The study of the Spillover and Leverage Effects of Financial Exchange-Traded Funds (ETFs)

by Maya Malinda

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Abstract

This study adopts the Generalized Autoregressive Conditional Heteroskedasticity-in-Mean Autoregressive Moving Average (GARCH-M-ARMA) and Exponentially Generalized Autoregressive Conditional Heteroskedasticity-in-Mean Autoregressive Moving Average (EGARCH-M-ARMA) models to analyze the spillover, asymmetric volatility, and leverage effects of financial exchange-traded funds (ETFs). The results show that bilateral relationships exist between financial and non-financial ETFs. Both ETFs have negative asymmetric volatility, suggesting that the value of stock indices and ETFs reveal conditional heterokesdasticity. Financial and non-financial ETFs also have negative leverage effects on benchmark indexes. Bilateral relations in terms of the spillover effects of volatilities and leverage effects exist between financial and non-financial ETFs.

Keywords: Spillover Effect, Asymmetric-Volatility, Leverage Effect, Financial ETFs
JEL Classification: Financial Economics (G1)

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1 - Introduction

Exchange-traded fund (ETF) was launched for the first time by State Street Global Advisors in 1993, and the ETF market place has grown significantly since then. The global ETF market had grown to $2.25 trillion assets in 2013 with more than four thousand funds. China's economy, the fourth biggest in the world, has achieved rapid and steady growth over the past 20 years. However, accessing China's capital market remains difficult for global investors. Under these circumstances, ETFs are becoming good investment channels, and for international investors, China ETFs have become a favorite choice for investment [Song (2006)].

Even though many investors are profiting from ETFs, critical issues about risks have caused markets to function in a different way. In particular, some critics have connected with ETFs the large fluctuations in volatility and enhanced correlations in the equity market. Volatility and correlations have indeed increased over the past few years; however, these conditions are consistent with the terms of the macroeconomic uncertainty. Nevertheless, a good advantage of ETFs is that they allow better direction-finding of market environments that display correlations and higher volatility [Mazza (2012)].

Financial giants have been crippled by weries of foreclosures and crises. Investors must be competent to recognize potential opportunities and risks. Financial ETFs can help investors to hedge risks, cut losses, or look for better investment opportunities. Financial ETFs can also provide investors some associated advantages, like tax benefits, and allow them to experience more beneficial trading with minimal transactions and lower brokerage costs.

Many empirical studies have proven that ETF indices create spillover and leverage effects. For example, Chen and Huang (2010) revealed that has strong spillover effects from returns for Hong Kong and Singapore. Also, Chen (2011) found significant results on the leverage effects and bilateral spillover effects of index return volatilities for ethical and non-ethical ETFs. Moreover, Chen and Diaz (2012) found a strong negative/positive influence of leverage and inverse leverage ETFs return on stock index returns. To summarize the relevant previous studies, they found significant results on the leverage effects and bilateral spillover effects of ETFs on index return volatilities.

Applying similar methods, some previous studies found spillover and the asymmetric-volatility effects in ETFs using EGARCH-M-ARMA. To illustrate, Chen and Diaz (2012) found that there is a strong positive (negative) influence of lagged leveraged (inversed leverage) ETFs return on current stock index returns. In a relatively new study, Krause and Tse (2013) verified this results and indicate that return spillovers and asymmetric volatility create a bi-directional volatility response effect of ETFs in the case of the United States and Canada.

Up to this point, however, there were very few studies on financial ETFs for the equities market. ETFs are expanding rapidly, and so are the types of ETFs. There are many types of ETFs, namely, bond, commodity, and equity ETFs, and each type of ETF is further divided into several sub-types. For example, an equity ETF includes industrial, material, and financial ETFs; while financial ETFs has 48 types, which includes bank, insurance, and capital market. We opted to focus on financial ETFs in this study because of the lack of research in this field.

The motivation of this study is to reveal the existence of unilateral and bilateral-return effects of financial ETFs and their benchmark indexes. These findings will help investors to see investment opportunities from financial ETFs of benchmark indices or stock index to predict movements of financial ETFs and vice versa.

This paper analyzes the existing bilateral effects and asymmetric volatility effect of return and volatility between stock indexes and ETF returns for financial and non-financial ETFs utilizing the Generalized Autoregressive Conditional Heteroskedasticity-in-Mean Autoregressive Moving Average (GARCH-M-ARMA) and Exponentially Generalized Autoregressive Conditional Heteroskedasticity-in-Mean Autoregressive Moving Average (EGARCH-M-ARMA) models. This paper contributes to the literature on financial and non-financial ETFs using returns and volatilities of underlying stock indexes and to strengthen investing strategies for better portfolio decisions.

This article is organized in sections. Section II presents the literature review. Section III describes the data and explains the GARCH-M-ARMA and EGARCH-M-ARMA models. Section IV presents the empirical results of the ETF spillovers and leverage effects of financial and non-financial ETFs, and Section V provides the conclusion.

2 - Literature review

The global investment market has witnessed a sudden increase in the number and capitalization of ETFs. Gao (2001) earlier explained that the reason for this expansion are diversification, convenience, simplicity, cost-effectiveness, transparency, flexibility, tax-efficiency, and variety. ETFs have certainly caught investors' attention on the many available investment opportunities that surfaced from their home markets. Schoenfeld (2001) mentioned that ETFs, which can be one or a combination of investment instruments, stands out as a diversification option because they provide varied and flexible options for investors to invest in the global equity markets. In achieving greater coverage in a variety of asset classes, ETFs also offers insights into the recent use of liquid index trackers [Noël (2009)]. Deborah (2009) also examined rankings of ETF providers, index presentation, industry development, and applications.

The EGARCH approach and the ARMA model for ETF and stock index returns were also adopted to analyze asymmetric volatility or leverage effects that released non-negativity constraints in the linear GARCH approach [Koutmos and Booth (1995); Nelson, (1991)]. In the application of GARCH-ARMA and EGARCH-ARMA models to evaluate spillover effects of ETFs, Chen and Huang (2010) analyzed the effect of the spillover and the leverage effects on returns and volatilities of stock indexes and ETFs for emerging markets and developed countries. The result shows that the spillover effects of returns are excellent for Hong Kong, followed by Singapore. The study found that spillover effects on stock index and ETF volatilities have bilateral relationship. The study of Chen (2011) applied leverage effects on ethical ETFs based on GARCH-ARMA and EGARCH-ARMA models. The research analyzed ethical and non-ethical ETFs against benchmark indexes; the results found that there are no differences in the spillover of returns from volatilities and leverage effects.

