QUANTITATIVE ANALYSIS OF THE PRICE DISCOVERY IN THE NAFTA STOCK MARKETS

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ABSTRACT

In this study I extend the work of Chukwuogor-Ndu and Kasibhatla (2007) who document that the US, Canada and Mexico markets are cointegrated as a result of the North America Free Trade Agreement. I examine the question: what is the proportional contribution to the price discovery of these indexes based on their cointegration. In the international finance literature it is widely assumed that the US market provides the leadership. I find that the US is not always the dominant market in the price discovery when I examine five iShares Exchange Traded Funds which are simultaneously listed in Canada, Mexico and the United States. The ETFs that I use in this study are the iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund. The US market is dominant only in the price formation of the Brazil and Gold ETFs whereas the leader in the price formation of the rest of the ETFs is the Canadian market.

Keywords: NAFTA, Cointegration, Price Discovery, Exchange Traded Funds
JEL codes: G13, G14

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I. INTRODUCTION

In this study I extend the work of Chukwuogor-Ndu and Kasibhatla (2007) who document the cointegration among the United States (US), Canadian and Mexican financial markets. I examine the question which is the leading market in the price formation in the North American Free Trade Agreement (NAFTA) financial markets. NAFTA facilitated the trade integration of the three countries. Prior to the financial crisis there were even discussions of moving forward with monetary integration of the three NAFTA partners. However, the financial crisis which was triggered by the collapse of the real estate market in the US has put those plans on hold. It is not surprising then that it is widely assumed in the international finance literature that the US market provides the leadership considering the large variety of instruments and speed of innovation in the US financial markets. This is the first study to the best of my knowledge to quantify the leading role of the US stock market in the price formation in the NAFTA stock markets. I find that the US is not always the dominant market in the price discovery when I examine five iShares Exchange Traded Funds (ETFs) which are simultaneously listed on the Toronto Stock Exchange - Canada, the Bolsa Mexicana De Valores - Mexico and the New York Stock Exchange – United States. The ETFs that I use in this study are the iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund. The US market is dominant only in the price formation of two of the five ETFs. The US market provides price leadership in the MSCI Brazil and COMEX Gold ETFs with proportional contributions of NYSE to the price formation of 65.7% and 98.6% respectively, whereas the leader in the price formation of the rest of the ETFs is the Canadian market. The proportional contributions of TSX to the price formation of the EAFE, Emerging Markets and S&P 500 ETFs are 84.1%, 57.1% and 84.5% respectively.

II. LITERATURE REVIEW

The North American Free trade Agreement (NAFTA) was implemented on January 01, 1994 with the purpose of trade facilitation in the North American region. The majority of the literature in the area of assessment of NAFTA implementation has been on determining the benefits of lowering trade barriers, improvement of investment across borders and labor market adjustments. Kehoe and Kehoe (1994), Hanson and Song (1998), Gould (1998), Lederman, Maloney, and Serven (2004), Cardarelli and Kose (2004) are a few studies in the area of assessment of NAFTA implementation. As Gould (1998) points out tariffs were immediately eliminated on 20% of the apparel and textiles, with a targeted elimination of tariffs on 80% of this trade by the year 2000, that automobile tariffs

were immediately slashed by half and that these tariffs should be eliminated by the year 2004. Considering that these are important political topics this is not surprising.

The focus of this paper, however, is on the financial sector integration. Gould (1998) provides insight into the financial sector integration:

"NAFTA immediately reduced, and will eliminate by 2000, Mexico's restrictions on Canadian and U.S. ownership and provision of commercial banking, insurance, securities trading, and other financial services. Under NAFTA, Canadian and U.S. financial firms are allowed to establish wholly owned subsidiaries in Mexico and to engage in the same range of activities as similar Mexican firms."

In a recent study, Correa and Seccareccia (2009) provide a comprehensive analysis of the contribution of the increased financial markets integration due to NAFTA to the recent financial crisis. Correa and Seccareccia (2009) argue that a major contributing factor to the crisis is the conflict between the Export Led Growth objective of establishing NAFTA and the increased monetary controls over inflation by each individual country of the agreement. The authors also argue that via NAFTA many of the financial innovations in the sub-prime markets transferred to the Canadian and Mexican markets which exacerbated the crisis.

Nevertheless, similar to Chukwuogor-Ndu and Kasibhatla (2007), Correa and Seccareccia (2009) assume that the US market provides the leadership in the price discovery in the three markets just like the rest of the literature. This is the first study to the best of my knowledge to examine and quantify the leadership role of the US market.

