How Do Local Markets Respond to Global Risk Factors Differently in Various Market Regimes? A Study of Country Exchange Traded Funds

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February 3, 2012

JEL Codes: C13, C32, G12

Keywords: Country Exchange Traded Funds, Risk Factors, Regime Switching

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Abstract

This paper explores how the returns of country exchange traded funds (ETFs) respond to global risk factors in different market regimes. We consider the ETFs for the U.S., Canada, U.K., Germany, France, Italy, Japan, and Australia from May 30, 2000 to March 31, 2011. To answer this question, we use the Bayesian information criterion to select a regime switching model (RS) with six global risk factors and identify three market regimes —— bull, transitory and bear markets. The empirical results show that both the returns of country ETFs and their sensitivities to the risk factors are highly regime dependent. First, the U.S. size and value factors are significant in explaining most of selected ETFs across regimes. More specifically, small capitalization is associated with lower returns for all country ETFs (except for Canada) in at least one market regime. High book-to-market ratio generates higher returns for all ETFs in most market regimes. Second, the global stock market return has a positive impact on the returns of all country ETFs. Third, all ETFs returns are negatively correlated with market volatility in bull and bear market regimes. Fourth, a stronger U.S. dollar generates a higher return for the U.S. ETF and lower returns for the other seven country ETFs across market regimes. Finally, the returns of Australia, Canada and U.K. ETFs, which invest heavily in materials, are positively correlated with commodity prices while other country ETF returns are negatively associated with these prices across market regimes.

1 Introduction

Exchange-traded funds (ETF) have drawn much attention in the investment community and capital market, although they have only come to existence for less than two decades. By the end of January 2011, there were 943 ETFs globally, which held \$1,004 trillion assets in total.[1] While international ETFs are very popular, few studies have explored the pricing mechanism for the country ETFs. This raises a number of interesting questions: How to model the returns of country ETFs? What risk factors are important in affecting these ETFs? How do the returns of these country ETFs respond to global risk factors differently in various market regimes? This paper attempts to answer these questions.

There is an extensive literature exploring determinants and appropriate pricing models for equity returns. To identify relevant determinants of equity returns, Basu (1977) and Fama and French (1992, 1993, 1996, 1998) investigate the roles of fundamental factors such as market capitalization, earning-to-price ratio and book-to-market ratio. Chen et al. (1986), Campbell (1987), and Fama and French (1989) examine macroeconomic factors such as interest rate, inflation rate, yield spread (YS) and credit spread (CS). Solnik (1974a, 1974b), Chen et al. (1986), Johnson and Soenen (2009) and Bakshi et al. (2010) examine international risk factors such as exchange rates, oil price, and commodity prices and shipping cost indices.

To study asset pricing, economists have used different asset pricing models. Basu (1977) and Fama and French (1992) use a static asset pricing model. Ferson and Harvey (1991, 1998) and Jagannathan and Wang (1996) use a conditional asset pricing model that allows betas to vary over time. Fridman (1994), Schaller and Norden (1997), Assoe (1998), and Liu et al. (2010) use a regime switching (RS) model to accommodate market regime changes.

One major distinction among these models is the variability of betas. A framework with a time varying feature can certainly bring more flexibility to modelling returns. As indicated by the existing literature, both the conditional asset pricing model and the RS model take into account the time varying feature of betas. Nevertheless, the latter which combines the time-varying features with the state-dependent features may shed more light on this

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[1] See the Investment Company Institute at http://www.ici.org.

issue. On one hand, Lewellen and Nagel (2006) find that the conditional asset pricing model performs as poorly as the traditional static model. On the other hand, Fridman (1994), Schaller and Norden (1997), Assoe (1998) and Liu et al. (2011) find that equity returns exhibit strong regime switching behaviours over time.

In this study, eight iShares country ETFs are studied with reference to a set of risk factors in a regime switching framework. We adopt this framework because the RS model can be better used to explore how local markets respond to global risk factors differently in various market regimes. This paper differs from the literature in a number of ways. First, few empirical studies have investigated the performance of country ETFs in different market regimes. Second, few existing studies on country ETFs adopt multifactor models which take into account common risk factors such as the commodity price index, exchange rates, and U.S. risk factors. Third, although some studies consider RS models, few estimate these models with a joint distribution on the returns of eight country ETFs.

The remaining of the paper is organized as follows. Section 2 reviews the existing literature. Section 3 introduces the multivariate RS model. Section 4 discusses the data and presents the empirical findings. Section 5 concludes.

2 Literature Review

Inspired by Ross's arbitrage pricing theory, the subsequent literature has investigated the impact of various risk factors on asset pricing based on various forms of the multifactor model. In this section, we review the existing studies on risk factors and pricing models, and select potential risk factors and proper models for the country ETFs.

2.1 Risk factors

To explore the determinants of asset returns, the existing literature has considered factors such as the book-to-market ratio [Fama and French (1992, 1993, 1996, 1998); Hou et al. (2006)], debt-equity ratio [Bhandari (1988); Hou et al. (2006)], earning-to-price ratio [Basu (1977); Fama and French (1992)], size [Banz (1981); Fama and French (1992, 1993, 1996, 1998)], momentum [Jegadeesh and Titman (1993); Carhart (1997); Chordia and Shivakumar (2002); Hou et al. (2008)], stock market volatility [Black (1976); French et al. (1987); Glosten et al. (1993); Ghysels et al. (2005); Ang et al. (2006); Koulakiotis (2006)], commodity price [Johnson and Soenen (2009)], oil price [Chen et al. (1986); Jones and Kaul (1996); Sadorsky (1999); Basher and Sadorsky (2006)], YS [Chen et al. (1986); Campbell (1987); Fama and French (1989)], CS [Chen et al. (1986); Keim and Stambaugh (1986)], exchange rate [Solnik (1974a, 1974b); Roll (1992); Dumas and Solnik (1995); Ferson and Harvey (1999)], and the Baltic Dry index for global shipping costs [Bakshi et al. (2010)]. The findings regarding the usefulness of these risk factors are somewhat mixed.

The book-to-market ratio, debt-equity ratio, and earning-to-price ratio are firm specific ratios. Fama and French (2004) state that "different price ratios have much the same information about expected returns." This implies that using one price ratio may account for all relevant price-ratios. In the same paper, Fama and French (2004) also confirm the findings in Fama and French (1992) that three factors (size, book-to-market and market) can explain most of the anomalies except for the momentum effect. Part of their findings contradicts Banz (1981) that "there is little difference in return between average sized and large firms." Despite of the difference, the Fama-French three factors prevail in subsequent studies and are applied to new investment vehicles such as sectoral ETFs. For instance, Liu et al. (2011) and Ma et al. (2011) apply the Fama-French factors to pricing the returns on sectoral ETFs in the U.S. market and find that these factors exhibit strong explanatory power.

A number of previous studies have documented a significant momentum effect. Some studies find that the momentum effect is due to stock price overreaction [e.g. Jegadeesh and Titman (1993); Hou et al. (2008)], while some other studies find there is no such phenomenon [e.g. Carhart (1997)]. Chordia and Shivakumar (2002) find that the momentum effect can be explained by macroeconomic factors of the business cycle. More specifically, they find that the momentum strategy only generates positive return during the expansionary period while it generates insignificant negative return during recession. Their findings imply that the RS model, which takes into account market regime changes, may be better to capture market momentum.

The existing empirical findings on volatility are equally mixed. French et al. (1987) and Ghysels et al. (2005) find a positive premium of market volatility on the U.S. value weighted portfolio, while Glosten et al. (1993) find a negative premium of market volatility on the U.S. stock market return. Ang et al. (2006) also find that market volatility is negatively associated with the mean U.S. stock return. In addition, Koulakiotis et al. (2006) find no significant relation between the returns of stock market indices and market volatility for seven OECD countries. Given the somewhat mixed findings in the literature, Liu et al. (2011) adopt the RS model for sectoral ETF returns and find that the signs of sensitivities of sectoral ETF returns to market volatility vary across sectors and market regimes. One plausible explanation for the mixed findings is that these different results reflect different estimation methodologies, different assets (across sectors and countries) and different time periods studied. For example, Glosten (1993) extends the GARCH model used by French et al. (1987) and finds different results. Besides, Liu et al. (2011) use the RS model and report mixed relations between sectoral returns and market volatility.

Foreign exchange risk is an important factor affecting the returns of international assets. Roll (1992) compares stock price indices across countries and finds that exchange rates play a significant role in explaining the returns of stock market indices represented by a common currency. Dumas and Solnik (1995) find some evidence supporting the existence of an exchange rate risk premium. In addition, Ferson and Harvey (1999) find that currency risk factors are important in pricing developed market returns. In light of these studies, the model for the returns of country ETFs should take into account foreign exchange risk.

The existing studies identify several material-related factors in pricing equity returns. Jones and Kaul (1996) and Sadorsky (1999) find a negative impact of oil price on stock returns. Johnson and Soenen (2009) find that changes of the Goldman Sachs commodity price indices can explain a small part of variation in stock market returns in Argentina, Brazil, Chile, Colombia and Peru. Bakshi et al. (2010) find that the percentage change of the Baltic Dry index (BDI) — an index for shipping costs— is positively associated with stock market returns in G7 countries. All of these three factors (oil price, commodity prices and the BDI index) are closely related to the changes of oil price.[2] These factors contain common information. Since that the Goldman Sachs commodity price index not only takes into account oil prices but also the prices of other raw materials, it could be a better choice for a risk factor.