Chen and Diaz (2012) established the strong positive (negative) influence of lagged leverage (inverse leveraged) ETF returns on current stock index returns. Lagged stock index returns have a negative (positive) effect on leveraged (inverse leveraged) ETF returns as a result of the addition (reduction) of total return swap exposure. Spillover effects of returns also showed a negative bilateral relationship. A bilateral relationship in the spillover effects of volatilities was also observed from the results. The findings provided evidence on the higher volatility caused by leveraged ETFs. The correlation between risks and returns is negative for both inverse leveraged ETF returns and stock indexes, and the positive correlation for leveraged ETFs was minor but still significant.

Krause and Tse (2013) used the EGARCH model, and found that price discovery flows consistently from the United States to Canada and also discovered volatility spillovers and bi-directional feedback effects. On the other hand, Chen, et. al (2014) used ARMA and Seasonal Autoregressive Moving Average (SARMA) revealed that Real Estate Investment Trust-Exchange-Traded Funds have bilateral-return influences with their tracked indices, demonstrated a robust positive connection.

3 - Data and methodology

This study uses daily closing prices of financial and non-financial ETFs, and their corresponding stock indexes from the Yahoo! Finance website. The study period involves various ETF inception dates until the 12th of May 2012. Only financial ETFs from the Broad Financial List, especially those in the insurance and financial services, were selected. The other selected five international financial ETFs are from Brazil, China, Canada, Europe, Emerging market and financial ETFs, and two U.S. financial ETFs. Non-financial ETFs came from the industrial sector, consumer, industrial, and material ETFs such as Brazil Consumer ETFs, China Industrial ETFs, and Capped Material Index from Canada, Emerging Market Metal Mining, Europe ETFs, Dow Jones U.S. Industrial, and Select Sector SPDR USA were also selected for comparison. The New York Stock Exchange (NYSE) Composite Index, S&PTSX Composite Index Toronto, and NASDAQ Composite were included as benchmark stock indexes.

The spillover and leverage effects of ETFs and stock index returns and their volatilities were estimated. Returns were measured as the logarithm of returns. The difference between the logarithm of price at time t-1 for ETFs and the difference between the logarithm of index (I) at time t and time t-1 for stock index were calculated with the equations below.

$$R^m_{i,t} = \ln\left(\frac{I_t}{I_{t-1}}\right) * 100, \qquad (1)$$

$$R^e_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) * 100, \qquad (2)$$

where $R^m_{i,t}$ and $R^e_{i,t}$ represent stock index returns and the i,t financial or non-financial ETFs returns at time t, respectively, I is stock index, and P is ETF price.

Previous research revealed using the GARCH model like that of Chan et al. (1991) using the bivariate GARCH model, proved that stock and futures market can be used to predict the future volatility in other markets. Liu and Pan (1997), on the other hand, found that volatility spillover and the leverage effect in the United States influenced the Asia financial market. In a more recent set of studies, Steeley (2006) found that bond market volatility influenced both stock and bond markets in utilizing a GARCH model. Morales (2008) used GARCH and EGARCH models and indicated clear confirmation of volatility determination among valuable metals returns. There is also an evidence of bidirectional volatility spillovers in the majority of studied cases. Furthermore, asymmetric spillover effects discovered that pessimistic information has a stronger impact in these markets than optimistic news. Using a bivariate GARCH approach, Dean et al. (2010) found that there is asymmetry in return and volatility spillover among bond and stock markets in Australia.

The advantage of this study, using the GARCH-M-ARMA and EGARCH-M-ARMA models is that both models reveal a more accurate prediction of financial ETFs and vice versa. This study mainly focuses on financial ETFs because of the lack of research in this field, and to further strengthened the determination of spillover and leverage effects.

The GARCH-ARMA models were adopted to determine if GARCH effects exist between stock index returns and ETF returns and to verify if the data have conditional heteroskedasticity [Chen and Huang (2010)]. The EGARCH model proposed by Nelson (1991) and the ARMA specification for stock index and ETF returns were also adopted to analyze asymmetric volatility or leverage effects with non-negativity constraints in the linear GARCH model. The components of the combination of GARCH (p, q) -ARMA (g, s) and EGARCH (p, q) - ARMA (g, s) models were illustrated [Niarchos et al. (1999); Huang and Yang (2002); Xu and Fung (2005)].

The interdependence between stock index and ETF returns is affected by market shocks. The spillover and leverage effects are illustrated as follows:

$$R^e_{i,t} = \alpha_0 + \sum_{i=1}^{g} \alpha_i R^e_{i,t-i} + wR^m_{i,t-1} + \varepsilon^e_{i,t} + \sum_{i=1}^{s} \theta_i \varepsilon^e_{i,t-i} + z\sqrt{h^e_{i,t}}, \qquad (3)$$

$$\log\left(h^{e^2}_{i,t}\right) = a_0 + \sum_{i=1}^{q}\left(a_i \left|\frac{\varepsilon^e_{i,t-i}}{h^e_{i,t-i}}\right| + \delta_i \frac{\varepsilon^e_{i,t-i}}{h^e_{i,t-i}} \right) + \sum_{i=1}^{p} \psi_i \cdot \log\left(h^{e^2}_{i,t-i}\right) + v\varepsilon^{m^2}_{i,t-1},$$

for EGARCH-M (4)

$$\varepsilon^e_{i,t} \mid \psi_{t-1} \sim N(0, h^e_{i,t}),$$

$$R^m_{i,t} = \beta_0 + \sum_{i=1}^{g} \beta_i R^m_{i,t-i} + dR^e_{i,t-1} + \varepsilon^m_{i,t} + \sum_{i=1}^{s} \gamma_i \varepsilon^m_{i,t-i} + k\sqrt{h^m_{i,t}}, \qquad (5)$$

$$\log\left(h^{m^2}_{i,t}\right) = b_0 + \sum_{i=1}^{q}\left(b_i \left|\frac{\varepsilon^m_{i,t-i}}{h^m_{i,t-i}}\right| + \delta_i \frac{\varepsilon^m_{i,t-i}}{h^m_{i,t-i}} \right) + \sum_{i=1}^{p} \zeta_i \cdot \log\left(h^{m^2}_{i,t-i}\right) + l\varepsilon^{e^2}_{i,t-1},$$

for EGARCH-M, (6)