This study is very closely related to a study by Grammig et al (2005). Similar to this study, Grammig et al (2005) use Hasbrouck (1995) methodology to study the price discovery of German stocks cross-listed in Germany and the US. Grammig et al (2005) find that the price discovery leadership is performed by the domestic German market. There is a difference between this and Grammig et al study. Grammig et al (2005) use ultra high frequency data, intradaily data; whereas in this study a low frequency, daily data is used. Also, Grammig et al (2005) allow for independent variability of the exchange rate however one of their main findings is that the exchange rate appears to be exogenous to the stock price. Additionally, Grammig et al (2005) point out that most studies using daily data do not allow for an independent role of the exchange rate but, instead, translate home market prices into dollars. Therefore, considering that I analyze daily data and based on Grammig et al (2005) findings I treat the exchange rate as being exogenous and thus translate home market prices into dollars.

It would have been preferable to use non-financial corporate stocks listed simultaneously in the three markets to be consistent with the Grammig et al (2005) study. I identify 220 Canadian stocks listed both in Canada and the US

and 89 Mexican stocks listed both in Mexico and the US.[2] However, there are no non-financial corporate stocks listed simultaneously in the three markets. Nevertheless, ETFs are like stocks. They are investment baskets of securities and thus are similar to open-end mutual funds but in contrast to mutual funds trade during the day like corporate stocks. Just like stocks ETFs can be shorted and traded on margin.

Next, I provide a description of the data used in this study and develop the methodology to formally examine the dominant role of the US market.

III. DATA AND METHODOLOGY

I use five iShares Exchange Traded Funds (ETFs) which are simultaneously listed on the Canada's Toronto Stock Exchange (TSX), Mexico's Bolsa Mexicana De Valores (BMV) and the US New York Stock Exchange (NYSE). The ETFs used in this study are the iShares MSCI Brazil Index Fund (Brazil), iShares MSCI EAFE Index Fund (EAFE), iShares MSCI Emerging Markets Index Fund (EmMarkets), iShares COMEX Gold Trust (Gold) and iShares S&P 500 Index Fund (S&P 500). I did not use the ETFs ticker symbols to denote each security because these ETFs have different ticker symbols in each country. The ETFs are described in detail in the Appendix.

Daily data on the ETFs are used in the analysis and are obtained from several different sources. The data on the Canadian listed ETFs are obtained from www.tsx.ca. The data on the Mexican listed ETFs are obtained from finance.yahoo.com and mx.ishares.com. The data on the US listed ETFs are obtained from finance.yahoo.com. The exchange rate data are from www.oanda.com.

Table 1 provides Summary Statistics for the TSX, BMV and NYSE listed ETFs. Because each starting date is the initial listing date of the ETF on the respective exchange the combining and matching of data necessary for the price discovery analysis requires the respective starting date of the analyzed datasets to be determined by the inception date of the latest listed ETF. Therefore, the 96 observations for the Brazil ETF are due to the shorter period 1/27/2010 to 7/09/2010 imposed by the inception of the latest ETF, the Canadian ETF. Similarly, the 304 observations of the EAFE ETF are due to the inception of the Mexican ETF, the 148 observations of the Emerging Markets ETF are due to the inception of the Canadian ETF, the 442 observations of the Gold ETF are due to the Mexican ETF and the 619 observations of S&P 500 ETF are due to the inception of the Mexican ETF. The summary statistics are the average closing prices and standard deviations of the closing prices of the five ETFs. Closing

[2] The list of Canadian stocks is on the following web-site: http://www.superstockpicker.com/canadian_US_stock_symbols.html, and the list of Mexican stocks is on the following web-site: http://www.site-by-site.com/adr/latin/adr_mex.htm. Both lists were retrieved from these websites on July 18, 2010.

prices are in Canadian Dollars for the Canadian ETFs, Mexican Pesos for the Mexican ETFs and US Dollars for the US ETFs.

Table 1: Summary Statistics

Summary Statistics for the Canada's Toronto Stock Exchange (TSX), Mexico's Bolsa Mexicana De Valores (BMV) and US New York Stock Exchange listed Exchange Traded Funds (ETFs). The ETFs are the iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund. Close is the closing price of the ETF in Canadian Dollars for the Canadian ETFs, Mexican Pesos for the Mexican ETFs and US Dollars for the US ETFs.