The existing literature also examines interest related factors such as YS and CS. Chen et al. (1986) find that stock returns are negatively related to the YS factor whereas some other studies [e.g. Campbell (1987); Fama and French (1989)] document positive risk premiums on the YS factor. Keim and Stambaugh (1986) find a positive risk premium on the CS factor while Fama and French (1993) find that the premium on CS factor is not significant. As found by Liu et al. (2011), the sensitivities of returns to the YS and CS factors vary across market regimes. Since different sample periods have different market conditions, it is reasonable to observe different risk premiums when sample periods are different.

2.2 Existing models

The traditional multifactor models are often criticized for its non-time-varying feature of betas. Bos and Newbold (1984) find that betas may not be constant over time, suggesting that a model with time-varying features may shed more light on asset pricing. To incorporate time varying features into asset pricing, Ferson and Harvey (1991) propose a two-step conditional asset pricing model. Following their work, Jagannathan and Wang (1996) and Ferson and Harvey (1998) find that the conditional model is more convincing than the traditional model with constant betas.

While the feature embedded in the conditional asset pricing model is certainly appealing, Lewellen and Nagel (2006) question the conditional asset pricing model and suggest that the conditional asset pricing model could not provide a full, quantitative test of the conditional CAPM. Beyond the continued debate on the traditional mutifactor model and conditional asset pricing model, Fridman (1994), Schaller and Norden (1997), Assoe (1998) and Liu et

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[2] As an indicator of ocean transportation costs, the Baltic dry index changes simultaneously in response to the changes of oil price. Oil products account for more than 60% of the S&P Goldman Sachs Commodity Index (GSCI) commodity index in value. Data source: S&P indices website. Link: http://www.standardandpoors.com/indices/sp-gsci/en/us

al. (2011) use RS models to analyse stock return and find supporting evidence of switching behaviours and model predictability. Therefore, utilizing the RS model may shed more light on asset pricing for the country ETFs.

3 A Multivariate Regime Switching Factor Model

This section discusses the specification and basic properties of the RS model, parameter estimation using the EM algorithm, the method for selecting the optimal number of regimes, standard errors' estimation using parametric bootstrap method. The mathematical specification is developed based on Zucchini and MacDonald (2009).

3.1 Specification

The RS factor model[3] can be written as:

$$R_t = Z_t \beta_{s_t} + P_{s_t} U_t, \tag{1}$$

where

$R_t = [R_{1t}, R_{2t}, \ldots, R_{Nt}]'$ is a vector of the returns on N ETFs;

Z_t is a matrix which has the same set of K variables in each row in period t:[4]

$$Z_t = \begin{bmatrix} Z_{1t} & Z_{2t} & \ldots & Z_{Kt} & 0 & 0 & \ldots & 0 & \ldots & 0 & 0 & 0 & 0 \\ 0 & 0 & \ldots & 0 & Z_{1t} & Z_{2t} & \ldots & Z_{Kt} & \ldots & 0 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \ldots & 0 & 0 & 0 & \ldots & 0 & \ldots & Z_{1t} & Z_{2t} & \ldots & Z_{Kt} \end{bmatrix}_{N \times NK};$$

s_t represents the market regime in period t, when $s_t = j$, $j \in \{1, 2, \ldots, M\}$;

$\beta_{s_t=j} = [\beta_{11j}, \beta_{12j}, \ldots, \beta_{1Kj}, \beta_{21j}, \beta_{22j}, \ldots, \beta_{2Kj}, \ldots, \beta_{N1j}, \beta_{N2j}, \ldots, \beta_{NKj}]'_{1 \times NK}$ is a vector

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[3] In this paper, it is assumed that all returns are subjected to the same market regime changes. Thus the parameters are jointly estimated in a multivariate specification.

[4] Z_{1t} is a vector of unity.

of coefficients conditional on the market regime in period t;[5]

$U_t = [u_{1t}, u_{2t}, \ldots, u_{Nt}]'$ is a vector of error terms;[6] $U_t \sim N(0, I)$, and I is an identity matrix;

$\Sigma_{s_t} = P_{s_t} P'_{s_t}$ is a variance covariance matrix conditional on the market regimes. More specifically,

$$\Sigma_{s_t} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \ldots & \sigma_{1N} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{N1} & \sigma_{N2} & \ldots & \sigma_{NN} \end{bmatrix}_{N \times N} .$$

3.2 Basics of the regime switching model

Let $X_t = P_{s_t} U_t = R_t - Z_t \beta_{s_t}$, which satisfies the Markov properties:

$$\Pr(S_t | S^{(t-1)}) = \Pr(S_t | S_{t-1}) \tag{2}$$

and

$$\Pr(X_t | X^{(t-1)}, S^{(t)}) = \Pr(X_t | S_t), \tag{3}$$

where $X^{(t-1)} = [X_1, X_2, \ldots, X_{t-1}]$, $S^{(t)} = [S_1, S_2, \ldots, S_t]$.

The model has two essential properties. First, the probability distribution of current state only depends on the state in the previous period (S_{t-1}). Second, the probability distribution of X_t only depends on S_t.

The transition probability matrix Γ is given by:

$$\Gamma = \begin{bmatrix} \gamma_{11} & \cdots & \gamma_{1M} \\ \vdots & \ddots & \vdots \\ \gamma_{M1} & \cdots & \gamma_{MM} \end{bmatrix},$$

where the transition probability γ_{ji} is the probability of the event that market regime change

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[5] All β_{n1j} $(n = 1, 2, \ldots, N)$ are intercept parameters and that all other β_{nkj} $(n = 1, 2, \ldots, N$ and $k = 2, \ldots, K)$ are slope parameters.

[6] Here we assume that there is no autocorrelation for u_{it} for all i. However, u_{it} and u_{jt} can be correlated for all $i, j = 1, 2, \ldots, N$.

from j to i. These transition probabilities satisfy the equation $\sum_{i=1}^{M} \gamma_{ji} = 1$ for all $i, j = 1, 2, \ldots, M$.

3.2.1 The complete data likelihood function

The complete data likelihood function (CDLL) is defined as follows:

$$
\begin{aligned}
L_T = \Pr(X^{(T)} = x^{(T)}) &= \sum_{s_1, s_2, \ldots, s_T = 1}^{M} \Pr(X^{(T)} = x^{(T)}, S^{(T)} = s^{(T)}) \\
&= \sum_{s_1, s_2, \ldots, s_T = 1}^{M} \left[\delta_{s_1} \prod_{t=2}^{T} \gamma_{s_{t-1}, s_t} \prod_{t=1}^{T} p_{s_t}(x_t) \right] \\
&= \delta \mathbf{P}(x_1) \Gamma \mathbf{P}(x_2) \ldots \Gamma \mathbf{P}(x_T) \mathbf{1}',
\end{aligned} \tag{4}
$$

where δ is a row vector of the initial probability distribution of all states $\{\Pr(s_1 = 1), \Pr(s_1 = 2), \ldots, \Pr(s_1 = M)\}$; γ_{s_{t-1}, s_t} represents the transition probability from state s_{t-1} to state s_t; $p_{s_t}(x_t) = \Pr(X_t = x_t | s_t)$; and $\mathbf{1} = [1, 1, \ldots, 1]_{1 \times M}$; and

$$
\mathbf{P}(x_t) = \begin{bmatrix} p_1(x_t) & 0 & \ldots & 0 \\ 0 & p_2(x_t) & \ldots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \ldots & p_M(x_t) \end{bmatrix}.
$$

3.2.2 Forward and backward probabilities

Two probabilities are needed for computing the conditional expectations of the EM algorithm. First, the forward probability is defined as follows:

$$
\begin{aligned}
\alpha_t &= \delta \mathbf{P}(x_1) \Gamma \mathbf{P}(x_2) \ldots \Gamma \mathbf{P}(x_t) \\
&= \delta \mathbf{P}(x_1) \prod_{\tau=2}^{t} \Gamma \mathbf{P}(x_\tau).
\end{aligned} \tag{5}
$$

The jth component of α_t is $\alpha_t(j)$, which satisfies

$$\alpha_{t+1}(j) = \left(\sum_{i=1}^{M} \alpha_t(i)\gamma_{ij} \right) p_j(x_{t+1}). \tag{6}$$

Using equation (6), we can derive the following equation by induction.

$$\alpha_t(j) = \Pr(X^{(t)} = x^{(t)}, s_t = j). \tag{7}$$

Second, the backward probability is defined as follows:

$$\begin{aligned} \rho_t' &= \mathbf{P}(x_{t+1})\Gamma\mathbf{P}(x_{t+2}) \dots \Gamma\mathbf{P}(x_T)\mathbf{1}' \\ &= \left(\prod_{\tau=t+1}^{T} \Gamma\mathbf{P}(x_\tau) \right) \mathbf{1}'. \end{aligned} \tag{8}$$

The jth component of ρ_t equals to

$$\rho_t(j) = \Pr(X_{t+1}^T = x_{t+1}^T | s_t = j), \tag{9}$$

where X_{t+1}^T denotes the vector $[X_{t+1}, X_{t+2}, \dots, X_T]$. This equation can be derived by induction.