$\varepsilon^{m}_{i,t} \mid \psi_{t-1} \sim N(0, h^{m}_{i,t})$,

where $R^{e}_{i,t}$ and $R^{m}_{i,t}$ are financial (or non-financial) ETF returns and stock index return at time t; $h^{e^2}_{i,t}$ is conditional variance; $\sum_{i=1}^{g}\alpha_i R^{e}_{i,t-i}$ is the higher order of the autoregressive AR (g) for ETF returns; $\varepsilon^{e}_{i,t}$ represents residual ETF returns at period t; and $\sum_{i=1}^{s}\theta_i\varepsilon^{e}_{i,t-i}$ is the higher order of the autoregressive MA(s) for ETF returns at period t. $\sum_{i=1}^{p}\psi_i h^{e^2}_{i,t-i}$ is the p order conditional heteroskedasticity of GARCH term for ETF returns at period t; $\sum_{i=1}^{q}a_i\varepsilon^{e}_{i,t-i}$ is the q order of the ARCH term for ETF returns at time t; δ_i is leverage term; t-1 is information set at period t-1; and θ_i is for the unknown parameter. $\sum_{i=1}^{p}\psi_i \log\left(h^{e^2}_{i,t-i}\right)$ is the notation for the ETF returns associated with p order of qualified heteroscedasticity of GARCH at time t; $\sum_{i=1}^{p}\zeta_i \cdot \log\left(h^{m^2}_{i,t-i}\right)$ is the notation for the stock index returns associated with p order of qualified heteroscedasticity of GARCH at time t;

$\sum_{i=1}^{q}\left(a_i\left|\frac{\varepsilon^{e}_{i,t-i}}{h^{e}_{i,t-i}}\right| + \delta_i\frac{\varepsilon^{e}_{i,t-i}}{h^{e}_{i,t-i}}\right)$ is the notation for the ETF returns associated with q order of qualified heteroscedasticity of ARCH; $\sum_{i=1}^{q}\left(b_i\left|\frac{\varepsilon^{m}_{i,t-i}}{h^{m}_{i,t-i}}\right| + \delta_i\frac{\varepsilon^{m}_{i,t-i}}{h^{m}_{i,t-i}}\right)$ is the notation for the stock index returns associated with q order of qualified heteroscedasticity of ARCH.

The null hypothesis, H_0, means no spillover effects of volatility (v=0; l=0), against the alternative hypothesis, H_1, related to having spillover effects of volatility, ($v \neq 0$; $l \neq 0$). If v is significantly higher than zero, then lagged residual stock index will affect ETF volatility. If l is significantly unequal to zero, then lagged residual ETF will influence stock index volatility. Possible volatility spillover effects were considered to verify cross-market dynamics for stock indexes and ETFs returns.

The unilateral effect of lagged ETF returns on stock index returns and vice versa, or the bilateral return influence and asymmetric volatility effects between financial or non-financial ETFs and the stock indexes that are being tracked were identified. Risk and return relationships in standard deviation are denoted by z and k coefficients; and in that order, a positive relationship exists in accordance with other previous studies that utilized the GARCH-M model [Chou (1987); French, et al.(1987)]. Therefore, this study can determine whether a positive or negative connection exists between risks and returns of stock indexes and financial or non-financial ETFs. Given the significance of these results, this research provides a different direction from that of previous studies that only considered the spillover and leverage effects of non-financial ETFs.

This study tested the null hypothesis, H_0, (which states that the sequence has no spillover effects of returns ($w = 0$; $d = 0$)) against the alternative hypothesis, H_1, (which states that the sequence has the spillover effect of returns ($w \neq 0$; $d \neq 0$)). The coefficients w and d represent the spillover effect of ETFs and stock index returns, respectively. If w is significantly different from zero, the lagged stock index returns will affect ETF. If d is significantly unequal to zero, the lagged ETF returns will affect the stock index returns. The use of GARCH models that incorporate the possibility of spillover enabled us to determine whether ETF and stock index returns in different markets are interdependent or whether they respond to domestic market shocks.

4 - Results

Table 1 shows that the average returns for the majority of the samples are positive, except for three financial ETFs, namely, Global X Brazil Financial (BRAF), Global X China Financial ETF (CHIX), and MSCI Europe Financial Index (EUFN); and for one non-financial ETFs, the Global China Industrials ETF (CHII). Generally, we can say that financial and non-financial ETFs are an investment for diversification because average returns positive, and standard deviations for both are relatively small. However, the majority of the financial data under study, including some of stock returns have negatively skewed,

Table 1. The Sample Size and Period of financial and non-financial ETFs and Stock Indexes

