in agribusiness stock prices are taken from the Morgan Stanley Capital International (MSCI) Agriculture & Food Chain Index and the Goldman Sachs Commodity Index (GSCI) Agriculture Index for each regional market from August 1993 to August 2013. To estimate the global portfolio index, we used the MSCI All Country World Index as a proxy. The U.S Treasury bill rate obtained from the U.S. Department of the Treasury was used as a proxy for the world risk-free rate. The other variables in Eq. (5) were taken from the International Monetary Fund, Food and Agriculture Association of the United Nations, COMTRADE Database from the United Nations, and the World Bank. Table 2 presents a detailed description of the covariates included in the stock market integration model.

5. Empirical results and discussion

5.1. Summary statistics, correlation, and panel unit root tests

Table 3 presents the summary statistics and panel unit root tests for the dependent variable (RSI) and the nine covariates in the stock market integration model. The mean value of the dependent stock market integration index RSI (−0.366) and its standard deviation (0.27) suggest that significant variation in stock market integration exists among the countries that we considered. In this work, we applied two panel unit root tests, the Levin, Lin, and Chu test (Levin et al., 2002; which assumes a common unit root process) and the Im, Pesaran, and Shin test (Im et al., 2003; which assumes an individual unit root process).

Table 3
Summary statistics and unit root test for the panel variables

Variables	Mean	Standard deviation	Maximum	Minimum	Skewness	Jarque-Bera normality test	Null: Unit root (common unit root process) Levin, Lin, and Chu	Null: Unit Root (individual unit root process) Im, Pesaran, and Shin
RSI	−0.366	0.266	−0.000	−1.937	−1.366	3,124.1**	−0.751	−3.547***
AMD	0.011	0.254	3.496	−2.674	−0.290	88,675.3*	−61.411***	−57.188***
DYD	0.0039	0.008	0.040	−0.018	0.628	444.7*	−2.774***	−5.448***
VOL	8.804	1.019	13.831	0.811	4.093	177,653.1*	−12.191***	−21.602***
EXV	0.001	0.021	1.229	0.001	41.254	23,488.7**	−609.315*	−369.007***
CRC	0.001	0.064	0.671	−0.669	−0.908	77,645.3**	−72.917***	−67.917***
IFL	0.002	0.105	2.823	−4.200	−6.543	9,991.7*	−31.601***	−34.119***
INT	−2.547	0.649	−0.091	−5.872	−0.317	656.1**	−0.305	−2.442**
AMO	0.223	0.365	2.054	0.000	2.271	17,984.8*	−5.788***	−8.148***
ATI	0.387	0.220	0.712	0.000	−0.371	333.2*	−6.005***	−9.011***

Note: All unit root tests are based on testing equations with intercept.
*, **, and *** denote significance at the 0.10, 0.05, and 0.01 levels, respectively.

The null hypothesis of unit root is rejected in at least one out of two tests for each variable.

The matrix of correlation coefficients between covariates (Table 4) indicates that there is little multicollinearity among them. With respect to the correlation index, only nine coefficients exceed the value 0.1, with 0.31 being the highest coefficient (EXV/VOL relation). These results on the volatility covariates could be explained because, as described by Guvenen (2009), higher standard deviation creates an asymmetric risk that is associated with the degree of dispersion of returns around the average. This implies that adverse shocks (bad news) influence the volatility of the financial asset more severely than shocks favorable to the market (good news). In the agribusiness sector, there are many factors that create uncertainties in the firm's financial performance, such as price bubbles, exchange rate variations, and climate conditions, among others.

5.2. Estimated results for the panel model

Following Carrieri et al. (2007), a series of Hausman and *F*-tests are conducted to select an appropriate specification for the panel model. When the significance levels of these tests are analyzed, in panel A, we see that the two-way fixed effect setting is preferred to the random effect model and, from panel B, the fixed effects model is found to be significant (Table 5).

As previously explained, we estimated an additional panel data model (called model B) in which specific binary variables are introduced in the panel regression. In this case, the cross-section fixed effects are replaced by the trade bloc binary variables described above. In order to test whether structural shifts in financial markets due to episodes of price bubbles have influenced agribusiness stock market integration, we replace the period fixed effects with the D95 and D06 binary variables. The estimation results for both models with White robust standard errors are presented in Table 6.