Combining equations (7) and (9), we can infer

$$\alpha_t(j)\rho_t(j) = \Pr(X^{(T)} = x^{(T)}, s_t = j). \tag{10}$$

Following equation (10), we can infer the CDLL

$$\alpha_t \rho_t' = \Pr(X^{(T)} = x^{(T)}) = L_T \tag{11}$$

and the conditional state probability

$$\Pr(s_t = j | X^{(T)} = x^{(T)}) = \alpha_t(j)\rho_t(j)/L_T. \tag{12}$$

The conditional transition probability can be written as follows:[7]

$$\Pr(s_{t-1} = j, s_t = i | X^{(T)} = x^{(T)}) = \alpha_{t-1}(j)\gamma_{ji}p_i(x_t)\rho_t(i)/L_T. \tag{13}$$

3.3 Parameter estimation

We use the log CDLL with the observations $x_1, x_2, \ldots, x_T$ and the missing data[8] $s_1, s_2, \ldots, s_T$ to estimate all parameters in the model. The log CDLL is derived as follows:

$$\begin{aligned}
&\log[\Pr(X^{(T)} = x^{(T)}, S^{(T)} = s^{(T)})] \\
&= \log\left(\delta_{s_1}\prod_{t=2}^{T}\gamma_{s_{t-1},s_t}\prod_{t=1}^{T}p_{s_t}(x_t)\right) \\
&= \log\delta_{s_1} + \sum_{t=2}^{T}\log\gamma_{s_{t-1},s_t} + \sum_{t=1}^{T}\log p_{s_t}(x_t).
\end{aligned} \tag{14}$$

In this setup, there are three sets of parameters:

1. The initial probability of state j: $\{\delta_{s_1}\}$
2. Transition probabilities: $\{\gamma_{s_{t-1},s_t}\}$
3. Variance covariance matrix $\{\Sigma_{s_t=j}\}$, intercept and slope parameters $\{\beta_{s_t=j}\}$

We estimate these parameters by maximizing the log CDLL. As proposed by Hamilton (1989), the likelihood function can be maximized either through numerical maximization or the expectation-maximization (EM) algorithm. In this paper, the EM algorithm is adopted.

First, we need to define two zero-one random variables. (1) One represents the sequence of state $\{s_1, s_2, \ldots, s_t\}$: $u_j(t) = 1$ if $s_t = j$; $u_j(t) = 0$ otherwise. (2) The other represents the transition from one state to the next in the next period: $v_{ji}(t) = 1$ if $s_{t-1} = j$ and $s_t = i$, $t = 1, 2, \ldots, T$ and $i, j = 1, 2, \ldots, M$; $v_{ji}(t) = 0$ otherwise.

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[7] The following two equations are needed to derive this function:

(1) $\Pr(X_1^T, s_t, s_{t+1}) = \Pr(X_1^t, s_t)\Pr(s_{t+1}|s_t)\Pr(X_{t+1}^T|s_{t+1})$;

(2) $\Pr(X_{t+1}^T|s_{t+1}) = \Pr(X_{t+1}|s_{t+1})\Pr(X_{t+2}^T|s_{t+1})$.

See appendix B in Zucchini and MacDonald (2009) for details.

[8] s_t is a latent random variable.

Then, the log CDLL can then be written as

$$\log\ L_T = \sum_{j=1}^{M} u_j(1)\log\delta_j + \sum_{j=1}^{M}\sum_{i=1}^{M}\left(\sum_{t=2}^{T} v_{ji}(t)\right)\log\gamma_{ji} + \sum_{j=1}^{M}\sum_{t=1}^{T} u_j(t)\log p_j(x_t).$$

E step

1. Assign initial values for all parameters $\{\hat{\delta}_j\}$, $\{\hat{\gamma}_{ji}\}$, $\{\hat{\Sigma}_{s_t=j}\}$ and $\{\hat{\beta}_{s_t=j}\}$ for all $i, j = 1, 2, \ldots, M$.

2. Use the initial values of the parameters to compute:

$$\hat{u}_j(t) = \Pr(s_t = j|x^{(T)}) = \alpha_t(j)\rho_t(j)/L_T$$

and

$$\hat{v}_{ji}(t) = \Pr(s_{t-1} = j, s_t = i|x^{(T)}) = \alpha_{t-1}(j)\gamma_{ji}p_i(x_t)\rho_t(i)/L_T.$$

M step

1. Replace $v_{ji}(t)$ and $u_j(t)$ by $\hat{v}_{ji}(t)$ and $\hat{u}_j(t)$ in the log CDLL.

2. Maximize the log CDLL w.r.t those three sets of parameters. We can split this process into three separate maximizations.

First, the term $\sum_{j=1}^{M}\hat{u}_j(1)\log\delta_j$ depends only on $\{\delta_j\}$. The solution is

$$\delta_j = \hat{u}_j(1)/\sum_{j=1}^{M}\hat{u}_j(1) = \hat{u}_j(1).$$

Second, the term $\sum_{j=1}^{M}\sum_{i=1}^{M}\left(\sum_{t=2}^{T}\hat{v}_{ji}(t)\right)\log\gamma_{ji}$ depends only on γ_{ji}. The solution is

$$\gamma_{ji} = f_{ji}/\sum_{i=1}^{M} f_{ji},$$

where $f_{ji} = \sum_{t=2}^{T} \hat{v}_{ji}(t)$.

Third, the term $\sum_{j=1}^{M} \sum_{t=1}^{T} \hat{u}_j(t) \log p_j(R_t - Z_t\beta_{s_t=j})$ depends only on $\{\Sigma_{s_t=j}\}$ and $\{\beta_{s_t=j}\}$. It can be written as follows:

$$\begin{aligned}
\text{Term 3} &= \sum_{j=1}^{M}\sum_{t=1}^{T}[\hat{u}_j(t)\log p_j(\mathrm{P}_{s_t}^{-1}R_t - \mathrm{P}_{s_t}^{-1}Z_t\beta_{s_t=j})] \\
&= \sum_{j=1}^{M}\sum_{t=1}^{T}\hat{u}_j(t)\log\left(\frac{1}{(2\pi)^{n/2}|\Sigma_{s_t=j}|^{1/2}}e^{-\frac{1}{2}[R_t-Z_t\beta_{s_t}]'\Sigma_{s_t=j}^{-1}[R_t-Z_t\beta_{s_t}]}\right) \\
&= \sum_{j=1}^{M}\sum_{t=1}^{T}\hat{u}_j(t)\left(-\frac{n}{2}\log 2\pi - \frac{n}{2}\log|\Sigma_{s_t=j}| - \frac{1}{2}[R_t - Z_t\beta_{s_t}]'\Sigma_{s_t=j}^{-1}[R_t - Z_t\beta_{s_t}]\right). \qquad (15)
\end{aligned}$$

This maximization problem can be solved numerically. Up until now, we have finished one round of the EM algorithm. We use these estimated parameters $\{\hat{\delta}_j\}$, $\{\hat{\gamma}_{ji}\}$, $\{\hat{\Sigma}_{s_t=j}\}$ and $\{\hat{\beta}_{s_t=j}\}$ as new initial values and repeat the EM steps many times until the changes of all parameters are within a predetermined threshold.

3.4 Determination of the number of regimes

Given the factor model described by equation (1), an increase of the number of regimes will increase the parameters to be estimated exponentially. Although a model with more regimes may give a better fit for the data, we wish to find a parsimonious model. Hence, we should adopt a criterion to select an appropriate number of regimes.

In this paper, we use the Bayesian information criterion (BIC) to choose the optimal number of regimes M. Let N be the number of dependent variables, K be the number of intercept and slope coefficients (betas) and T be the number of observations. Then, the total number of parameters to be estimated is $M^2 + (1 + K + N)NM - M$. The BIC is calculated as follows:

$$\text{BIC} = [M^2 + (1 + K + N) * N * M - M]\ln(T) - 2\ln(L_T). \qquad (16)$$

3.5 Bootstrap estimates of standard errors

The EM algorithm adopted in this study has a drawback. That is, it does not generate a probability distribution of the parameter estimates. To conduct statistical inference on these parameters, we use the bootstrap method to estimate the standard error of parameter estimates.

This bootstrap method is implemented in four steps. First, we simulate a sequence of returns[9] using the parameters estimated by the EM algorithm. Second, we use the newly generated returns to replace the original returns and estimate the parameters based on the new generated returns. Third, we repeat steps one and two many times to get a probability distribution for each parameter. Finally, we use the empirical probability distributions to compute the standard errors for all parameter estimates.

4 Empirical Analysis

4.1 Data of selected country ETFs

In this paper, we choose to study country ETFs. Since there are a number of country ETFs in the market, we choose the following criteria to select our research sample. First, all these country ETFs should be managed by the same company to maintain portfolio consistency. Second, the trading history must be long enough so that we could have large samples for our estimation. Third, these ETFs must be liquid in the sense that the ETFs shares are actively traded.

Among all country ETFs existing in the market, only iShares international index funds satisfy the above criteria. We choose eight developed market ETFs which account for a substantial portion of the global market capitalization in total.[10] They are the ETFs for the United States (US), Canada (CA), United Kingdom (UK), Germany (GER), France (FRA),

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[9] It refers to the returns of country ETFs only.

[10] These eight countries account for 76.52% of the MSCI all country world investable market index (ACWI IMI) in value. This index is designed to capture up to 99% of the developed and emerging investable market universe. See file "ACWI IMI factsheet" on the website of MSCI Inc.