ETFs	Market	Index	Code	Type	Period	Obs	Mean	SD	Skew	Kurt	J-B
Financial ETFs	BRAZIL	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2010/7/29-	374	0.001	0.013	-0.59	7.24	301.58***
		Global X Brazil Financials ETF (BRAF)-NYSEArca	BRAF	ETF	2012/5/12		0.000	0.022	0.06	6.94	242.09***
	CHINA	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2010/1/22-	571	0.000	0.013	-0.34	5.94	217.14***
		Global X China Financials ETF (CHIX)-NYSEArca	CHIX	ETF	2012/5/12		0.000	0.020	0.20	6.76	340.06***
	CANADA	S&PTSX Composite index (Interi (^GSPTSE)Toronto	GSP	Stock	2001/3/30-	2631	0.000	0.012	-0.41	11.90	8750.97***
		iShares S&PTSX Capped Financials Index (XFN.TO)-Toronto	XFN	ETF	2012/5/12		0.000	0.013	0.18	13.12	11244.1***
	EMERGING	NASDAQ Composite (^IXIC)-Nasdaq	NAS	Stock	2010/2/11-	421	0.001	0.014	-0.34	6.03	169.34***
		iShares MSCI Emerg Mrkts Financials Idx (EMFN)-Nasdaq	EMFN	ETF	2012/5/12		0.000	0.022	-0.10	4.37	33.696***
	EUROPE	NASDAQ Composite (^IXIC)-Nasdaq	NAS	Stock	2010/2/3-	527	0.001	0.014	-0.30	5.67	164.844***
		iShares MSCI Europe Financials Index (EUFN)-Nasdaq	EUFN	ETF	2012/5/12		0.000	0.025	0.09	5.39	126.608***
	USA	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2006/5/5-	1487	0.000	0.017	-0.12	10.21	3225.34***
		iShares Dow Jones US Insurance (IAK)-NYSEArca	IAK	ETF	2012/5/12		0.000	0.023	0.29	11.43	4420.76***
	USA	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2010/6/21-	2963	0.000	0.014	-0.09	11.81	9576.66***
		iShares Dow Jones US Financial Services (IYG)-NYSEArca	IYG	ETF	2012/5/12		0.000	0.022	0.45	14.22	15643.4***
Non-financial ETFs	BRAZIL	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2010/8/7-	457	0.000	0.013	-0.46	6.44	241.168***
		Global X Brazil Consumer ETF (BRAQ)-NYSEArca	BRAQ	ETF	2012/5/12		0.000	0.018	-0.39	4.47	53.1617***
	CHINA	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2009/12/1-	587	0.000	0.013	-0.37	6.10	248.705***
		Global X China Industrials ETF (CHII)-NYSEArca	CHII	ETF	2012/5/12		-0.001	0.021	0.16	5.28	130.062***
	CANADA	S&PTSX Composite index (Interi (^GSPTSE)Toronto	GSP	Stock	2005/12/28-	1554	0.000	0.014	-0.39	10.53	3714.20***
		iShares S&PTSX Capped Materials Index (XMA.TO)-Toronto	XMA	ETF	2012/5/12		0.001	0.023	0.06	10.41	3557.67***
	EMERGING	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2009/6/2-	724	0.001	0.013	-0.37	5.53	209.923***
		EGShares Emerging Markets MetalsMining (EMT)-NYSEArca	EMT	ETF	2012/5/12		0.000	0.022	-0.17	4.53	73.921***
	EUROPE	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2005/3/10-	1793	0.000	0.015	-0.13	11.54	5458.99***
		Vanguard MSCI Europe ETF (VGK)-NYSEArca	VGK	ETF	2012/5/12		0.000	0.019	-0.06	9.33	2997.92***
	USA	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	2000/7/14-	2909	0.000	0.014	-0.09	11.70	9178.40***
		iShares Dow Jones US Industrial (IYJ)-NYSEArca	IYJ	ETF	2012/5/12		0.000	0.015	-0.16	7.25	2203.37***
	USA	NYSE COMPOSITE INDEX (NEW METHO (^NYA)-NYSE	NYA	Stock	1998/12/22-	3322	0.000	0.013	-0.09	11.59	10210.5***
		Industrial Select Sector SPDR (XLI)-NYSEArca	XLI	ETF	2012/5/12		0.000	0.015	-0.07	7.69	3052.01***

Source: Yahoo Finance, various years, Finance.yahoo.com.

which means that perhaps the future data will be smaller than mean.

The result for financial ETFs and non-financial ETFs kurtosis are leptokurtic, which means that the stock will have a quite low quantity of variance, because returns are usually closer to the mean. Kurtosis also helps us to recognize the level of risk in the stock. Leptokurtic distribution is preferred by investors who wish to keep away from large and inconsistent swings in portfolio returns, which may negatively affect the volatility structures of their investments. All Jarque-Bera statistics are significant for all samples showing that the assumption of normal distribution of the residual cannot be accepted.

Table 2 indicates that the results of the Augmented Dickey Fuller test are all significant, showing that the observed time series for ETFs returns and stock indexes returns are stationary. This paper uses the minimum Akaike Information Criterion (AIC) for getting the best model for the ARMA, GARCH, and EGARCH models [Engle and Ng (1991)]. Test for serial correlation applies the Breusch-Godfrey LM test, and shows that the null hypothesis cannot be rejected for all of ETFs and stock Index returns, which means no serial correlation. The use of the ARCH-LM test illustrates that the null hypothesis of no ARCH effects for all samples can be rejected. The results of the ARCH-LM test again shows that the GARCH-ARMA and EGARCH-ARMA models have the capability to eliminate ARCH errors in the residuals. Leverage effect is verified through EGARCH-ARMA estimations by checking significant autocorrelation, and by examining the volatility of stock index and ETF returns that exhibit conditional heterokesdasticity [Chen and Diaz (2012)]. The results of EGARCH- ARMA models for the leverage effect (δ) indicate that all financial and non-financial ETFs and stock index returns are significant in Table 3, which is consistent with the results obtained by [Chen (2004), Balaban (2005), Li (2007), and Chen and Huang (2010)]. All ETFs produce negative asymmetric volatility effects. Two financial instruments converged in their values. The empirical result of EGARCH-M-ARMA for ETF risk (z) shows that based on the ARCH-M model, the expected risk and return is positive for EMFN and EMT ETFs and negative for IYG and VGK ETFs. The result also indicates that the expected risk and return for stock index risk (k) is positive for BRAF/NYA ETFs and negative for EMFN/NAS and IYJ/NYA ETFs. The spillover effect of return (w) in relation to lagged stock index returns has a negative effect on EUFN financial ETF and BRAQ non-financial ETF. According to EGARCH-M-ARMA models, the spillover effect of returns (d) has a positive effect on the returns of

Table 2. Summary statistics of Unit Root, of financial and non-financial ETFs and Stock Indexes