In model A, four variables were found to be statistically significant, compared with 12 in model B. The magnitudes of the estimated coefficients are highly consistent in both models, except for the dividend yield differential, inflation rate, and agricultural market openness.

5.2.1. Individual market performance category

In both models we found a positive relationship between RSI and the size of the agribusiness sector as a percentage of total GDP (AMD). This result suggests that increased capitalization of agribusiness firms as a percentage of GDP stabilizes the firm's valuation. The previous statement confirms the notion

Table 4
Correlation matrix for panel series of the model

	RSI	AMD	DYD	VOL	EXV	CRC	IFL	INT	AMO	ATI
RSI	1.0000									
AMD	0.0005*	1.0000								
DYD	0.0451	−0.0227	1.0000							
VOL	−0.2191*	−0.0245	−0.0381	1.0000						
EXV	−0.0513*	−0.0009	0.0016	0.3140**	1.0000					
CRC	−0.0046	0.0613*	−0.0234	0.0280	−0.0117	1.0000				
IFL	−0.0091	−0.0005	−0.0032	0.0201	0.0179	−0.0124	1.0000			
INT	0.0957*	−0.0368	0.0360	0.3097**	0.1035*	0.0544*	0.0158	1.0000		
AMO	0.0026	0.0432	−0.0116	−0.1161*	−0.0222	0.0045	−0.0047	−0.2719**	1.0000	
ATI	0.0910	−0.0127	0.0086	−0.1737*	−0.0432	−0.0374	0.0061	0.0333	−0.0440	1.0000

Note: *, **, and *** denote significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 5
Hausman and F-tests for model selection of the panel regression

Hypothesis	Adj R^2	RSS	Chi-Sq	F
Panel A: Hausman test for random effects				
H_0: One-Way Cross-section Random Effects	0.03	255.96		15.98
H_1: One-Way Cross-section Fixed Effects	0.29	246.69		0.119
H_0: One-Way Period Random Effects	0.08	327.24		71.15
H_1: One-Way Period Fixed Effects	0.11	310.98		0.013**
H_0: Two-Way Random Effects	0.04	235.46		55.34
H_1: Two-Way Cross-section Random Period Fixed Effects	0.12	221.42		0.101*
H_0: Two-Way Random Effects	0.04	235.46		Failed†
H_1: Two-Way Cross-section Fixed Period Random Effects	0.29	233.78		
H_0: Two-Way Random Effects	0.04	235.46		Failed†
H_1: Two-Way Fixed Effects	0.34	219.24		
H_0: Two-Way Cross-section Random Period Fixed Effects	0.12	221.42		31.00
H_1: Two-Way Fixed Effects	0.33	219.24		0.012**
H_0: Two-Way Cross-section Fixed Period Random Effects	0.29	233.78		144.10
H_1: Two-Way Fixed Effects	0.33	219.24		0.012**
Panel B: F-Test for fixed effects				
H_0: Without fixed effects	0.22	402.99	1,198.01	55.15
H_1: One-Way Cross-section Fixed Effects	0.44	312.13	0.037**	0.050**
H_0: Without Fixed Effects	0.22	501.34	388.64	2.45
H_1: One-Way Period Fixed Effects	0.16	399.89	0.013**	0.000***
H_0: Without Fixed Effects	0.20	415.87	2,001.24	13.34
H_1: Two-Way Fixed Effects	0.67	323.98	0.001**	0.000***
H_0: One-Way Cross-section Fixed Effects	0.43	303.19	1,878.34	83.99
H_1: Two-Way Fixed Effects	0.56	299.00	0.000***	0.000***
H_0: One-Way Period Fixed Effects	0.16	415.34	590.11	4.65
H_1: Two-Way Fixed Effects	0.51	304.00	0.000***	0.000***

Note: *, **, and *** denote significance at the 0.10, 0.05, and 0.01 levels, respectively.
†Test failed as the test variance (either cross-sectional or period) is invalid.