Italy (ITA), Australia (AUS), and Japan (JAP).[11] The summary statistics of ETF returns are reported in Tables 1 and 2. During the period from May 30, 2000 to March 31, 2011, Australia and Canada had the first and second highest mean returns while Japan and Italy had the first and second lowest mean returns. The standard deviations of the returns of these ETFs are fairly comparable. Among all pairs of country ETFs, Canada and Japan ETFs have the lowest correlation (0.5692) while France and Germany ETFs have the highest correlation (0.8935).

Since the returns on different sector ETFs behave differently in response to changes of common factors [see Liu et al. (2011)], studying the compositions of ETFs would help explain the behaviours of these country ETF returns. Here, we rank the sector weights in these country ETFs. The rankings are reported in Table 3.

As we can see from Table 3, consumer discretionary, energy, financials and materials are the heaviest invested sectors across these country ETFs. These holding distributions may provide some implications about the behaviours of these ETFs. First, the Germany, Japan, U.S. and France ETFs invest heavily in the consumer discretionary sector. Since this sector mainly provides non-essential goods and services, it tends to perform well when the market performs well. Thus, the performance of these four ETFs could be regime dependent. Second, the Canada, U.K. and Italy ETFs invest heavily in energy. Hence, changes of energy prices may have a positive impact on returns of these ETFs. Third, the U.S., Canada, U.K., France, Italy and Australia ETFs invest heavily in the financial sector with the highest weights. The performance of these ETFs may be subject to changes of interest rate, financial market sentiment and so on. Fouth, Australia, Canada, Germany and U.K. ETFs invest heavily in materials. It implies that increases in raw material prices may lead to higher returns of these ETFs.

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[11] The daily closing prices from May 30, 2000 to March 31, 2011 for all eight country ETFs are retrieved from Bloomberg. We take log difference of the daily prices to get the daily return for these ETFs. Hence, we have the daily returns from May 31, 2000 to March 31, 2011.

4.2 Risk factors

As implied by the CAPM, asset returns are systematically related to overall market returns. Thus, the return of the total market should be priced into asset returns. In the paper, we use the MSCI All Country World Investable Market Index (WOD) as the proxy of the world stock market. This index covers over 9,000 securities across large, mid and small cap segments and across style and sector segments in 45 developed and emerging stock markets.[12]

As shown by Roll (1992), Dumas and Solnik (1995), Ferson and Harvey (1999), exchange rates play an important role in pricing international assets. In addition, exchange rates may be quite influential since investors can still trade these country ETFs in the U.S. stock market after the target markets close. Hence, we believe that exchange rates may partly explain the returns of these country ETFs. In this paper, we choose the U.S. dollar index[13] (DXY) as the proxy for exchange rates in relation to the U.S. dollar. This index measures the value of the U.S. dollar against a basket of foreign currencies. An increase of the index indicates that the U.S. dollar appreciates against other currencies.

The existing literature has also documented significant risk premiums on material-related factors such as commodity prices[14], oil price and the Baltic Dry index [Chen et al. (1986); Johnson and Soenen (2009); Bakshi et al. (2010)]. In this paper, we use percentage change of the S&P Goldman Sachs Commodity Index[15] (COM) instead of percentage changes of oil price and the Baltic dry index because this index captures more information and thus may explain a larger portion of ETF returns than the other two factors. This may be particularly relevant to the ETFs that are exposed to percentage changes of commodity prices [see Table 3].

As found by Frankel (1993), Chang et al. (1995), Russell (1998) and Gutierrez (2009), U.S. exchange traded foreign assets exhibit a significant exposure to the U.S. market factor

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[12] See "ACWI IMI factsheet" on the website of MSCI Inc. The daily closing prices during the period from May 30, 2000 to March 31, 2011 are retrieved from Bloomberg. We take log difference to calculate returns from May 31, 2000 to March 31, 2011.

[13] The daily closing prices from May 30, 2000 to March 31, 2011 are retrieved from Bloomberg. We take log difference to calculate percentage changes.

[14] Johnson and Soenen (2009) use the S&P Goldman Sachs Commodity Index.

[15] It is a world production weighted index based on the quantity of production of each commodity. The daily closing prices are retrieved from Bloomberg. We take log difference to get the percentage changes.

and behave like U.S. securities. We suspect that these U.S. exchange listed country ETFs may also be exposed to some U.S. common risk factors. Hence, we also consider U.S. factors such as size and value, market volatility, yield spread and credit spread.

The Fama-French factors — size and value factors — have been recognized as significant risk factors [see Fama and French (1992, 1993, 1996, 1998)]. The size factor, "Small minus big" (SMB), is the difference between the returns of small capitalization portfolio and big capitalization portfolio for the U.S. market. It is computed as the average return on three small portfolios minus the average return on three big portfolios.[16] The value factor, "High minus low" (HML), is the difference between the returns of portfolio with value stocks and portfolio with growth stocks for the U.S. market. It is computed as the average return on two value portfolios minus the average return on two growth portfolios.[17] The SMB and HML data are retrieved from Kenneth R. French data library.[18]

The existing literature has a mixed empirical results on the role of stock market volatility for asset pricing [e.g. Ghysels et al. (2005) and Ang et al. (2006)]. Liu et al. (2011) find that the risk premium on volatility can be different in magnitudes and signs depending on specific market conditions. Following Liu et al. (2011), we also consider stock market volatility and use the Chicago Board Options Exchange Volatility Index[19] (VIX) as the proxy for market volatility.

We also consider yield spread (YS) and credit spread (CS) in our asset pricing model. In section 2, the discussion on the YS and CS factors suggests that they may predict country ETF returns in the RS model. The existing studies on asset pricing have used these two factors for U.S. securities. For example, Liu et al. (2011) incorporate these factors into their RS model to explore the returns on sector ETFs in the U.S. market and find significant risk premiums. Whether the YS and CS factors affect the returns on U.S. listed country ETFs remains unclear. Here we wish to investigate the roles of YS and CS factors on our country ETF returns. The YS factor is the difference between the 20-year U.S. Treasury bond and

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[16] $\text{SMB} = \frac{1}{3}(\text{Small Value} + \text{Small Neutral} + \text{Small Growth}) - \frac{1}{3}(\text{Big Value} + \text{Big Neutral} + \text{Big Growth})$.

[17] $\text{HML} = \frac{1}{2}(\text{Small Value} + \text{Big Value}) - \frac{1}{2}(\text{Small Growth} + \text{Big Growth})$.

[18] Link: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html.

[19] The daily closing prices from May 30, 2000 to March 31, 2011 are retrieved from the website of the Chicago Board Options Exchange. The natural logarithm difference is used to get its change rates.

the 3-month U.S. Treasury bill and the CS factor is the difference between return of Moody's Baa bond and return of Moody's Aaa bond.[20]

The summary statistics for these eight risk factors are reported in Table 4. The correlations for risk factors are reported in Table 5.

4.3 Empirical findings

4.3.1 Model selection

Our preliminary analysis suggests that the six factors (SMB, HML, WOD, VIX, DXY, COM) are statistically significant in linear models for all eight country ETFs returns. Hence, we use these six factors as the starting point for the RS model selection. In this selection process, we use BIC to select the optimal number of risk factors and market regimes. The values of BIC are reported in Table 6. As we can see from the table, the model with six factors and three states has the lowest BIC value. The remaining of this section discusses the results of this RS model.

4.3.2 Transition probability

The estimated transition probabilities across regimes are given below:

$$\begin{bmatrix} 0.9793(1.50\text{E-}130) & 0.0007(5.86\text{E-}17) & 0.0200(2.46\text{E-}16) \\ 0.0045(9.25\text{E-}19) & 0.9747(3.01\text{E-}128) & 0.0209(8.82\text{E-}18) \\ 0.0762(3.47\text{E-}15) & 0.0469(8.63\text{E-}17) & 0.8769(3.70\text{E-}127) \end{bmatrix}$$

p-value for each transition probability is in the parentheses. The element in jth row and ith column represents the transition probability from regime j ($j = 1, 2, 3$) to regime i ($i = 1, 2, 3$). The high probabilities in the main diagonal of the matrix indicate that all three regimes are highly persistent. Among all market regimes, regime 1 is most persistent while regime 3 is least persistent.

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[20] The data are retrieved from the Federal Reserve at St. Louis Economic research data centre at http://research.stlouisfed.org/fred2.

4.3.3 Interpretation of market regimes

We interpret the market regimes by evaluating the performance of the first and second moments of the country ETF returns and the risk factors across regimes reported in Tables 7, 8 and 9. The highest average returns for all these ETFs occur in regime 1 while the lowest returns appear in regime 3 [see Table 7]. In addition, the mean WOD factor is the highest in regime 1 and lowest in regime 3. The WOD and VIX factors move in opposite directions in these two regimes [see Table 8].

Therefore, we label regime 1 as the "bull" market and regime 3 as the "bear" market. The statistics indicate that regime 2 acts as an intermediate state between regimes 1 and 3. Hence, we label it as the "transitory" market. These results are consistent with the findings based the data of the same period [see Liu et al. (2011)].

Table 9 reports the correlations among these country ETF returns across regimes. It is interesting to see that the correlations tend to be high in the bull and bear markets while they are relatively low in the transitory market. That is, these ETF returns are more closely correlated when the market has a clear upward/downward trend and less closely correlated when the market is in the transition between the bull and bear markets.