ETFs	Market	Code	Type	ADF	ARMA	AIC	LM	ARCH-LM	GARCH	AIC	ARMA-LM	EGARCH	AIC	ARCH-L
Financial ETFs	BRAZIL	NYA	Stock	-18.52947***	(3,3)	-5.851	0.392	88.4210***	(3,1)	-6.144	0.722	(2,1)	-6.187	2.234
		BRAF	ETF	-18.2365***	(1,2)	-4.833	0.272	10.02260***	(2,1)	-5.056	0.745	(2,2)	-5.052	0.587
	CHINA	NYA	Stock	-25.47335***	(1,1)	-5.787	3.492	48.6436***	(3,3)	-6.064	1.136	(2,2)	-6.112	0.442
		CHIX	ETF	-22.80675***	(2,2)	-4.988	1.810	35.3196***	(3,2)	-5.200	2.245	(3,2)	-5.222	1.939
	CANADA	GSP	Stock	-52.78048***	(2,2)	-5.990	0.610	425.3316***	(3,3)	-6.464	0.603	(1,3)	-6.482	0.390
		XFN	ETF	-38.42727***	(1,2)	-5.829	2.325	328.1506***	(2,3)	-6.435	0.331	(2,1)	-6.443	2.392
	EMERGING	NAS	Stock	-21.48991***	(0,3)	-5.689	0.281	67.7654***	(3,2)	-5.972	0.722	(1,2)	-6.021	1.024
		EMFN	ETF	-21.78522***	(1,1)	-4.831	0.247	9.5351***	(3,2)	-4.929	0.810	(3,0)	-4.982	0.619
	EUROPE	NAS	Stock	-23.18567*R5*	(3,3)	-5.727	2.282	67.5660***	(3,3)	-5.969	0.688	(3,3)	-6.049	0.374
		EUFN	ETF	-23.24754***	(3,0)	-4.533	0.732	29.7358***	(3,3)	-4.692	0.710	(2,3)	-4.726	3.771
	USA	NYA	Stock	-30.85679***	(3,3)	-5.376	1.749	296.6376***	(3,2)	-5.923	1.407	(3,3)	-5.966	0.648
		IAK	ETF	-42.23498***	(1,1)	-4.694	0.126	294.3146***	(1,3)	-5.503	0.235	(3,2)	-5.526	0.369
	USA	NYA	Stock	-42.20152***	(3,3)	-5.757	1.629	569.9392***	(3,2)	-6.278	0.586	(2,3)	-6.313	0.105
		IYG	ETF	-59.03104***	(3,2)	-4.792	4.761	336.8734***	(3,3)	-5.574	0.299	(3,3)	-5.601	5.241
Non-Financial ETFs	BRAZIL	NYA	Stock	-23.01554***	(3,3)	-5.853	1.273	49.7363***	(2,3)	-6.117	1.677	(2,2)	-6.176	0.018
		BRAQ	ETF	-20.20459***	(2,2)	-5.229	0.706	42.9210***	(1,1)	-5.360	2.602	(1,3)	-5.389	0.105
	CHINA	NYA	Stock	-25.70534***	(2,2)	-5.822	1.260	51.5469***	(1,2)	-6.081	0.523	(2,3)	-6.144	0.931
		CHII	ETF	-22.10892***	(2,2)	-4.875	3.707	51.5404***	(2,2)	-5.086	2.065	(1,1)	-5.085	2.306
	CANADA	GSP	Stock	-41.77709***	(3,3)	-5.689	0.303	235.6174***	(3,1)	-6.184	1.157	(2,2)	-6.209	1.068
		XMA	ETF	-39.93016***	(3,3)	-4.721	1.831	99.4856***	(3,3)	-5.065	0.685	(1,1)	-5.080	1.032
	EMERGING	NYA	Stock	-28.06256***	(3,3)	-5.818	0.022	71.5624***	(3,3)	-6.045	2.101	(2,2)	-6.086	0.965
		EMT	ETF	-25.06849***	(2,2)	-4.842	0.261	26.1289***	(1,3)	-4.939	0.254	(1,2)	-4.966	2.901
	EUROPE	NYA	Stock	-33.81221***	(3,3)	-5.533	1.503	355.3070***	(1,3)	-6.136	0.391	(2,3)	-6.179	0.452
		VGK	ETF	-47.9706***	(3,3)	-5.110	2.245	290.7812***	(2,2)	-5.572	0.085	(1,2)	-5.589	0.487
	USA	NYA	Stock	-41.91756***	(3,3)	-5.743	1.620	564.3177***	(1,2)	-6.260	0.722	(3,3)	-6.297	0.189
		IYJ	ETF	-56.39291***	(3,3)	-5.522	1.097	297.3291***	(1,2)	-5.931	1.040	(3,3)	-5.966	2.448
	USA	NYA	Stock	-44.92324***	(3,3)	-5.798	0.504	610.1103***	(3,2)	-6.258	0.129	(1,2)	-6.293	0.493
		XLI	ETF	-58.98298***	(2,1)	-5.584	0.125	359.8646***	(1,3)	-5.929	0.092	(1,2)	-5.957	0.616

Note: ADF is the t-statistic for the Augmented Dickey-Fuller test with a constant and trend at the level. LM is Breusch-Godfrey serial correlation test and we use Lag(4) to be the best l period. AIC is Akaike Info Criterion. *, **, and *** denote significance at 10%, 5*, and 1% or less, respectively. The *p*-Values are shown in brackets.