Table 6
Estimation results for the models A and B

	Model coefficients	White robust standard errors	Model B coefficients	White robust standard errors
Intercept (μ_t)	−0.3876	(0.0641)**	−0.5773	(0.0341)**
AMD	0.0012	(0.0300)**	0.0029	(0.0132)
DYD	0.6155	(0.6879)	−0.2865	(0.5147)
VOL	−0.0097	(0.0004)***	−0.0123	(0.0003)***
EXV	−0.0088	(0.1253)	−0.3255	(0.1369)***
CRC	−0.0875	(0.2234)	−0.0451	(0.0504)
IFL	0.0134	(0.0452)	−0.0118	(0.0277)*
INT	0.0883	(0.0221)	0.2421	(0.0061)**
AMO	−0.1977	(0.0310)**	−0.0128	(0.0302)***
ATI	0.3888	(0.0299)**	0.4561	(0.0401)**
D95			0.0499	(0.0349)***
D06			−0.0491	(0.0044)***
DEUNI			0.3162	(0.046)**
DNAFT			0.3703	(0.0474)**
DMERC			0.3523	(0.0116)***
DAPEC			0.2967	(0.0125)***
Adj R^2		0.4521		0.4188
RSS		291.2434		398.3212

Note: *, **, and *** denote significance at the 0.10, 0.05, and 0.01 levels, respectively.

that high sector growth expectations would promote market integration via greater financial stability. In emerging markets, the relationship between sector GDP growth and stock valuation has been demonstrated previously by the work of Pendell and Cho (2013).

The market volatility coefficients (VOL) are (−) 0.0097 for model A and (−) 0.0123 for model B, suggesting that this has a negative effect on the integration process between stock markets. Increased levels of volatility do not promote regional stock market integration because this mainly depend of the development level of each stock market, and is driven by a different economic process than pricing returns (Bekaert et al., 2011). In fact, Esqueda et al. (2013) demonstrated that the correlation between local and global market returns increases as a result of market-oriented policies, but these policies do not drive up local market volatility. In both models, DYD did not show statistically significant coefficients and present signs in different directions (positive in model A and negative in model B). Following Ang and Liu (2007), the inclusion of a price bubble dummy for expected returns in model B could impact the effect of DYD negatively on market integration, since the world dividend yield was calculated in excess of a risk-free rate. However, given their significance, this impedes us from being able to make conclusions regarding a single effect of this variable on RSI.

Certainly, the aforementioned results confirm that countries can benefit from trade regionalism policies in terms of stock return pricing, by acting as an economic bloc rather than as individual markets. The main consequence of such policies is an increase in market options and stability as a result of higher capitalization levels.

5.2.2. *Macroeconomic conditions category*

This category includes macroeconomic and stability indicators, namely: exchange rate volatility (EXV), inflation rate (IFL), interest reference rate (INT), and currency reserves changes (CRC).

As expected, EXV has a significant and negative effect on agribusiness stock market integration in both models (−0.088 and −0.3255 for models A and B, respectively), confirming an inverse relationship with respect to stock market integration. According to Gounopoulos et al. (2013), unexpected changes in currency values affects price convergence among stock markets because of their effect on macroeconomic stability and economic expectations. Both coefficients are high in absolute value, suggesting that this variable has an important impact as driving factor of regional stock markets. Because it affects the economy's ability to finance international trade, the large-scale use of currency reserves has significant macroeconomic implications. In fact, our model's coefficients show an inverse relationship between changes in currency reserves (CRC) and stock market integration. Changes in currency reserves are often associated with exchange rate changes that increase the risks of holding instruments. This has a positive relationship with the risk exposures of stock instruments due to the use of foreign exchange reserves to resist currency appreciation, which has been demonstrated previously by Mohanty and Turner (2006). INF has an inverse coefficient in both models and only in model B is it statistically significant. Following Bittencurt (2011), we can infer that this inverse relationship is because high inflation levels intensify market frictions and reduce the efficiency of the financial system. This relationship turns more significant in model B due to the inclusion of markets turmoil variables (price bubbles). In this context, De Grauwe (2012) demonstrated that high levels of price volatility dampen the attraction of capital flows, further decreasing arbitrage activities between stock markets and the integration level among them. Interest rates represent the return on alternative assets to stocks, and the discount rates used on stock return valuations. In models A and B, INT is positively correlated with market integration, recording values of 0.09 and 0.24, respectively. Ehrmann et al. (2011) conclude that higher interest rates increase stock market integration because they divert capital from the stock market to the bond market. With the increasing ease of market access as a result of trade agreements, regional stock investments are promoted because higher bond returns attract local investors to introduce their capital into regional markets.