4.3.4 Determinants of the selected country ETF returns

We now discuss the intercept and slope parameter estimates and the performance of the RS model compared to the six-factor linear model that does not consider any market regimes. As we can see from Table 11, the intercept parameter estimates for all ETFs in the six-factor linear models are statistically insignificant whereas almost all of these estimates are statistically significantly different from zero in the RS model.[21] Clearly, the RS model is able to identify the nonzero intercept estimates by incorporating market regimes and capturing more information than the linear factor model.

Table 12 reports the slope parameter estimates for both the RS model and six-factor linear model. As can be seen from Table 12, the RS model is different from the six-factor

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[21] The ones for the U.S., U.K., Canada and Germany ETFs in the transitory market (regime 2) are not statistically significant.

model in two ways. First, all slope parameter estimates associated with the six factors are statistically significant in the RS model for most of the country ETFs and market regimes while the slope parameter estimates of some factors are not significant in the six-factor linear model.[22] Second, the RS model accommodates three different market regimes and captures more information about the behaviours of the country ETF returns. The remaining of this section discusses the performance of each factor in the RS model.

We now discuss the two Fama-French factors — size and value factors. First, the slope parameter estimates associated with these two factors are statistically significant for most country ETFs across three regimes. It suggests that the U.S. market size and value factors explain in part the returns of these U.S. exchange listed country ETFs. This confirms the previous finding that returns of U.S. listed foreign assets are exposed to the U.S. market risk factors [see Frankel (1993), Chang et al. (1995), Russell (1998), and Gutierrez (2009)]. Second, other than the returns of the Canada ETF, the size factor is negatively associated with the returns of all other country ETFs in some regimes. For instance, the return of U.K. ETF is negatively correlated with the size factor in all three regimes. Third, the value factor is positively associated with the returns of the rest of country ETFs in all three regimes except for the U.S., Canada and Japan ETFs. As for the U.S. and Canada ETFs, their returns are negatively correlated with the value factor in the transitory regime. The return of the Japan ETF is negatively correlated with the value factor in the bull regime.

The slope parameter estimates of the world market factor for all eight country ETFs are positive in all three regimes. This is consistent with the existing studies. Moreover, different country ETFs have different sensitivities to the world market factor across market regimes. For instance, the slope parameter estimate associated with the world market factor for the France, Japan and Australia ETFs are greater in the bull regime than in the bear regime. This suggests that these three ETFs become defensive in the bear market. In addition, the German ETF return tends to positively overreact to the world market factor in all three

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[22] The slope parameter estimates of the size factor are not significant for the Germany, Japanese and Australia ETFs. The slope parameter estimates of the value factor are not statistically significant for the France and Japan ETFs. The slope parameter estimates of the commodity prices are not significant for the U.K. and Italy ETFs.

regimes.[23]

Now, we discuss the market volatility factor. The slope parameter estimates of the market volatility factor for all country ETFs are negative in regimes 1 and 3. In regime 2, the market volatility factor contributes negative premiums to the U.S. and Canada ETFs and positive premiums to all other country ETFs. That is, the market volatility factor is negatively correlated with the returns of all ETFs in the bull and bear regimes. But, it is negatively correlated to the returns of the US and Canada ETFs in the transitory regime.

The slope parameter estimates of the U.S. dollar factor for all country ETFs are as expected. They are positive for the US ETF and negative for the other seven ETFs in all three regimes. This result can be explained intuitively. The stronger the U.S. dollar, the lower the returns of foreign ETFs valued in the U.S. dollar. The positive correlation between the return of the U.S. ETF and U.S. dollar factor suggests that the market demands more for U.S. dollar assets driving up the prices of these assets. Thus the return of the U.S. ETF goes up for given initial prices.

We now examine the commodity prices factor. The slope parameter estimates are negative for the U.S., Germany, France, Italy and Japan ETFs in all three regimes. On the contrary, the slope parameter estimates are positive for the U.K. (except for regime 2), Canada and Australia ETFs. This phenomenon confirms in part our conjecture that those country ETFs exposed to commodity prices tend to be positively correlated with the commodity prices factor. As we can see from Table 13, the materials and energy sectors account for 33.97%, 48.1% and 36.04% of the U.K., Canada and Australia ETFs in value, respectively. Given an increase in commodity prices, the profit gained from materials and energy sectors outweighs the loss from the other sectors. As a result of the net gain due to higher commodity prices, the values of the underlying assets go up and thus lead to higher returns of these country ETFs. As for the other country ETFs, it works in the opposite direction.

Table 10 reports the variance-covariance estimates of the residuals for our RS model. As we can see from the main diagonal of each matrice in the table, the variances of model residuals are the greatest in “bear” regime and lowest in bull regime. These suggest that

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[23] The slope parameter estimates of the world market factor are greater than one.

these country ETFs exhibit a higher (lower) idiosyncratic risk in bear (bull) regime that cannot captured by the common risk factors.

5 Concluding Remarks

In this paper, we apply a regime switching factor model to price the returns of eight country ETFs. These country ETFs are for the countries U.S., U.K., Canada, Germany, France, Italy, Japan and Australia. We incorporate six risk factors in our RS model based on the Bayesian information criterion. These factors are size, value, world stock market, market volatility, U.S. dollar index and commodity prices.

The model identifies three market regimes: bull market (regime 1), transitory market (regime 2) and bear market (regime 3). The bull market is characterized by positive asset returns and low market volatility while asset returns are negative and market volatility is high in the bear regime. The transitory market acts as an intermediate market regime between the bull and bear regimes. Among these three regimes, the bull regime is the most persistent while the bear regime is the least persistent.

We find that the world market has a positive premium for all country ETF returns across market regimes. The U.S. size and value factors can explain the returns of most of these county ETFs. This finding suggests that the returns of these U.S. listed country ETFs are closely related to the size and value factors. Market volatility is negatively correlated with returns of most country ETFs with exceptions for the UK, Germany, France, Italy, Japan and Australia ETFs in the transitory regime. The U.S. dollar index is priced into the returns of these country ETFs contributing a positive premium on the U.S. ETF return and negative premiums on the returns of all other country ETFs across regimes. The returns of the U.K., Canada and Australia ETFs, which heavily invest in materials and energy sectors, are positively correlated with changes of commodity prices while the returns of all other country ETFs have negative relations with these changes in all three market regimes.

Table 1: Summary statistics of returns on country ETFs

Country	Mean	Std. Dev.	Skewness	Kurtosis
Australia	0.000391	0.0194	-0.4023	7.5200
Canada	0.000321	0.0167	-0.5810	5.7893
United States	0.000009	0.0139	-0.2070	6.4486
United Kingdom	-0.000023	0.0168	-0.2263	9.3719
Germany	0.000020	0.0187	-0.0279	7.8829
France	-0.000009	0.0180	-0.1275	5.6592
Italy	-0.000108	0.0181	-0.2417	6.3124
Japan	-0.000137	0.0163	0.1624	6.1652

Note: The daily closing prices of these country ETFs from May 30, 2000 to March 31, 2011 are retrieved from Bloomberg. The daily returns are calculated by taking the log difference of daily prices. The standard deviations vary across these ETFs. The kurtosis is high for all country ETFs returns.

Table 2: Correlations of returns on country ETFs

Country ETF	US	CA	UK	GER	FRA	ITA	AUS	JAP
US	1.0000							
CA	0.7113	1.0000						
UK	0.7829	0.6886	1.0000					
GER	0.7933	0.6692	0.8163	1.0000				
FRA	0.7859	0.6957	0.8386	0.8935	1.0000			
ITA	0.7188	0.6725	0.7920	0.8274	0.8690	1.0000		
AUS	0.6765	0.6770	0.7026	0.6875	0.7194	0.6939	1.0000	
JAP	0.6958	0.5692	0.6606	0.6724	0.6561	0.5977	0.6134	1.0000

Note: The daily returns are calculated by taking the log difference of daily prices of country ETFs. The daily closing prices from May 30, 2000 to March 31, 2011 are retrieved from Bloomberg. These daily returns are positively correlated.

Table 3: Comparison of sector weights across country ETFs

	Ranking							
Sector	U.S.	Canada	U.K.	Germany	France	Italy	Japan	Australia
Consumer Discretionary	3	5	7	1	3	5	2	7
Consumer Staples	7	7	3	9	5	7	7	3
Energy	4	2	2	-	4	2	10	4
Financials	1	1	1	2	1	1	3	1
Health Care	5	10	5	5	6	-	6	6
Industrials	-	4	8	4	2	4	1	5
Information Technology	-	8	10	7	10	-	4	10
Materials	9	3	4	3	7	-	5	2
Producer Durables	6	-	-	-	-	-	-	-
Product Durables	10	-	-	-	-	-	-	-
Technology	2	-	-	-	-	-	-	-
Telecommunication Service	-	6	6	8	9	6	8	8
Utilities	8	9	9	6	8	3	9	9

Note: Each number in the table represents the ranking of the weight of a sector held by each corresponding ETF. More specifically, a smaller number stands for a heavier weight of that sector. The symbol "-" indicates that the ETF does not hold any securities from the corresponding sector. The data is retrieved from iShares.com on July 17, 2011.