		TSX		BVM		NYSE	
	N	**Mean**	**StDev**	**Mean**	**StDev**	**Mean**	**StDev**
Brazil	96	19.62	0.94	868.46	39.46	68.82	4.26
EAFE	304	20.37	4.79	707.11	108.60	60.14	14.30
EmMarkets	148	23.83	0.84	517.34	22.00	40.52	1.83
Gold	442	10.27	1.38	118.14	22.53	94.76	13.20
S&P 500	619	13.69	2.97	1366.72	153.56	114.24	21.67

Based on the Granger representation theorem as discussed in Engle and Granger (1987) and considering the recent developments in the area of price discovery I utilize Hasbrouck (1995) methodology to determine the price discovery dominant market. In this study I follow the Engle-Granger cointegration methodology as discussed in Enders (2004) and thus I test for stationarity in the ETF prices first. I use Augmented Dickey - Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit root tests to establish non-stationarity. The null hypothesis of the ADF and PP tests is that the series has unit root whereas the null hypothesis of the KPSS test is that the series is stationary. The tests can be performed on three non-stationarity model specifications, the zero mean model, the single mean model and a trend model.

The Granger representation theorem states that if two random series are integrated of order one there is a possible natural combination of them, which will not be integrated. The presence of natural association and high correlation between the prices among the US, Canadian and Mexican markets as documented by Chukwuogor-Ndu and Kasibhatla (2007) suggests cointegration among these three markets. The presence of cointegration among the ETF prices calls for the identification of a Vector Error Correction Model (VECM) based on the differences in these prices. The VECM that I use in the study is based on the Johansen and Juselius (1990) methodology. Johansen and Juselius (1990) method helps identify and quantify the long-run and short-run fluctuations among the three markets. The VECM is:

$$\Delta p_t = \Pi p_{t-1} + \phi_1 \Delta p_{t-1} + \phi_1 \Delta p_{t-2} + ...u_t, \quad (1)$$

where p_t is the 3x1 vector of log levels of the US listed ETF, Canadian listed ETF and Mexican listed ETF, Π is the matrix of the product of the equilibrium adjustment coefficients α and the long-run parameters β, and u_t is the error term.

Hasbrouck (1995) methodology utilizes this VECM to extract information about the contribution of each market to the price discovery by transforming the VECM into a vector moving average model:

$$\Delta p_t = A(L)u_t, \quad (2)$$

with A(L) the matrix polynomial in the lag operator, L, and total innovation variance:

$$\sigma_w^2 = a_{11}^2\sigma_1^2 + a_{12}^2\sigma_2^2 = \vec{a}\Omega\vec{a}', \quad (3)$$

where Ω is the covariance matrix. The total innovation variance reflects the impact on the price of the arrival of new information. If the covariance matrix of the innovation variance is diagonal then equation (3) can be used to decompose the long-run variance into components related to innovations a_{ij}. The parameters a_{ij}, are the impulse responses which are interpreted as the effect of one standard deviation change in one variable on another variable due to the arrival of new information. Based on the variance decomposition for the three ETFs the information shares are computed as follows:

$$I_i = \frac{a_{ii}^2\sigma_i^2}{\sigma_w^2}, \quad (4)$$

where a_{ij} are obtained from the vector moving average representation of the VECM, σ_i^2 is the variance in result of arrival of new information in market 'i' and σ_w^2 is the total innovation variance.

The information shares as computed in equation (4) provide insight into the dominating market 'i' in the price formation of the studied ETFs, the highest information share determines the dominant market in the price formation. The empirical analysis of the price formation of the US, Canadian and Mexican listed iShares ETFs is provided next.

IV. ANALYSIS

I start the analysis with the first step of the Engle-Granger cointegration methodology, unit root tests. Table 2 provides results for the Augmented Dickey - Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) unit root tests. Panel A of Table 2 reports results for the Canadian Market, Panel B provides results for the Mexican Market and Panel C for the US market.

The ADF and PP test results strongly reject stationarity in the ETFs prices. The KPSS test results strongly reject stationarity in all series with the exception of the Emerging Markets ETF for which stationarity is rejected at the 10% significance level. The tests allow for testing on three non-stationarity model specifications, the zero mean model, the single mean model and a trend model. In the interest of brevity only the test results for the zero mean model are reported because the results for the other two model specifications are identical but these results are available upon request.