5.2.3. *Agricultural trade category*

Opening the market to trade should lead to increased integration if it generates foreign portfolio investments that did not occur before such liberalization (Lahrech and Sylwester, 2013). We include agricultural market openness (AMO) and agricultural trade intensity (ATI) to capture the effect of agricultural trade on stock market integration. As expected, agricultural trade intensity (ATI), which measures total agricultural trade with bloc members as a proportion of total agricultural trade with the world, unlike agricultural market openness (AMO) which measures agricultural trade with the world as a proportion of nominal GDP, is positive and significant in both models. While the ATI values were 0.3888 for model A and 0.4561 for model B, the AMO coefficient was −0.1977 and −0.01288 respectively.

We infer that ATI has a positive relationship with RSI because the higher the trade flow between regional bloc members, the higher the level of regional stock market integration. This implies that increasing levels of market access and trade due to regional liberalization policies promote stock market integration and thus capital flows between countries or sectors, further supporting the hypothesis of this work.

Although previous studies on developed countries (Aghion et al., 2009; De Grauwe, 2012) suggested that volatility and/or risk are important factors in the behavior of stock markets, our results demonstrate that for the agribusiness sector the effect of this type of determinant variable is not so significant. This could benefit emerging countries or developing markets that usually present higher risk qualifications. Overall, we confirm the relevance of the agribusiness sector within the country, and that economic blocs are key driving factors of stock market integration. These results constitute a novel contribution to the literature, as most studies have not considered sectorial characteristics, production, and trade among the factors that promote the integration of stock markets.

5.2.4. *Price bubbles and trade blocs*

Price bubbles are driving factors of market integration because of their effects on price differences and consequently arbitrage activities (Gilbert, 2010). In our model, all price bubble variables present statistically significant coefficients. This result supports the existence of two-way fixed effects. Among these, the first period dummy (D95) had a positive and significant effect on market integration with an estimated coefficient of 0.0499. However, the second period (D06) had a negative effect of −0.0491. The larger impact on market integration from the D95 bubble could be a consequence of the increased arbitrage activities among commodity traders when compared to the 2006 bubble because of the higher domestic/international price spread during the 1995 bubble when compared to 2006 (Esposti and Listorti, 2013; Gilbert, 2010). The D95 bubble had the effect of increasing stock prices and as such return pricing behavior for agribusiness stocks. In other words, the greater price spread during the 1995 crisis seems to have promoted arbitrage activities among regional investors who held agribusiness stocks from markets with lower commodity prices to markets with higher commodity prices.

The last group of variables included in model B is the presence of regional trade agreements pertaining to each of the countries considered in this work. For both models, they present positive and statistically significant coefficients. Our findings provide a clear picture of the positive effect of the implementation of trade agreements on regional market integration, further confirming previous results (Caporale and Spagnolo, 2012; Gochoco-Bautista and Remolona, 2012). The impact on market integration is relatively homogeneous for all agreements, suggesting that regardless of the level of the economic development of each country and stock market price arbitrage among different markets, the benefit in all blocs is present to a similar degree.