Table 4: Summary statistics of six risk factors

Factor	Mean	St.d	Skewness	Kurtosis
SMB	0.026873	0.5938	-0.1021	3.3689
HML	0.024211	0.6886	-0.0428	5.9505
WOD	0.000027	0.0117	-0.1467	10.2599
VIX	-0.000110	0.0623	0.6503	4.1504
DXY	-0.000139	0.0056	-0.0336	1.3511
COM	0.000445	0.0169	0.0259	4.3720
YS	2.511014	1.6193	-0.4980	-1.3048
CS	1.131690	0.5200	2.6506	7.2500

Note: SMB and HML are retrieved from the Kenneth R. French data library. WOD, DXY, COM are from Bloomberg. VIX is from the Chicago Board Option Exchange website. YS and CS are from the Federal Reserve at St. Louis Economic Research Data Centre. The data of these eight factors are from May 31, 2000 to March 31, 2011.

Table 5: Correlations of six risk factors

Factor	SMB	HML	WOD	VIX	DXY	COM	YS	CS
SMB	1.0000							
HML	-0.1073	1.0000						
WOD	-0.0295	0.1025	1.0000					
VIX	-0.0702	-0.0437	-0.6541	1.0000				
DXY	0.0272	-0.1251	-0.2492	0.0272	1.0000			
COM	-0.0428	0.1601	0.3283	-0.1532	-0.2731	1.0000		
YS	0.0321	-0.0243	0.0099	-0.0198	-0.0073	0.0041	1.0000	
CS	0.0078	-0.0521	-0.0121	-0.0168	0.0003	-0.0326	0.3608	1.0000

Note: SMB and HML are retrieved from the Kenneth R. French data library. WOD, DXY, COM are from Bloomberg. VIX is from the Chicago Board Option Exchange website. YS and CS are from the Federal Reserve at St. Louis Economic Research Data Centre. The data of these eight factors are from May 31, 2000 to March 31, 2011.

Table 6: Values of Bayesian information criterion

Number of Regimes	1	2	3	4	5
Six-factor	52870	48522	**48082**	48194	48608
Six-factor+YS	52932	48640	48256	48424	48912
Six-factor+CS	52931	48641	48255	48420	48888
Six-factor+YS+CS	52993	48761	48432	48651	49180

Note: Each element stands for a value of the Bayesian Information Criterion. The model in each row has its own number of independent variables. For instance, "Six-factor+YS" stands for the model with seven factors SMB, HML, WOD, VIX, DXY, COM and YS. The number of regimes ranges from 1 to 5.

Table 7: Country ETF returns across regimes

Country ETF	Regime 1	Regime 2	Regime 3
US	0.000497	-0.000356	-0.001246
UK	0.000612	-0.000212	-0.002241
CA	0.000890	0.000190	-0.001747
GER	0.000838	-0.000060	-0.003173
FRA	0.000669	-0.000186	-0.002433
ITA	0.000563	0.000163	-0.003418
JAP	0.000275	-0.000392	-0.001308
AUS	0.001007	0.000649	-0.002667

Note: The mean returns for all country ETFs in regime 1 are the highest while the counterparts in regime 3 are the lowest.

Table 8: Six mean risk factors across regimes

Factor	Regime 1	Regime 2	Regime 3
SMB	0.015214	0.083933	-0.042060
HML	0.021847	0.094081	-0.109093
WOD	0.000556	-0.000313	-0.001449
VIX	-0.001086	-0.000443	0.004579
DXY	-0.000122	-0.000317	0.000155
COM	0.001022	0.000633	-0.002306

Note: For SMB, HML and WOD, the mean returns in regime 1 are the highest while the mean returns in regime 3 are the lowest. On the contrary, the VIX and COM factors behave in the opposite way. The mean DXY factor is positive in regime 3 and negative in the other two regimes.

Table 9: Correlations of country ETF returns across regimes

	US	UK	CA	GER	FRA	ITA	JAP	AUS
Regime 1								
US	1.0000							
UK	0.7960	1.0000						
CA	0.7008	0.7196	1.0000					
GER	0.7958	0.8502	0.6948	1.0000				
FRA	0.8014	0.8624	0.7011	0.9180	1.0000			
ITA	0.7583	0.8262	0.6816	0.8626	0.9054	1.0000		
JAP	0.6326	0.6258	0.5275	0.6408	0.6334	0.5774	1.0000	
AUS	0.7090	0.7562	0.7086	0.7317	0.7533	0.7184	0.6164	1.0000
Regime 2								
US	1.0000							
UK	0.6038	1.0000						
CA	0.5088	0.3797	1.0000					
GER	0.6793	0.6494	0.4327	1.0000				
FRA	0.6088	0.6446	0.4358	0.7963	1.0000			
ITA	0.4677	0.5374	0.3764	0.6845	0.6763	1.0000		
JAP	0.5757	0.4763	0.3911	0.5169	0.4453	0.3443	1.0000	
AUS	0.3354	0.2624	0.3522	0.3499	0.3652	0.3061	0.3033	1.0000
Regime 3								
US	1.0000							
UK	0.8371	1.0000						
CA	0.7985	0.7816	1.0000					
GER	0.8388	0.8621	0.7537	1.0000				
FRA	0.8484	0.8963	0.7978	0.9209	1.0000			
ITA	0.7844	0.8495	0.7702	0.8629	0.9180	1.0000		
JAP	0.7927	0.7693	0.6870	0.7728	0.7779	0.7271	1.0000	
AUS	0.7642	0.7883	0.7603	0.7760	0.8127	0.7765	0.7452	1.0000

Note: This table reports the correlations of country ETF returns across regimes.

Table 10: Variance-Covariance for residuals of RS model for country ETF returns

	US	UK	CA	GER	FRA	ITA	JAP	AUS
Regime 1								
US	1.37E-05(3.70E-15)							
UK	6.42E-06(1.15E-10)	3.20E-05(1.92E-20)						
CA	6.44E-06(1.95E-12)	6.13E-06(2.04E-10)	4.73E-05(9.90E-31)					
GER	7.20E-06(1.92E-10)	1.28E-05(1.33E-13)	3.17E-06(2.50E-09)	3.53E-05(1.27E-19)				
FRA	7.46E-06(9.65E-09)	1.34E-05(3.27E-14)	2.06E-06(5.23E-10)	2.22E-05(6.02E-18)	3.47E-05(5.50E-25)			
ITA	9.15E-06(9.73E-10)	1.42E-05(3.76E-13)	3.87E-06(7.74E-11)	2.04E-05(9.44E-17)	2.63E-05(4.17E-17)	4.80E-05(6.12E-22)		
JAP	1.27E-06(1.97E-08)	2.94E-06(1.44E-09)	1.64E-06(3.86E-10)	2.86E-06(4.45E-07)	2.58E-06(2.31E-4)	1.53E-06(8.59E-4)	6.16E-05(1.49E-28)	
AUS	5.31E-06(1.34E-10)	8.62E-06(2.00E-08)	1.01E-05(8.66E-18)	3.93E-06(1.29E-08)	6.59E-06(1.18E-10)	6.97E-06(1.30E-09)	9.39E-06(1.43E-10)	7.00E-05(1.84E-21)
Regime 2								
US	1.56E-05(9.82E-18)							
UK	-4.00E-07(1.43E-13)	8.17E-05(5.21E-22)						
CA	2.50E-06(2.53E-15)	-3.00E-07(1.46E-13)	1.29E-04(6.37E-31)					
GER	-1.10E-06(1.70E-13)	1.58E-05(4.87E-16)	-1.20E-06(3.76E-11)	8.80E-05(2.40E-21)				
FRA	-6.60E-06(3.41E-12)	1.77E-05(1.54E-16)	2.30E-06(2.56E-13)	3.88E-05(7.86E-20)	8.88E-05(1.31E-25)			
ITA	-4.50E-06(4.05E-13)	1.21E-05(8.50E-16)	2.90E-06(3.22E-13)	3.06E-05(4.52E-19)	3.04E-05(2.87E-19)	9.51E-05(2.91E-23)		
JAP	-3.50E-06(2.24E-11)	-7.00E-07(4.12E-12)	2.90E-06(5.02E-13)	-1.21E-05(4.96E-10)	-2.12E-05(8.23E-08)	-2.23E-05(5.75E-07)	1.30E-04(6.22E-29)	
AUS	-1.10E-06(5.17E-13)	-8.10E-06(1.80E-11)	1.90E-05(8.79E-20)	-3.70E-06(1.31E-11)	1.40E-06(1.53E-13)	-2.40E-06(1.91E-12)	2.00E-07(1.54E-13)	1.20E-04(2.19E-23)
Regime 3								
US	1.29E-04(2.51E-15)							
UK	7.01E-05(3.51E-11)	2.96E-04(7.69E-20)						
CA	6.10E-05(6.98E-13)	6.66E-05(4.93E-11)	2.59E-04(3.98E-29)					
GER	8.92E-05(5.04E-11)	1.61E-04(1.33E-13)	5.13E-05(1.55E-09)	3.37E-04(1.60E-19)				
FRA	6.46E-05(1.63E-09)	1.58E-04(2.59E-14)	6.23E-05(1.01E-10)	1.93E-04(6.50E-18)	2.36E-04(2.53E-24)			
ITA	5.50E-05(4.41E-11)	1.59E-04(1.79E-13)	6.88E-05(1.45E-11)	1.79E-04(4.50E-17)	1.93E-04(2.51E-17)	3.35E-04(1.46E-21)		
JAP	7.17E-05(6.08E-09)	9.90E-05(7.98E-10)	4.20E-05(1.63E-09)	1.08E-04(1.03E-07)	8.17E-05(1.82E-05)	7.83E-05(7.39E-05)	3.19E-04(3.32E-27)	
AUS	4.60E-05(8.83E-11)	1.08E-04(3.20E-09)	8.29E-05(2.66E-18)	1.06E-04(3.69E-09)	1.02E-04(5.83E-11)	1.03E-04(9.15E-10)	1.20E-04(6.64E-11)	4.59E-04(3.37E-21)

Note: This table reports the variance-covariance estimates for residuals of the RS model for country ETF returns. *p*-values are shown in the parentheses. As can be seen, all variances/covariances are significantly different from zero.