Table 3: Spillover effects of return and volatilities for stock and ETF returns

ETFs & Indices	Code	Returns		Volatilities		Risk		Leverage Effect	
		Stock	ETF	Stock	ETF	Stock	ETF	Stock	ETF
		1 (d)	*2 (w)*	*3 (l)*	*4 (v)*	*5 (k)*	*6 (z)*	*7 (δ)*	*8 (δ)*
Financial ETFs	BRAF/NYA	-0.029	-0.123	**17.167**	**297.477**	**0.206**	0.131	**-0.253**	**-0.063**
		0.253	0.260	**0.0732***	**0.0008*****	**0.0046*****	0.371	**0.000****	**0.0206***
	CHIX/NYA	**0.041**	-0.029	149.463	**84.509**	-0.063	0.063	**-0.306**	**-0.069**
		0.0711*	0.660	0.158	**0.0988***	0.563	0.691	**0.000*****	**0.000****
	XFN/GSP	-0.012	0.143	**49.949**	**33.999**	-0.063	-0.067	**-0.098**	**-0.084**
		0.572	0.178	**0.0021****	**0.0117****	0.248	0.143	**0.000****	**0.000****
	EMFN/NAS	**0.063**	0.049	99.800	**91.168**	**-0.247**	**1.332**	**-0.198**	**-0.209**
		0.051**	0.539	0.332	**0.0155****	**0.0412*****	**0.003*****	**0.0000*****	**0.0000***
	EUFN/NAS	0.026	**-0.128**	78.427	103.903	0.196	-0.172	**-0.356**	**-0.055**
		0.234	**0.0714***	0.152	0.169	0.371	0.143	**0.000*****	**0.0317***
	IAK/NYA	-0.033	0.015	**-47.547**	2.258	-0.057	-0.057	**-0.236**	**-0.151**
		0.226	0.728	**0.0001*****	0.906	0.330	0.223	**0.000*****	**0.000****
	IYG/NYA	**-0.036**	0.005	**38.181**	-0.472	-0.062	**-0.057**	**-0.161**	**-0.151**
		0.0037***	0.905	**0.0135****	0.971	0.168	**0.0011*****	**0.000*****	**0.000****
Non-Financial ETFs	BRAQ/NYA	**0.059**	**-0.214**	**279.676**	106.671	-0.065	-0.158	**-0.287**	**-0.087**
		0.0149**	**0.0198****	**0.0116****	0.160	0.575	0.408	**0.000*****	**0.0008***
	CHII/NYA	**0.053**	-0.054	122.561	51.110	-0.076	0.044	**-0.327**	**-0.095**
		0.0238**	0.526	0.268	0.438	0.484	0.781	**0.000*****	**0.0001***
	XMA/GSP	0.009	0.027	**62.576**	**82.742**	0.073	0.108	**-0.096**	**-0.084**
		0.574	0.595	**0.004*****	**0.000*****	0.362	0.195	**0.000*****	**0.000****
	EMT/NYA	**0.054**	-0.031	141.640	31.858	0.031	**0.776**	**-0.318**	**-0.145**
		0.047**	0.691	0.157	0.144	0.767	**0.000*****	**0.000*****	**0.000****
	VGK/NYA	0.047	-0.098	**33.302**	**24.414**	-0.063	**-0.206**	**-0.187**	**-0.110**
		0.198	0.158	**0.0803***	**0.0156****	0.221	**0.000*****	**0.000*****	**0.000****
	IYJ/NYA	-0.022	0.019	**-42.090**	**23.192**	-0.072	-0.004	**-0.162**	**-0.528**
		0.151	0.628	**0.0016*****	**0.0911***	0.0935*	0.934	**0.000*****	**0.082***
	XLI/NYA	0.028	0.003	**32.737**	**17.690**	-0.027	-0.030	**-0.124**	**-0.091**
		0.182	0.928	**0.0038*****	**0.051***	0.549	0.465	**0.000*****	**0.000****

Note:*,**, and *** are significance at 10%, 5%, 1% levels, respectively. The p-Values are shown in brackets.

stock indexes for CHIX/NYA, EMFN/NAS, BRAQ/NYA, CHII/NYA and EMT/NYA ETFs and negative effects on returns of stock index for IYG/NYA ETFs. The spillover effects of volatilities with EGARCH-M-ARMA models show that six ETFs and stock indexes have positive effects on the volatility of the ETFs, and vice versa in terms of lagged stock index volatility. Bilateral connections such as BRAF/NYA, XFN/GSP, XMA/GSP, VGK/NYA, IYJ/NYA, and XLI/NYA ETFs also exist. Lagged stock index volatility has a positive effect on EMFN/NYA and CHIX/NYA ETFs. Lagged ETF volatility has a positive effect on the volatility of the stock index for IYG/NYA and BRAQ/NYA, whereas lagged ETF volatility has a negative effect on the volatility of the stock index for IAK/NYA ETFs. Lagged stock index volatility has significant and positive effects on the volatility of CHIX and EMFN ETFs.

Tables 4 and 5 show the results for the GARCH-M-ARMA model, which determine the stable convergence of GARCH. The sum of all coefficients, namely, α_i, ψ_i,β_i, γ 1and ζ_i,is constrained to be lesser or equal than 1, which is consistent with the result of [Baillie and DeGennaro (1990) and Chen and Huang (2010)]. The estimated values for ψ_i and ζ_i are not equal with those of α_i and β_i in terms of the volatility of financial and non-financial ETFs. This finding implies the existence of the volatility clustering phenomenon. Table 4 presents empirical evidence showing that the previous unexpected return (θ_1) for XFN and IAK is significant at the 1% level and has greater negative impact on financial ETF returns compared to that of non-financial returns XMA and VGK ETFs, which indicated that previous unexpected returns have a negative influence on Canada and USA markets for financial ETFs returns and Canada and Europe market for non-financial ETFs returns. On the other hand, the study finds positive impact of CHIX financial ETFs and IYJ non-financial ETFs returns. The coefficient θ_2 is significant at the 1% level and has positive lagged innovations result for CHIX, BRAQ, CHII, and IYJ ETFs, but negative lagged innovations for XFN and EMT; while the coefficient θ_3 for XMA ETFs have a negative lagged innovation result. Table 4 also shows the impact of lagged innovations on current conditional variance, almost all a_1 coefficients have positive and significant results except for the EUFN ETF. The results for a_2 coefficients of CHIX, XFN, EMFN, IAK and XMA ETFs have negative significant values, while