From the coefficients of trade bloc dummies variables presented in model B, we found the highest degree of integration in a developed market, such as NAFTA, followed by MERCOSUR, EU, and APEC. In the case of NAFTA and MERCOSUR, factors such as distance and public policies could drive a greater degree of market integration. This argument is supported by Lahrech and Sylwester (2013), who find a positive relationship between the integration of financial markets and the distance between them. However, our results for the EU—where the markets considered in Germany, Italy, France, Portugal, and Spain are geographically closer to one another than the markets in, for example, NAFTA—are more similar to those of Bekaert et al. (2011). Their results demonstrate an inverse relationship between the number of stock markets and the degree of pricing efficiency when a large number of stock markets are analyzed. Moreover, they suggest that financial provisions policies to reduce transaction costs for capital flows can promote greater integration in regional risk pricing. Recently, both blocs have generated legal initiatives with the aim of fulfilling this objective and promoting capital flows between their member countries.

Furthermore, the heterogeneity of the members of a Regional Trade Agreement (RTA) might play a more important role than geographic distance between them. For example, in the case of APEC the differences between their stock markets in terms of trade volume, the distance (for example, between Chile and Russia), and the competitive trade policies among them could work against effective cooperation between countries. The negative effect of these policies on capital flows and financial cooperation has been demonstrated previously in the works of Click and Plummer (2005) and Karim and Ning (2013).

Overall, our findings suggest that trade blocs as well as price bubbles play a relevant role in arbitrage activities between stock markets. Moreover, market stability indicators (i.e., AMD and/or VOL) have more explanatory power than performance level, such as, for example, DYD, as drivers of regional stock market integration. The integration of stock markets is more exposed to individual and regional market stability than world-level conditions. Finally, the empirical evidence documented here demonstrates that market stability is a significant factor for convergence in regional risk pricing on stock markets.

6. Conclusions

The recent trend toward economic regionalism and its effect on the agricultural sector has become a catalyst for research on the stock dynamics of agribusiness firms. This work aimed to explore the drivers of regional stock market integration with a focus on the agribusiness sector across the most important trade blocs around the world. This was a previously unexplored issue in the literature on stock market integration.

In this study, a regional integration framework, which combines information from three categories and nine explanatory variables, is used to examine the contributing factors to regional stock market integration. We also consider agriculture-specific factors to control for possible structural breaks and trade agreement effects.

We conclude that our categories have been important factors in promoting regional stock market integration, further suggesting that the market performance, macroeconomic conditions, and agricultural trade of each country mainly drive this process. Among them, market stability indicators and intraregional trade levels have greater explanatory power than performance variables as drivers of regional stock market integration. Besides this, the integration of stock markets is more exposed to individual and regional market stability than world-level conditions (for example, ATI vs. AMO). Furthermore, stock market integration was strengthened by the implementation of trade agreements and during the 1995 price bubble.

The level of market integration differs according the number of countries participating in the each stock market. The integration level is higher for small trade blocs (in terms of countries), such as, for example, NAFTA and MERCOSUR, when compared with a more segmented bloc such as the EU or APEC. Our results suggest that the level of development and public policies also play a role in the integration pattern of each regional market. In particular, the systematic risk exposure to movements in stock markets within a trading bloc therefore remains an important factor in the pricing of agribusiness stocks.

Stock market development and financial liberalization policies might play important roles in the agribusiness stock market integration. While the evolution and driving factors of integration documented in this study confirm our expectations, it is very interesting to observe increasingly integrated financial markets for the agribusiness sector. In the case of developed countries, this situation is mainly promoted by their macroeconomic stability which allows higher pricing returns from their main financial instruments, such as country funds and American Depository Receipts (ADRs) which offers better information and investor awareness. In the case of developing countries, this process will continue through reduction in barriers to capital flows and further liberalization of capital markets and policies oriented to promote more efficient capital flows among markets.

Overall, this work confirms that liberalization is a complex and gradual process in which the impact on pricing returns of agribusiness stocks has not been deeply considered. In this sense, there is still room for policy makers in emerging markets to further liberalize and debate about the effect of multi- versus bilateral trade agreements on financial markets. Although TB-CAPM is an innovative model in international asset pricing and is based on several strong assumptions, other alternative measures for market integration can be considered. For example, to use the stochastic discount factor as alternative measure for market integration, which deals with heterogeneous agents with complete versus incomplete markets that is very characteristic of the agribusiness sector. Finally, one might want to consider controlling for other factors such as market liberalization and capital flows in developing countries and investment constraints in the agriculture sector.

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