Table 2: Unit Root Test Results

Augmented Dickey-Fuller, Phillips-Perron and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) Unit Root Tests on the logarithm of the US Dollar closing prices of the Canada, Mexico and US listed iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund. P-values Reported.

Panel A: TSX

ADF (Augmented Dickey-Fuller) Unit Root Test						KPSS Unit Root Test	
	Log Levels H0=I(1) ADF Test Stat.	Probability (Pr.)	Log First Differences H0=I(1) ADF Test Stat.	Log First Differences H0=I(1) ADF Test Stat.	Probability (Pr.)	Log Levels H0=I(0) LM Probability (Pr.)	Log First Differences H0=I(0) LM Probability (Pr.)
Brazil	-0.01	0.6812	ΔBrazil	-102.35	0.0001	<0.01	0.45
EAFE	-0.19	0.6393	ΔEAFE	-334.43	0.0001	<0.01	0.64
EmMarkets	0.02	0.6860	ΔEmMarkets	-122.50	0.0001	0.0579	0.22
Gold	0.26	0.7455	ΔGold	-496.37	0.0001	<0.01	0.73
S&P 500	-0.17	0.6445	ΔS&P 500	-500.22	0.0001	<0.01	0.73

Phillips-Perron Unit Root Test					
	Log Levels H0=I(1) PP Test Stat.	Probability (Pr.)	Log First Differences H0=I(0) PP Test Stat.	Log First Differences H0=I(0) PP Test Stat.	Probability (Pr.)
Brazil	0.0022	0.6820	ΔBrazil	-88.6072	0.0010
EAFE	-0.1835	0.6410	ΔEAFE	-271.7704	0.0010
EmMarkets	0.0063	0.6840	ΔEmMarkets	-130.5842	0.0010
Gold	0.2587	0.7450	ΔGold	-467.4934	0.0010
S&P 500	-0.1677	0.6450	ΔS&P 500	-632.2154	0.0010

Panel B: BVM

ADF (Augmented Dickey-Fuller) Unit Root Test						KPSS Unit Root Test	
	Log Levels H0=I(1) ADF Test Stat.	Probability (Pr.)	Log First Differences H0=I(1) ADF Test Stat.	Log First Differences H0=I(1) ADF Test Stat.	Probability (Pr.)	Log Levels H0=I(0) LM Probability (Pr.)	Log First Differences H0=I(0) LM Probability (Pr.)
Brazil	-0.01	0.6803	ΔBrazil	-79.98	0.0001	<0.01	0.43
EAFE	-0.17	0.6429	ΔEAFE	-347.73	0.0001	<0.01	0.64
EmMarkets	0.01	0.6850	ΔEmMarkets	-316.21	0.0001	0.0564	0.26
Gold	0.25	0.7423	ΔGold	-575.47	0.0001	<0.01	0.75
S&P 500	-0.15	0.6489	ΔS&P 500	-1052.5	0.0001	<0.01	0.84

Phillips-Perron Unit Root Test					
	Log Levels H0=I(1) PP Test Stat.	Probability (Pr.)	Log First Differences H0=I(0) PP Test Stat.	Log First Differences H0=I(0) PP Test Stat.	Probability (Pr.)
Brazil	-0.0008	0.6810	ΔBrazil	-87.0563	0.0010
EAFE	-0.1713	0.6440	ΔEAFE	-326.3132	0.0010
EmMarkets	0.0065	0.6840	ΔEmMarkets	-178.2478	0.0010
Gold	0.2481	0.7430	ΔGold	-440.7319	0.0010
S&P 500	-0.1486	0.6500	ΔS&P 500	-746.8962	0.0010

Panel C: NYSE

ADF (Augmented Dickey-Fuller) Unit Root Test						KPSS Unit Root Test	
	Log Levels H0=I(1) ADF Test Stat.	Probability (Pr.)	Log First Differences H0=I(1) ADF Test Stat.	Log First Differences H0=I(1) ADF Test Stat.	Probability (Pr.)	Log Levels H0=I(0) LM Probability (Pr.)	Log First Differences H0=I(0) LM Probability (Pr.)
Brazil	-0.01	0.6805	ΔBrazil	-102.98	0.0001	<0.01	0.45
EAFE	-0.17	0.6441	ΔEAFE	-369.17	0.0001	<0.01	0.62
EmMarkets	0.01	0.6847	ΔEmMarkets	-172.49	0.0001	0.0372	0.352
Gold	0.25	0.7430	ΔGold	-453.87	0.0001	<0.01	0.67
S&P 500	-0.14	0.6504	ΔS&P 500	-826.04	0.0001	<0.01	0.81