Table 4. GARCH-M-ARMA of financial and non-financial ETFs return

ETFs	Code	Model	Mean Equation							Conditional Variance Equation						
			α0	α1	α2	α3	θ1	θ2	θ3	a0	a1	a2	a3	ψ1	ψ2	ψ3
Financial ETFs	BRAF	GARCH (2,1)	-0.004	-0.776			0.834	0.055		0.000	-0.005	0.856		0.120		
		ARMA (1,2)	0.254	0.488			0.455	0.403		0.056*	0.917	0.000***		0.000***		
	CHIX	GARCH(3,2)	-0.001	-0.855	-0.961		0.890	0.990		0.000	1.309	-1.276	0.849	0.083	0.016	
		ARMA (2,2)	0.639	0.000***	0.000***		0.000***	0.000***		0.038**	0.000***	0.000***	0.000***	0.000***	0.543	
	XFN	GARCH (2,3)	0.001	0.785			-0.752	-0.071		0.000	1.743	-0.752		0.109	-0.092	-0.0
		ARMA (1,2)	0.194	0.000***			0.000***	0.002***		0.000***	0.000***	0.000***		0.000***	0.036**	0.71
	EMFN	GARCH (3,2)	-0.005	-0.264			0.149			0.000	0.265	-0.354	0.942	0.090	0.035	
		ARMA (1,1)	0.0548*	0.431			0.669			0.139	0.000***	0.000***	0.000***	0.000***	0.069*	
	EUFN	GARCH (3,3)	0.002	0.008	-0.065	-0.063				0.000	-0.594	0.759	0.507	-0.019	0.084	0.19
		ARMA (3,0)	0.535	0.832	0.144	0.137				0.006***	0.000***	0.000***	0.000***	0.464	0.000***	0.000
	IAK	GARCH (1,3)	0.000	0.743			-0.802			0.000	0.152	-0.076	0.893	0.029		
		ARMA (1,1)	0.535	0.000***			0.000***			0.000***	0.000***	0.007***	0.000***	0.117		
	IYG	GARCH (3,3)	0.000	0.283	0.421	-0.003	-0.339	-0.432		0.000	1.298	0.056	-0.364	0.027	0.134	-0.1
		ARMA (3,2)	0.850	0.715	0.472	0.901	0.662	0.494		0.025**	0.000***	0.805	0.001***	0.056*	0.000***	0.000
Non-Financial ETFs	BRAQ	GARCH (1,1)	0.001	-1.681	-0.937		1.725	0.987		0.000		0.876		0.096		
		ARMA (2,2)	0.744	0.000***	0.000***		0.000***	0.000***		0.031**		0.000***		0.000***		
	CHII	GARCH (2,2)	-0.003	-1.151	-0.583		1.229	0.649		0.000	0.285	0.531		0.028	0.118	
		ARMA (2,2)	0.343	0.000***	0.0237**		0.000***	0.007***		0.0129**	0.484	0.154		0.396	0.002***	
	XMA	GARCH (3,3)	0.000	1.866	-1.582	0.650	-1.866	1.576	-0.668	0.000	1.394	-1.373	0.860	0.050	-0.031	0.07
		ARMA (3,3)	0.801	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.001***	0.092*	0.000
	EMT	GARCH (1,3)	-0.005	0.024	0.763		0.028	-0.820		0.000	0.944			-0.030	0.206	-0.13
		ARMA (2,2)	0.126	0.872	0.000***		0.848	0.000***		0.092*	0.000***			0.070*	0.000***	0.000
	VGK	GARCH (2,2)	0.001	1.307	-0.174	-0.251	-1.416	0.308	0.200	0.000	0.546	0.309		-0.008	0.142	
		ARMA (3,3)	0.529	0.000***	0.562	0.116	0.000***	0.325	0.242	0.000***	0.007***	0.099*		0.650	0.000***	
	IYJ	GARCH (1,2)	0.000	-1.181	-1.281	-0.481	1.168	1.260	0.458	0.000	0.891			0.009	0.091	
		ARMA (3,3)	0.863	0.000***	0.000***	0.107	0.000***	0.000***	0.127	0.000***	0.000***			0.532	0.000***	
	XLI	GARCH (1,3)	0.000	-0.277	-0.040		0.260			0.000	0.915			0.049	0.098	-0.06
		ARMA (2,1)	0.904	0.503	0.041**		0.530			0.000***	0.000***			0.000***	0.000***	0.000

Note:*,**, and *** are significance at 10%, 5%, 1% levels, respectively. The p-Values are shown in brackets.