Table 11: Intercept parameter estimates of RS model for country ETF returns

	RS Model			Six-Factor Model
Country ETF	Regime 1	Regime 2	Regime 3	
US	0.000024 (1.58E-10)	0.000346 (2.04E-12)	0.000493 (5.70E-10)	-6.07E-07 (0.9960)
UK	-0.000030 (7.02E-01)	0.000053 (3.18E-01)	-0.000083 (9.21E-01)	-0.000113 (0.5360)
CA	0.000069 (1.51E-07)	0.000370 (1.72E-07)	0.000382 (1.70E-03)	0.000093 (0.6440)
GER	0.000158 (7.00E-05)	-0.000139 (4.80E-06)	-0.001167 (7.00E-04)	-0.000081 (0.6770)
FRA	-0.000048 (2.52E-02)	-0.000111 (3.84E-02)	-0.000302 (1.28E-02)	-0.000144 (0.4180)
ITA	-0.000127 (4.42E-06)	-0.000059 (4.74E-06)	-0.000980 (1.28E-05)	-0.000337 (0.0970)
JAP	-0.000194 (2.00E-04)	-0.000532 (9.00E-04)	0.000010 (8.00E-04)	-0.000164 (0.4490)
AUS	0.000156 (7.52E-02)	0.000575 (1.18E-02)	-0.000216 (4.00E-03)	0.000150 (0.5330)

Note: This table reports the intercept parameter estimates for the six-factor models and the regime-switching (RS) model for country ETF returns. *p*-values are shown in the parentheses.

Table 12: Slope parameter estimates of RS model for country ETF returns

		SMB	HML	WOD	VIX	DXY	COM
US							
	Regime 1	0.0018 (1.07E-06)	0.0019 (8.66E-01)	0.6523 (1.81E-89)	-0.0623 (3.98E-56)	0.1887 (4.05E-38)	-0.0198 (3.06E-16)
RS Model	Regime 2	-0.0007 (7.27E-11)	-0.0032 (1.44E-01)	0.8448 (1.20E-87)	-0.0435 (5.96E-61)	0.2438 (6.61E-41)	-0.0184 (2.52E-15)
	Regime 3	0.0014 (5.56E-10)	0.0019 (2.48E-01)	0.8525 (5.45E-89)	-0.0809 (1.35E-58)	0.4477 (1.73E-36)	-0.0374 (5.64E-15)
Six-factor Model		0.0009 (0.000000)	0.0005 (0.000000)	0.8620 (0.000000)	-0.0612 (0.000000)	-0.3176 (0.000000)	0.0269 (0.000000)
UK							
	Regime 1	-0.0011 (1.04E-27)	0.0018 (3.04E-21)	0.8834 (3.50E-102)	-0.0533 (2.54E-20)	-0.3826 (5.08E-22)	0.0005 (2.70E-01)
RS Model	Regime 2	-0.0012 (1.66E-15)	0.0004 (1.28E-22)	0.9749 (1.05E-107)	0.0001 (8.09E-24)	-0.3090 (2.32E-21)	-0.0335 (5.36E-02)
	Regime 3	-0.0010 (8.95E-23)	0.0024 (2.64E-22)	0.9437 (8.68E-101)	-0.0648 (3.00E-22)	-0.0157 (8.52E-22)	0.0543 (6.00E-01)
Six-factor Model		-0.0011 (0.000000)	0.0021 (0.000000)	0.9567 (0.000000)	-0.0470 (0.000000)	-0.2638 (0.000000)	0.0075 (5.28E-01)
CA							
	Regime 1	0.0017 (7.36E-32)	0.0022 (2.36E-01)	0.6915 (4.81E-94)	-0.0448 (7.27E-25)	-0.3341 (1.43E-36)	0.2409 (8.34E-33)
RS Model	Regime 2	0.0019 (8.30E-28)	-0.0022 (2.10E-02)	0.6912 (3.51E-82)	-0.0107 (3.52E-30)	-0.3176 (4.10E-38)	0.0622 (5.72E-40)
	Regime 3	0.0016 (2.80E-34)	0.0013 (4.90E-02)	0.8537 (1.68E-88)	-0.0380 (9.59E-31)	-0.1495 (5.48E-32)	0.2254 (8.20E-35)
Six-factor Model		0.0018 (0.000000)	0.0010 (1.00E-02)	0.8174 (0.000000)	-0.0360 (0.000000)	-0.2946 (0.000000)	0.1963 (0.000000)
GER							
	Regime 1	0.0004 (3.07E-01)	0.0002 (1.53E-19)	1.0181 (9.54E-68)	-0.0531 (1.37E-16)	-0.6017 (1.02E-54)	-0.0450 (2.51E-21)
RS Model	Regime 2	0.0020 (4.49E-01)	0.0003 (1.32E-18)	1.5451 (3.20E-69)	0.0055 (1.59E-21)	-0.4163 (2.10E-54)	-0.0545 (8.01E-27)
	Regime 3	-0.0012 (5.00E-04)	0.0015 (1.22E-19)	1.0228 (9.53E-68)	-0.0706 (1.24E-18)	-0.4508 (2.41E-49)	-0.0586 (1.33E-26)
Six-factor Model		-1.80E-5 (9.58E-01)	0.0010 (0.000000)	1.1317 (0.000000)	-0.0467 (0.000000)	-0.4845 (0.000000)	-0.0585 (0.000000)
FRA							
	Regime 1	-0.0003 (5.62E-02)	0.0018 (9.08E-47)	0.9819 (4.13E-69)	-0.0565 (6.90E-09)	-0.5710 (2.51E-65)	-0.0174 (1.39E-09)
RS Model	Regime 2	0.0009 (6.97E-01)	0.0020 (7.28E-44)	1.4365 (1.38E-71)	0.0306 (2.14E-13)	-0.4267 (1.92E-66)	-0.0165 (5.74E-16)
	Regime 3	-0.0004 (8.71E-01)	0.0027 (1.78E-40)	0.9489 (3.81E-71)	-0.0836 (8.63E-11)	-0.4884 (9.42E-66)	-0.0345 (9.87E-10)
Six-factor Model		-0.0001 (0.000000)	0.0021 (6.62E-01)	1.0703 (0.000000)	-0.0485 (0.000000)	-0.4924 (0.000000)	-0.0294 (1.10E-02)
ITA							
	Regime 1	-0.0007 (7.59E-07)	0.0031 (2.42E-45)	0.8370 (2.66E-93)	-0.0591 (1.65E-12)	-0.7350 (1.34E-83)	-0.0187 (1.31E-05)
RS Model	Regime 2	0.0017 (1.15E-08)	0.0020 (5.87E-45)	1.0500 (7.99E-89)	0.0198 (6.47E-16)	-0.6850 (1.96E-79)	-0.0220 (2.75E-05)
	Regime 3	0.0018 (5.09E-09)	0.0039 (4.40E-43)	0.8938 (1.37E-92)	-0.0800 (1.81E-14)	-0.7477 (2.04E-81)	-0.0021 (1.83E-04)
Six-factor Model		0.0008 (0.000000)	0.0035 (0.000000)	0.9345 (0.000000)	-0.0479 (0.000000)	-0.7214 (0.000000)	-0.0161 (2.19E-01)
JAP							
	Regime 1	0.0008 (9.19E-05)	-0.0017 (5.98E-03)	0.9180 (1.09E-66)	-0.0279 (1.65E-13)	-0.0959 (4.27E-15)	-0.0581 (1.18E-11)
RS Model	Regime 2	0.0033 (6.04E-05)	0.0022 (1.35E-02)	1.2584 (1.64E-66)	0.0024 (1.89E-17)	-0.1853 (9.42E-15)	-0.0110 (2.18E-16)
	Regime 3	-0.0009 (6.97E-07)	0.0008 (8.01E-02)	0.7873 (8.75E-71)	-0.0645 (8.38E-16)	-0.0664 (1.86E-14)	-0.0680 (1.39E-17)
Six-factor Model		0.0005 (1.43E-01)	-0.000067 (8.35E-01)	0.9215 (0.000000)	-0.0316 (0.000000)	-0.0887 (3.30E-02)	-0.0608 (0.000000)
AUS							
	Regime 1	-0.0004 (7.88E-01)	0.0022 (2.23E-29)	1.1358 (5.32E-61)	-0.0383 (6.61E-13)	-0.4325 (1.25E-54)	0.0627 (5.79E-15)
RS Model	Regime 2	0.0004 (6.02E-01)	0.0012 (7.10E-31)	0.6360 (8.91E-63)	0.0062 (1.54E-17)	-0.4779 (4.77E-57)	0.0154 (1.47E-17)
	Regime 3	0.0003 (7.99E-01)	0.0044 (7.89E-31)	0.7766 (4.59E-58)	-0.1270 (1.34E-13)	-0.4433 (8.53E-55)	0.0902 (1.60E-16)
Six-factor Model		0.0003 (4.09E-01)	0.0043 (0.000000)	0.9127 (0.000000)	-0.0542 (0.000000)	-0.4870 (0.000000)	0.0651 (0.000000)

Note: This table reports the slope parameter estimates for the factors of the six-factor models and the regime-switching (RS) model for country ETF returns. *p*-values are shown in the parentheses.