Phillips-Perron Unit Root Test					
	Log Levels H0=I(1) PP Test Stat.	Probability (Pr.)	Log First Differences H0=I(0) PP Test Stat.	Log First Differences H0=I(0) PP Test Stat.	Probability (Pr.)
Brazil	-0.0021	0.6810	ΔBrazil	-100.7499	0.0010
EAFE	-0.1647	0.6460	ΔEAFE	-319.4551	0.0010
EmMarkets	0.0011	0.6820	ΔEmMarkets	-161.8423	0.0010
Gold	0.2525	0.7440	ΔGold	-427.8207	0.0010
S&P 500	-0.1374	0.6520	ΔS&P 500	-675.0280	0.0010

Table 3 provides Johansen Cointegration Test results using the Trace statistic, with null hypothesis lack of cointegration, one cointegrating vector or two cointegrating vectors. For the tests, I assume an intercept and constant trend in the cointegrating equation and no trend in the vector autoregression. I chose these assumptions for the tests because in this study I attempt to extend the work of Chukwuogor-Ndu and Kasibhatla (2007) and they use these assumptions in their study. Similar to Chukwuogor-Ndu and Kasibhatla (2007) I find that the relationship among the three markets can be described with a vector error correction model of rank two because of NAFTA. The lag length structure for the unit root tests and the VECMs is selected based on the Akaike Information Criterion and Schwarz Bayesian Criterion. The lag length of five provided the best model fit based on these two criteria.

Table 3: Cointegration Test Results

Cointegration Test Results (5% Confidence Level) on the logarithm of the US Dollar closing prices of the Canada, Mexico and US listed iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund.

		Unrestricted Cointegration Rank Test (Trace)			
	Null	Eigenvalue	Trace Statistic	0.05 Critical Value	Probability (Pr.)**
Brazil	r=0	0.3236	55.0130	24.08	<0.0001
	r≤1	0.1923	19.4348	12.21	<0.0001
	r≤2	0.0001	0.0054	4.14	0.8813
EAFE	r=0	0.1699	60.0658	24.08	<0.0001
	r≤1	0.0115	4.3999	12.21	0.7721
	r≤2	0.0031	0.9321	4.14	0.3523
EmMarkets	r=0	0.2202	44.6064	24.08	<0.0001
	r≤1	0.0612	9.0400	12.21	0.1057
	r≤2	0.0000	0.0013	4.14	0.9187
Gold	r=0	0.2052	187.7661	24.08	<0.0001
	r≤1	0.1785	87.3856	12.21	<0.0001
	r≤2	0.0033	1.4609	4.14	0.2743
S&P 500	r=0	0.1666	115.8817	24.08	<0.0001
	r≤1	0.0057	3.9875	12.21	0.8236
	r≤2	0.0008	0.4676	4.14	0.5689

**MacKinnon-Haug-Michelis (1999) p-values.

Table 4 provides results on the equilibrium adjustment coefficients α and the long-run parameters β of the VECM as described in equation (1). The long-run parameter β of the NYSE is normalized to one as a relative point for the parameters of the other markets. Based on the stationarity tests the individual

ETF log prices have unit roots. However, now after I estimated the VECM I can derive a linear combination of the three prices which is stationary based on the long-run parameters β. For example, if I were to examine the long-run relationship between the three NAFTA markets for the iShares MSCI Brazil ETF the stationary combination between the three markets can be described as follows:

$$1*\text{LogPrice}_{\text{NYSE},t} - 6.8644 * \text{LogPrice}_{\text{BMV},t} + 7.5948 * \text{LogPrice}_{\text{TSX},t}, \quad (5)$$

and the NYSE price has a coefficient of one because it is normalized.

The equilibrium adjustment coefficients α measure the speed of adjustment to long-run equilibrium after shock in the variables. The higher the value of the adjustment coefficient α the higher the speed of restoring long-run equilibrium among the three markets. If the coefficient α is negative there would be a downward adjustment in the variable to restore equilibrium, which is the case for the Brazilian ETF. If the coefficient α is positive there would be an upward adjustment in the variables.

Table 4: Vector Error Correction Model Results

Vector Error Correction Model equilibrium adjustment coefficients α and the long-run parameters β of the logarithm of the US Dollar closing prices of the Canada, Mexico and US listed iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund.