Table 5. GARCH-M-ARMA of financial and non-financial Stock index return

ETFs	STOCK	Model	Mean Equation							Conditional Variance Equation						
			β0	β1	β2	β3	γ1	γ2	γ3	b0	b1	b2	b3	ζ1	ζ2	ζ3
Financial ETFs	NYA/	GARCH (3,1)	0.003	-0.579	-0.756	-0.730	0.649	0.782	0.881	0.000	1.710	-1.691	0.870	0.070		
	BRAF	ARMA (3,3)	0.005***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.001***	0.000***	0.000***	0.000***	0.000***		
	NYA/	GARCH(3,3)	0.001	0.805	-0.863					0.000	-0.625	0.569	0.544	-0.026	0.231	0.26
	CHIX	ARMA (1,1)	0.399	0.000***	0.000***					0.015**	0.000***	0.000***	0.000***	0.299	0.000***	0.000
	GSP/	GARCH (3,3)	0.001	-1.178	-0.813		1.205	0.842		0.000	0.518	-0.625	0.863	0.076	0.047	0.08
	XFN	ARMA (2,2)	0.289	0.000***	0.000***		0.000***	0.000***		0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000
	NAS/	GARCH (3,2)	0.002				-0.012	-0.036	-0.034	0.000	1.028	-0.674	0.398	0.004	0.197	
	EMFN	ARMA (0,3)	0.328				0.803	0.525	0.540	0.007***	0.000***	0.0254**	0.002***	0.931	0.001***	
	NAS/	GARCH (3,3)	0.004	-0.055	0.069	0.915	0.049	-0.045	-0.991	0.000***	0.490	0.105	0.179	0.097	0.079	0.01
	EUFN	ARMA (3,3)	0.042**	0.005***	0.000***	0.000***	0.000***	0.00***	0.000***	0.800	0.902	0.955	0.923	0.011**	0.840	0.97
	NYA	GARCH (3,2)	0.001	-0.037	0.043	0.040	-0.043	-0.094	-0.078	0.000	0.567	0.209	0.046	-0.025	0.188	
	/IAK	ARMA (3,3)	0.273	0.975	0.935	0.936	0.971	0.861	0.890	0.000***	0.000***	0.208	0.734	0.000***	0.000***	
	NYA	GARCH (3,2)	0.000	0.344	0.237	0.125	-0.391	-0.252	-0.118	0.000	0.780	0.146	-0.064	-0.020	0.142	
	/IYG	ARMA (3,3)	0.353	0.703	0.832	0.775	0.665	0.828	0.797	0.000***	0.000***	0.517	0.612	0.040**	0.000***	
Non-Financial ETFs	NYA/	GARCH (2,3)	0.001	-0.715	0.313	0.759	0.679	-0.376	-0.851	0.000	0.322	0.451		0.013	0.226	-0.04
	BRAQ	ARMA (3,3)	0.589	0.000***	0.182	0.000***	0.000***	0.060	0.000***	0.126	0.362	0.0997*		0.696	0.000***	0.67
	NYA/	GARCH (1,2)	0.001	0.041	0.746		-0.093	-0.757		0.000	0.796			-0.055	0.229	
	CHII	ARMA (2,2)	0.372	0.890	0.001***		0.761	0.002***		0.003***	0.000***			0.009***	0.000***	
	GSP/	GARCH (3,1)	0.000	0.172	0.483	0.115	-0.180	-0.513	-0.150	0.000	2.021	-1.432	0.371	0.032		
	XMA	ARMA (3,3)	0.654	0.834	0.244	0.824	0.826	0.225	0.781	0.014**	0.000***	0.028**	0.190	0.009***		
	NYA/	GARCH (3,3)	0.001	-0.057	-0.169	0.855	0.016	0.143	-0.902	0.000	-0.605	0.460	0.621	-0.007	0.266	0.21
	EMT	ARMA (3,3)	0.482	0.486	0.0258**	0.000***	0.817	0.025**	0.000***	0.006***	0.000***	0.000***	0.000***	0.726	0.000***	0.000
	NYA/	GARCH (1,3)	0.001	0.038	0.167	0.358	-0.105	-0.212	-0.388	0.000	0.847			-0.021	0.172	-0.01
	VGK	ARMA (3,3)	0.0606*	0.962	0.769	0.310	0.897	0.729	0.295	0.000***	0.000***			0.000***	0.000***	0.70
	NYA/	GARCH (1,2)	-0.001	-0.712	-0.228	0.458	0.648	0.174	-0.506	0.000	0.864			-0.023	0.133	
	IYJ	ARMA (3,3)	0.162	0.000***	0.142	0.000***	0.000***	0.232	0.000***	0.000***	0.000***			0.000***	0.000***	
	NYA/	GARCH (3,2)	0.000	0.036	-0.346	0.747	-0.060	0.297	-0.779	0.000	1.330	-1.083	0.628	0.037	0.074	
	XLI	ARMA (3,3)	0.920	0.728	0.000***	0.000***	0.536	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	

Note:*,**, and *** are significance at 10%, 5%, 1% levels, respectively. The p-Values are shown in brackets.

IYG ETF has the only negative significant result for a_3. Meanwhile, the ψ_1 coefficients are significant except for the EMT ETF, revealing that the lagged conditional variance of ETF returns has a positive impact on the current conditional variance except for the for ψ_2 coefficients of XFN and XMA ETFs which showed a negative influence. The last column of Table 4 shows that the ψ_3 coefficients show that EUFN and XMA ETFs have positive significant results, but negative significant results are observed in IYG, EMT and XLI ETFs. The authors observed that NYA/BRAF, GSP/XFN, and NAS/EMFN for financial ETFs and NYA/BRAQ and NYA/IYJ for non-financial ETFs have positive and have strong significance at the 1% level of the lagged innovation (1), indicating that these stock index returns have a positive influence, as shown in Table 5. For γ_2 coefficients, the findings show positive results for NYA/BRAF, GSP/XFN, NYA/EMT, and NYA/XLI; and negative results for the γ_3 coefficients of NAS/EUFN, NYA/BRAQ, NYA/EMT, NYA/IYJ, and NYA/XLI except for NYA/BRAF which has a positive result. The conditional variance equation represented by ζ_1 also shows a significant positive effect on stock index returns associated with financial ETFs for NYA/BRAF, GSP/XFN, and NAS/EUFN and non-financial ETFs for GSP/XMA and NYA/XLI. The result for ζ_2 and ζ_3 coefficients have shown positive significant results for financial and non-financial ETFs, which means that lagged innovations and lagged conditional stock index return variance generate the current conditional variance. The authors also found in the volatility of the stock index return that the coefficient of b_1 are almost positive, except for NYA/CHIX financial ETFs and NYA/EMT non-financial ETFs. The positive result means that lagged innovations and lagged conditional stock index return variance generate a positive impact on the current conditional variance. For b_3 coefficients all financial and non-financial ETFs have positive significant results, and for b_2 coefficients, just NYA/CHIX financial ETFs; and only NYA/BRAQ and, NYA/EMT for non-financial ETFs have positive results.

5 - Conclusions

This research documented the results of the GARCH-M-ARMA and EGARCH-M-ARMA models to analyze the spillover of returns and volatilities and the leverage effects of financial and non-financial ETFs.

Findings show that a bilateral connection exists between financial and non-financial ETFs, which affects the benchmark indexes. The spillover effects of volatilities in non-financial ETFs have a strong positive influence on stocks; however, stock indexes have several negative effects on non-financial ETFs. Another finding provides evidence that non-financial ETFs and stock indexes have more spillover effects of volatility than financial ETFs and stocks as exhibited by XMA/GSP, VGK/NYA, and XLI/NYA. These findings indicate that the spillover effects of volatilities have positive bilateral effects on stock indexes and non-financial ETFs in Canada, Europe, and the USA. Financial ETFs in Brazil and Canada have positive spillover effects of volatility.

The spillover effects of ETF return also have a positive effect on a stock index. Tests with EGARCH-M-ARMA reveal that all ETF (financial and non-financial) and stock index returns are strongly negative for leverage effect (δ).

Risk and return relationships are denoted by the z and k coefficients showed that expected risk and return on ETF risk (z) is negative for the USA and European market and positive for emerging market. The result also indicates the expected risk and return for stock index risk (k) is negative for emerging market but positive for Brazil. This study can help fund managers and investors establish appropriate strategies for portfolio investment, especially for financial ETFs in the international finance market. Investors can also evaluate stock and benchmark indexes before investing in ETFs, and vice versa.

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