Table 13: Weights of materials and energy sectors in country ETFs

Country ETF	CA	AUS	UK	ITA	FRA	GER	US	JAP
Weight	48.1%	36.04%	33.97%	25.37%	19.20%	16.58%	16.51%	9.32%

Note: This table reports the total weight of materials and energy sectors in these eight country ETFs. The data are retrieved from the fact sheets on the website of iShares on July 17, 2011.

References

[1] ACWI IMI factsheet, iShares website, available at: [http://us.ishares.com/product_info/fund/overview/ACWI.htm].

[2] Ang, A., Hodrick, R. J., Xing Y. and Zhang X. (2006). The cross-section of volatility and expected returns, *Journal of Finance*, Vol. 61, Issue 1, pp. 259–299.

[3] Assoe, K. G. (1998). Regime-switching in emerging stock market returns, *Multinational Finance Journal*, Vol. 2, Issue 2, pp. 101–132.

[4] Bakshi, G., Panayotov G. and Skoulakis, G. (2010). The Baltic Dry Index as a predictor of global stock returns, commodity returns, and global economic activity, Working paper, University of Maryland.

[5] Banz, R. W. (1981). The relationship between return and market value of common stocks, *Journal of Financial Economics*, Vol. 9, Issue 1, pp. 3–18.

[6] Basher, S. A., and Sadorsky, P. (2006). Oil price risk and emerging stock markets, *Global Finance Journal*, Vol. 17, Issue 2, pp. 224–251.

[7] Basu, S. (1977). Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis, *Journal of Finance*, Vol. 32, Issue 3, pp. 663–682.

[8] Bhandari, L. C. (1988). Debt/equity ratio and expected common stock returns empirical evidence, *Journal of Finance*, Vol. 43, Issue 2, pp. 507–528.

[9] Black, F. (1976). Studies of stock price volatility changes, *Proceedings of the Business and Economic Statistics Section*, American Statistical Association, Washington, pp. 177–181.

[10] Bos, T., and Newbold, P. (1984). An empirical investigation of the possibility of stochastic systematic risk in the market model, *Journal of Business*, Vol. 57, Issue 1, pp. 35–41.

[11] Campbell, J. (1987). Stock returns and the term structure, *Journal of Financial Economics*, Vol. 18, Issue 2, pp. 373–399.

[12] Carhart, M. M. (1997). On persistence in mutual fund performance, *Journal of Finance*, Vol. 52, Issue 1, pp. 57–82.

[13] Chen, N. F., Roll, R. and Ross, S. A. (1986). Economic forces and the stock market, *Journal of Business*, Vol. 59, Issue 3, pp. 383–403.

[14] Chordia, T., and Shivakumar, L. (2002). Momentum, business cycle, and time-varying expected returns, *Journal of Finance*, Vol. 57, Issue 2, pp. 985–1019.

[15] Dumas, B., and Solnik, B. (1995). The world price of foreign exchange risk, *Journal of Finance*, Vol. 50, Issue 2, pp. 445–479.

[16] Fama, E. F., and French, K. R. (1989). Business conditions and expected returns on stocks and bonds, *Journal of Financial Economics*, Vol. 25, Issue 1, pp. 23–49.

[17] Fama, E. F., and French, K. R. (1992). The cross-section of expected stock returns, *Journal of Finance*, Vol. 47, Issue 2, pp. 427–465.

[18] Fama, E. F., and French, K. R. (1993). Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics*, Vol. 33, Issue 1, pp. 3–56.

[19] Fama, E. F., and French, K. R. (1996). Multifactor explanations of asset pricing anomalies, *Journal of Finance*, Vol. 51, Issue 1, pp. 55–84.

[20] Fama, E. F., and French, K. R. (1998). Value versus growth: The international evidence, *Journal of Finance*, Vol. 53, Issue 6, pp. 1975–1999.

[21] Fama, E. F., and French, K. R. (2004). The capital asset pricing model: Theory and evidence, *Journal of Economic Perspectives*, Vol. 18, Issue 3, pp. 25–46.

[22] Ferson, W. E., and Harvey C. R. (1991). The variation of economic risk premiums, *Journal of Political Economy*, Vol. 99, Issue 2, pp. 385–415.

[23] Ferson, W. E. and Harvey C. R. (1998). Fundamental determinants of national equity market returns: A perspective on conditional asset pricing, NBER Working Papers, No. 5860.

[24] Ferson, W. E. and Harvey C. R. (1999). Economic, financial, and fundamental global risk in and out of the EMU, NBER working papers, No. 6967.

[25] Frankel, J. A. (1993). The internationalization of equity markets, NBER working paper, No. 4590.

[26] French, K. R., Schwert, G. W. and Stambaugh, R. F. (1987). Expected stock returns and volatility, *Journal of Financial Economics*, Vol. 19, Issue 1, pp. 3–29.

[27] Fridman, M. (1994). A two state capital asset pricing model. IMA preprint series, No. 1221.

[28] Ghysels, E., Santa-Clara, P. and Valkanov, R. (2005). There is a risk-return trade-off after all, *Journal of Financial Economics*, Vol. 76, Issue 3, pp. 509–548.

[29] Glosten, L. R., Jagannathan, R. and Runkle, D.E. (1993). On the relation between the expected value and the volatility of the nominal excess return on stocks, *Journal of Finance*, Vol. 48, Issue 5, pp. 1779–1801.

[30] Gutierrez, J.A., Martinez, V. and Tse, Y. (2009). Where does return and volatility come from? The case of Asian ETFs, *International Review of Economics and Finance*, Vol. 18, Issue 4, pp. 671–679.

[31] Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle, *Econometrica*, Vol. 57, Issue 2, 357–384.

[32] Hou, K., Karolyi, G. A. and Kho, B. C. (2006), What factors drive global stock return?, Working paper, Ohio State University, Charles A. Dice Center for Research in Financial Economics, No. 2006–9.

[33] Hou, K., Peng, L. and Xiong, W. (2008), A tale of two anomalies: The implications of investor attention for price and earnings momentum. Available at SSRN: http://ssrn.com/abstract=890875.

[34] Jagannathan, R. and Wang, Z. (1996). The conditional CAPM and the cross-section of expected return, *Journal of Finance*, Vol. 51, Issue 1, pp. 3–53.

[35] Jegadeesh, N., and Titman, S. (1993). Returns to buying winners and selling losers: implications for stock market efficiency, *Journal of Finance*, Vol. 48, Issue 1, pp. 65–91.

[36] Johnson, R., and Soenen, L. (2009). Commodity prices and stock market behaviour in south American countries in the short run, *Emerging Market Financ & Trade*, Vol. 45, Issue 4, pp. 69–82.

[37] Jones, C. M., and Kaul, G. (1996). Oil and the stock market, *Journal of Finance*, Vol. 51, Issue 2, pp. 463–491.

[38] Keim, D. B., and Stambaugh, R. F. (1986). Predicting returns in the stock and bond markets, *Journal of Financial Economics*, Vol. 17, Issue 2, pp. 357–390.

[39] Koulakiotis, A., Papasyriopoulos, N. and Molyneux, P. (2006). More evidence on the relationship between stock price returns and volatility: A note, *International Research Journal of Finance and Economics*, Issue 1, pp. 21–28.

[40] Lewellen, J., and Nagel, S. (2006). The conditional CAPM does not explain asset-pricing anomalies, *Journal of Financial Economics*, Vol. 82, Issue 2, pp. 289–314.

[41] Liu, P., Xu, K. and Zhao, Y. (2011). Market regimes, Sectorial investment, and time-varying risk premiums, *International Journal of Managerial Finance*, Vol. 7, Issue 2, pp. 107–133.

[42] Ma, Y., MacLean, L., Xu, K. and Zhao, Y. (2011). A portfolio optimization model with regime-switching risk factors for sector exchange traded funds, *Pacific Journal of Optimization*, Vol. 7, Issue 2, pp. 281–296.

[43] MSCI standard index series methodology, MSCI. Available at: www.mscibarra.com/eqb/gimi/stdindex/MSCI_Nov07_STMethod.pdf

[44] Roll, R. (1992). Industrial structure and the comparative behaviour of international stock market indices, *Journal of Finance*, Vol. 47, Issue 1, pp. 3–41.

[45] Russell, J. W. (1998). The international diversification fallacy of exchange-traded securities, *Financial services review*, Vol. 7, Issue 2, pp. 95–106.

[46] Sadorsky, P. (1999). Oil price shocks and stock market activity, *Energy Economics*, Vol. 21, Issue 5, pp. 449–469.

[47] Schaller, H., and Norden, S. V. (1997). Regime switching in stock market returns, *Applied Financial Economics*, Vol. 7, Issue 2, pp. 177–191.

[48] Solnik, B. H. (1974a). The international pricing of risk: An empirical investigation of the world capital market structure, *Journal of Finance*, Vol. 29, Issue 2, pp. 365–378.

[49] Solnik, B. H. (1974b). An equilibrium model of the international capital market, *Journal of Economics Theory*, Vol. 8, Issue 4, pp. 500–524.

[50] Zucchini, W. and MacDonald, I. (2009). Hidden Markov models for time series: An introduction using R, CRC Press, Taylor & Francis Group.