Normalized Cointegrating Coefficients (Standard Error in Parentheses)				
Brazil	LNYSE	LBMV	LTSX	Log Likelihood
	1	6.8644	-7.5948	
		(0.4576)	(0.5263)	11244.45
Normalized Cointegrating Coefficients (Standard Error in Parentheses)				
EAFE	LNYSE	LBMV	LTSX	Log Likelihood
	1	-1.0159	0.0149	
		(0.4975)	(0.0015)	16825.32
Normalized Cointegrating Coefficients (Standard Error in Parentheses)				
EmMarkets	LNYSE	LBMV	LTSX	Log Likelihood
	1	-0.6795	-0.3785	
		(0.1601)	(0.1371)	15867.33
Normalized Cointegrating Coefficients (Standard Error in Parentheses)				
Gold	LNYSE	LBMV	LTSX	Log Likelihood
	1	1.5702	-2.5701	
		(0.0981)	(0.0193)	12627.54
Normalized Cointegrating Coefficients (Standard Error in Parentheses)				
S&P 500	LNYSE	LBMV	LTSX	Log Likelihood
	1	-1.0435	0.0395	
		(0.0233)	(0.0095)	21656.71

Next, based on the Hasbrouck (1995) methodology I identify the proportional contributions to the price formation by the three markets as established in equation (4). The results of the decomposition are presented in Table 5 with the leading market being highlighted.

It is surprising that the price leadership is not always provided by the NYSE even though iShares is a US company and based on Grammig et al (2005) findings the domestic market should have provided the leadership role. Only the MSCI Brazil and COMEX Gold ETFs have the majority of the price discovery in the US market, with proportional contributions of NYSE to the price formation of 65.7% and 98.6% respectively. The EAFE, Emerging Markets and S&P 500 ETFs have the Canadian market providing the price discovery leadership, with proportional contributions of TSX to the price formation of 84.1%, 57.1% and 84.5% respectively.

Table 5: Information Shares

Proportional Contributions in the Price Formation of the logarithm of the US Dollar closing prices of the Canada, Mexico and US listed iShares MSCI Brazil Index Fund, the iShares MSCI EAFE Index Fund, the iShares MSCI Emerging Markets Index Fund, the iShares COMEX Gold Trust and the iShares S&P 500 Index Fund.

	TSX	BVM	NYSE
Brazil	0.2750	0.0680	**0.6570**
EAFE	**0.8410**	0.0140	0.1460
EmMarkets	**0.5710**	0.0610	0.3680
Gold	0.0030	0.0100	**0.9860**
S&P 500	**0.8450**	0.0010	0.1540

The reason for this difference might be due to the fact that iShares is a financial company and thus might not be considered a US based company as we would consider a non-financial company to be domestic or foreign. The company iShares has independent Canadian and Mexican subsidiaries. Also, the ETF market is much more developed in the US than it is in Canada and Mexico. Based on the following website etf.stock-encyclopedia.com, currently there are 111 ETFs listed in Canada, with 22 of these ETFs being iShares products. For comparison, according to finance.yahoo.com currently there are 1,046 ETFs in the US, with approximately 170 of these ETFs being iShares products.

There are more US listed ETFs in each one of the market segments of the ETFs used in this study indicating higher competition and suggesting that the iShares product is not necessarily being the most popular one. Also, the relatively low number of marketed ETFs in Canada provides for the much greater interest in the iShares products in these markets relative to the US market, which explains the larger contribution to the price discovery by the Canadian market in the price formation of these ETFs.

V. CONCLUSION

In this study I extend the work of Chukwuogor-Ndu and Kasibhatla (2007) who document that the US, Canada and Mexico financial markets are cointegrated because of the NAFTA agreement. NAFTA facilitated the trade integration of the three countries. Prior to the financial crisis there were even discussions of moving forward with monetary integration of the three NAFTA partners. However, the financial crisis which was triggered by the collapse of the real estate market in the US has put those plans on hold. It is not surprising then that it is widely assumed in the international finance literature that the US market provides the price discovery leadership. I examine the question what is the proportional contribution to the price formation of these three countries of five simultaneously listed in all three markets ETFs. This is the first study to the best of my knowledge to quantify the role of Canadian, Mexican and US stock markets in price formation.

The implementation of the North American Free trade Agreement on January 01, 1994 provides an interesting divide between the development of the Canadian, US and Mexican markets. Data permitting, in a future research it would be interesting to examine the information share dynamics of these three markets around the event of implementation of the NAFTA agreement.

REFERENCES

Cardarelli, R., and Kose, M. A. (2004). Implications of Canada-U.S. Economic Integration: Dynamics of Business Cycles and Productivity. *IMF Working Paper Series* (Washington: International Monetary Fund).

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*, 1, 37-53.

Correa, E. and Seccareccia, M. (2009). The United States Financial Crisis and Its NAFTA Linkages. *International Journal of Political Economy*, 38, 70-99.

Enders, W. (2004). *Applied Econometric Time Series,* Wiley Series in Probability and Statistics, John Wiley& Sons, New Jersey.

Engle, R. and Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55, 251-276.

Gould, D.M. (1998). Has NAFTA Changed North American Trade? *FRB of Dallas Economic Review,* First Quarter, 12-13.

Grammig, J., Melvin, M. and Schlag, C. (2005) Internationally Cross-listed Stock Prices During Overlapping Trading Hours: Price Discovery and Exchange Rate Effects. *Journal of Empirical Finance*, 12, 139-164.

Hanson, R. C. and Song, M. H. (1998). Shareholder Wealth Effects and Free Trade: US and Mexico Stock Market Response to NAFTA. *International Review of Economics and Finance, 7*, 209-224.
Hasbrouck, J. (1995). One Security, Many Markets: Determining the Contributions to Price Discovery. *The Journal of Finance*, 50, 1175-1199.
Johansen, S. and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration – With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, 52, 169-210.
Kehoe, P. J. and Kehoe, T.J. (1994). Capturing NAFTA's Impact with Applied General Equilibrium Models. *FRB of Minneapolis Quarterly Review*, Spring, 17–34.
Lederman, D., Maloney, W. F. and Serven, L. (2004). Lessons from NAFTA for Latin America and the Caribbean Countries: A Summary of Research Findings. *The World Bank Publications*, (Washington: World Bank).
MacKinnon, J. G., Haug, A. and Michelis, L. (1999) Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration., *Journal of Applied Econometrics*, 14, 563-577.

APPENDIX

Detailed description of the Exchange Traded Funds used in this study:

1) iShares MSCI Brazil Index Fund –has overall objective of tracking the performance of the Morgan Stanley Capital International Brazil Index which consists of the leading Brazilian stocks. This ETF has ticker symbol EWZ in the US and Mexico, and XBZ in Canada. The Canadian data are for the period, 1/27/2010 to 7/09/2010, the Mexican data are for the period, 6/20/2007 to 7/09/2010, and the US data are for the period 7/14/2000 to 7/09/2010.

2) iShares MSCI EAFE Index Fund –has overall objective of tracking the performance of the Morgan Stanley Capital International European, Australasian and Far Eastern markets index which consists of the leading stocks in this geographic region. This ETF has ticker symbol EFA in the US and Mexico, and XIN in Canada. The Canadian data are for the period, 4/21/2003 to 7/09/2010, the Mexican data are for the 1/13/2006 to 7/09/2010, and the US data are for the period 8/27/2001 to 7/09/2010.

3) iShares MSCI Emerging Markets Index Fund–has overall objective of tracking the performance of the Morgan Stanley Capital International European, Australasian and Far Eastern markets index which consists of the leading stocks in this geographic region. This ETF has ticker symbol EEM in the US and Mexico, and XEM in Canada. The Canadian data are for the period, 10/29/2009 to 7/09/2010, the Mexican data are for the period, 6/15/2005 to 7/09/2010, and the US data are for the period 4/15/2003 to 7/09/2010.

4) iShares COMEX Gold Trust –has overall objective of tracking the performance of the gold bullion. This ETF has ticker symbol IAU in the US and Mexico, and IGT in Canada. The Canadian data are for the period, 12/01/2005 to

7/09/2010, the Mexican data are for the period, 8/21/2007 to 7/09/2010, and the US data are for the period 1/28/2005 to 7/09/2010.

5) iShares S&P 500 Index Fund –has overall objective of tracking the performance of the Standard and Poor's 500 index. This ETF has ticker symbol IVV in the US and Mexico, and XSP in Canada. The Canadian data are for the period, 4/21/2003 to 7/09/2010, the Mexican data are for the period, 9/28/2004 to 7/09/2010, and the US data are for the period 5/19/2000 to 7/09/2010.